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Abstract *Agricultural conservation easements have positive externalities but few studies examine the supply-side. This paper explores whether easements may also overcome a credit-market failure, as banks may not be lending based on the full developed value of land. Original survey data test our research hypotheses and show profitable owners and nonoperators to be using easement payments to extract capital from their land by using the preservation programs as a bank. The results also show that the unprofitable owners and operators are reinvesting in their agricultural enterprises. Both results are consistent with an underlying credit-market failure, and the latter suggests that easements may provide indirect efficiency enhancement. The results suggest an integration of policies on agricultural finance and land preservation might lead to improved efficiency.*

Key words: Farmland preservation, Credit-market failure, Agricultural land use policy.

JEL codes: Q1, Q24.

Introduction

Conservation easement (CE) programs are the highest-profile technique in farmland preservation. At the state level alone, CE programs in the United States spent $3.6 billion to preserve 2.37 million acres of agricultural land (American Farmland Trust 2014) with the largest impact coming in the Mid-Atlantic, a region where development outbids agriculture. Gardner (1977) finds that preservation may enhance efficiency by correcting a market failure whereby agricultural land often produces positive externalities such as protection of groundwater, wildlife habitat, natural places, and scenic quality (Kline and Wichelns 1996). Economists investigate CE-program impacts, typically with hedonic analyses of capitalized easement values with selection effects (Nickerson and Lynch 2001; Lynch, Gray, and Geoghegan 2007; Liu and Lynch 2011; Schilling, Sullivan, and Duke 2013; Lawley and Towe 2014). Other studies explain CE participation (Lynch and Lovell 2003; Duke 2004), adverse selection, and cost effectiveness (Arnold, Duke, and Messer 2013; Lynch, Gray, and Geoghegan 2010; Horowitz, Lynch, and Stocking 2009), program efficiency (Lynch and Musser 2001), and nonmarket amenity valuation (Bergstrom and Ready 2009; Duke 2008).

Collectively, economic studies on CEs offer three main results. First, landowners are savvy when selling CEs, namely by exploiting information asymmetries to capture rents; this suggests that programs are not cost effective because they do not procure CEs at the least cost. Second, cost ineffectiveness also arises because land markets value CEs below the appraisals that determine CE payments. However, these sources of cost ineffectiveness do not necessarily imply overall program inefficiency, on the margin, because nonmarket valuation studies show that under most circumstances CE payments (though cost-ineffectively high) remain well below the external benefits. Evidence thus shows that CEs are efficient on the margin, but studies also identify ways to enhance program cost effectiveness. This paper explores whether CE programs might have additional, indirect efficiency impacts beyond positive externalities—specifically by providing some credit-constrained farm owners with access to capital.[1]

We develop hypotheses and assess original data related to potential efficiency-relevant indirect effects triggered by overcoming illiquidity through infusing capital (CE payments) into the agricultural economy. This is exploratory research, so rather than offer the definitive explanation of the link between credit and CE, we offer a theory and test whether the evidence is consistent with the theory.[2] The empirical evidence presented is consistent with a theory in which some owners are credit-constrained and find that participating in CE programs is one way to improve liquidity. Briggeman, Towe, and Morehart (2009) define credit constraints as imperfections in capital markets such that some borrowers cannot access capital at the current interest rate, can access less than they would optimally choose (credit rationing), or do not even apply for credit because they anticipate denial. Credit constraints perpetuate a liquidity problem and reduce farm production and profitability (Pederson, Chung, and Nel 2012).

The theoretical framework investigates the indirect effects of CE payments on liquidity and develops hypotheses about whether CE payments

[1]*Few studies consider efficiency-relevant impacts of the inputs and outputs of the CE policy process. Most CE studies examine three overlapping markets: (1) governments demanding CE in the easement market; (2) farmers demanding land from farm owners in the restricted land market; and (3) farmers and developers demanding land from farm owners in the unrestricted land market. This paper considers a potential* output *of the financial transaction that is the CE purchase.*

[2]*To our knowledge, this is the first work that posits a possible link between CE programs and access to credit. Our contribution is to test whether the evidence is consistent with a theory in which credit-constrained farm owners are systematically participating in CE programs. In this way, it is similar to other studies that pose novel hypotheses rather than offer definitive causal relationships. One similar study is Brorsen, Doye, and Neal (2015), who offer evidence consistent with one possible explanation to the small farm size puzzle, that is, why are large farms sold given that small farms have higher per acre values? In effect, the theory and evidence in support of the hypothesis is the contribution.*

could be liquid capital exchanged for landed capital. Assuming credit constraints, do the data contradict a theory in which owners use CE payments to enhance their operations' viability? The tested hypotheses suggest that farm credit markets could potentially be imperfect, and that potentially some costliness, stickiness, or lumpiness exists so that some owners cannot access all their land capital—especially development-based equity. This in turn suggests that, if CE programs provide a mechanism to access this capital and the literature cited below shows that agriculture can be credit constrained, then CEs can potentially affect farmer profitability. Principally, CEs can affect the efficiency of the farm economy by enhancing some farmers' ability to reinvest, adopt new technologies, and thereby adjust their operations. Efficiency-relevant implications are also developed with respect to how CE payments are used and by whom. In sum, this paper offers evidence suggesting that CE programs may correct a credit-market failure facing some farmers. This indirectly helps agriculture compete with developed uses while supplying well-recognized positive externalities in urbanizing regions.

Methods and Data

This section conceptualizes the direct and indirect efficiency implications of CEs and then reviews existing survey evidence. An original data set is described with the related exploratory hypotheses that test for CE impacts on illiquidity and how CE payments are used.

Theoretical Motivation

Many observers likely perceive questions of CE efficiency to be straightforward, that is, CEs are tax/subsidy policies that correct market price. However, Duke and Lynch (2006) argue that the underlying property rights relationships instead frame CEs as a participatory land market intervention; CE programs buy easements in a market for lesser rights in land, which then remove that land from the unrestricted market. Without the misleading tax-based rationale, CE programs do not "correct" market prices but instead redirect public funds, raising demand for easements in the unrestricted market. In turn, CEs adjust the restricted market, expanding supply and lowering price. Although this argument reveals how CE programs directly benefit farmers who seek to enter the industry or buy more land, it also suggests that CEs are unlikely to be an optimal policy because their payments in no way equate fiscal costs with the external benefits they seek to internalize (Duke and Lynch 2006); CE payments might over-, under-, or perfectly internalize land market externalities.

Although CE costs and benefits are not equated on the margin, nonmarket valuation studies suggest that CE interventions have high external benefits and are small relative to the agricultural land market (for syntheses, see Bergstrom and Ready 2009; Duke 2008). Therefore, on the margin, this "demand-side rationale" suggests that CE efforts are likely efficiency-enhancing because they are internalizing some positive externalities. The remainder of this paper explores whether CE interventions may also enhance the supply side, correcting a credit-market failure and helping agriculture compete.

Indirect effects of CE policy involve losses (such as the cost of raising and spending CE budgets with tax system distortions), efforts that promote synergies (such as retaining an agricultural critical mass), and the internal and external benefits of retaining agricultural land use in an area that is becoming more urbanized. Table 1 identifies and explains several supply-side, indirect impacts of CE on efficiency, and this subsection focuses on the credit-market failure. Owners of unrestricted agricultural land often have great equity in the land—that is, they are "land rich and cash poor"—a common circumstance in regions with high development pressure raising land prices above capitalized agricultural rents. Although farm borrowing has been studied, it has not received attention focused on urbanizing regions. Between 1992 and 2011, U.S. farm business debt rose 39% (Patrick and Ifft 2014). Yet farm owner leveraging declined to a rate below 10% (Goodwin and Smith 2014) likely as a result of recently doubled farmland values (Weber and Key 2014). In addition, Patrick and Ifft (2014) find stability in the broad categories of debt use, where most is long-term debt to purchase land (with the loan secured with that land) and also shorter-term debt used to purchase inputs and equipment. These national trends do not apply well in urbanizing areas, where equity is based largely on development land value. Although Weber and Key (2014) found national evidence that owners bought more land if they had larger appreciation gains, it is unclear if this effect carries over to development-based appreciation rather than agricultural profits appreciation.[3] Our approach differs in studying farmland appreciation due to urbanizing pressure and focuses on states with this pressure, while Weber and Key (2014) examined larger states with less urbanization pressure.

Mishra, Moss, and Erickson (2008) find that farm debt affects farmland values, supporting their argument that agricultural assets differ from many other financial assets. Mishra, Moss, and Erickson (2008) then argue that arbitrage assumptions about trading off debt and equity in a perfectly functioning financial market do not hold in the farm sector. In addition, empirical studies reveal credit constraints. Briggeman, Towe, and Morehart (2009) found that 53.7% of farm sole-proprietorships freely receive credit but that credit challenges or constraints exist in a smaller subset (10.5%), and the remainder did not apply for credit (35.7%). These authors conclude that credit constraints lower the overall value of production by 3%. Pederson, Chung, and Nel (2012) found liquidity constraints among some farmer types. In their study, a 1% increase in access to credit increased income by 0.49% and investment in depreciable assets by 0.33%. Other studies have found evidence of farm credit constraints, though the evidence is more suggestive because of unobservability and endogeneity complications (Lambert and Bayda 2005).[4] Evidence shows that new farmers, even when operating relatively efficiently, are more likely to face credit constraints, though there is mixed evidence about whether these constraints rise during economic downturns (Bierlen and Featherstone 1998; Hartarska and Nadolnyak 2012). Among many impacts, credit constraints limit technology adoption and productivity (Briggeman, Towe, and Morehart 2009). Thus, existing studies show that credit constraints exist for some farmers and this affects their

[3] *A referee suggests that increasing profitability-based lending since the 1980s, as opposed to collateral-based lending, may help explain why lenders do not recognize development-based equity.*

[4] *Lambert and Bayda (2005, p. 288) find that: "The positive relationship between the intermediate debt-to-asset ratio and technical efficiency supports both the credit-evaluation theory and liquidity preference. Lenders are presumed to finance more-efficient farmers having a high probability of repayment." This in turn suggests that farms on the margin of profitability may be facing credit constraints.*

Table 1 Direct and Indirect Resource Allocation Efficiency Implications of Conservation Easement Programs

Decision/Market Failure	Institutional Change	Effect on Efficiency	Efficiency Implication	Evidence
Preserve agricultural land using a CE	Land becomes restricted (direct impact on land market)	+	Demand-side: agricultural land use produces positive externalities, which are enhanced through permanent protection. Prevents negative externalities from "sprawl".	Bergstrom and Ready (2009)
Fund preservation with taxes	Indirect	–	Dead-weight loss in raising funds and administrative costs for agricultural programs of 20–50%.	Alston and Hurd (1990) Wu and Babcock (1996)
Maintain critical mass	Indirect	+	Agglomeration economics enhance the viability of input subsector and processing and marketing subsector.	Lynch and Carpenter (2003) and Lynch (2006)
Retain agricultural uses in the face of urbanization	Indirect	+	The CEs protect a valuable land use in the face of urbanization, and "agriculture-related opportunities of urbanization outweigh the challenges" (Wu, Fisher, and Pascual 2011). When a region experiences increasing urban land uses, it affects agricultural infrastructure, farm production costs, and net farm income. Without CEs, these opportunities would be lost.	Wu, Fisher, and Pascual 2011
Credit-market failure	Indirect	+	If owners cannot borrow against all their land value, then they cannot optimally invest in agriculture. This failure would raise the relative value of development. The CEs may overcome this failure by providing liquid capital for development increment.	Examined in this paper

Note: This table focuses on the efficient allocation of agricultural resources, not on the cost-effectiveness of spending on preservation programs; CE= "Conservation easements". The last three rationales provided have the constituent elements of pecuniary externalities because they operate through existing pricing systems. But unlike most pecuniary externalities, these indirect effects become efficiency-relevant because they increase the relative returns to agricultural land use, which was argued to be the efficient land outcome because of positive externalities and precluded negative externalities.

profitability and productivity. Our paper will extend this line of research to focus on farmers' abilities to access development-based equity.

If banks will not lend to farmers based on development-based equity because they view this value as a poor risk of collateral, then a credit market failure might exist. Any credit-market correction would be an indirect efficiency enhancement—in effect, CE programs infuse agriculture with the very capital that arises from development pressure. The credit-market failure prevents farmers from optimizing; for instance, they cannot fully reinvest in their operations and thus cannot compete fully with development. If credit were constrained, unrestricted land would have a lower value in agricultural use (capitalized agricultural rents) than when no credit-market failure existed, which inefficiently increases the relative value of selling for development for some farmers on the margin. Similarly, if CEs increase farm profitability among easement sellers because they overcome illiquidity, then capitalized farm profits increase agricultural land values—albeit in the restricted market. CEs thus might facilitate preservation from within, as agriculture increases its relative competition for land. In addition, it is well known that CEs preserve farmland but not necessarily working farms. If CE payments allowed optimal reinvestment, they would encourage working farms. It is the working-farm aspect that delivers many of the aforementioned positive externalities (Duke and Aull-Hyde 2002).

Two possibilities exist regarding how capital markets function with respect to this development-based equity, and the functioning may be different for different farmers. Capital markets may function well, and landowners can borrow with low cost against all their equity or reduce the cost of borrowing a smaller stake. Or CEs may simply provide access to capital without the cost of borrowing—of course, assuming away transaction costs in entering a CE program and carrying some assumptions about a landowner's view of the value of different investments over time.

Our exploratory hypotheses arise from a competing theory: owners may not be able to access development-increment capital because there may be a credit constraint in areas with development pressure. It would be those farms on the margin of profitability that would be most sensitive to credit constraints, where small changes in access to credit may determine the future development or farm outcome. According to this second theory, CEs may collateralize capital for farm owners by enabling them to bypass an imperfect credit market. This theory implies two inefficiencies. It has a credit-market failure and suggests society may lose the external benefits of having farms if farmers need to exit agriculture to access all their equity. An additional inefficiency of this second narrative has to do with the fate of preservation dollars. If CE payments leak outside the agricultural sector, then the payments are transfers from taxpayers to farm owners who happen to benefit from development-pressure appreciation. If instead CE payments are recycled back into agriculture through operational reinvestment, then the taxpayer expenditures help ensure that agriculture land use persists. Investments made in fixtures (such a buildings) raise the value of land, while investments in mobile capital (equipment) raise the value of farming to the owner and land values if the equipment carries through to subsequent owners. Investments made in achieving an optimal scale or size of an operation would similarly raise agricultural use returns and land values. If so, agriculture would be more competitive, and positive externalities are more likely to persist. The specific hypotheses tested will show that both profitable owners and non-operators seem to be extracting capital—suggesting no indirect efficiency of CE programs—while the unprofitable owners and operators are reinvesting—suggesting indirect efficiency.

Prior Empirical Results on CE Payment Use

Survey data suggest considerable heterogeneity among owners in the use of CE payments. These data come from: 1) Duke and Ilvento (2004), who surveyed all preserved owners in Delaware; 2) Clark (2010), who surveyed similar owners in Ohio; 3) Esseks, Nelson, and Stroe (2006), who surveyed 422 owners in many states that had their CE paid from the federal matching-grant Farm and Ranch Lands Protection Program (FRPP); 4) Esseks and Schilling (2013), who surveyed 506 owners from the same population; and 5) Lynch (2007), who surveyed both preserved and nonpreserved farmland owners in Maryland. The three state surveys found evidence that preserved farmers differ from other farmers in terms of ownership; generally owners of preserved farms tend to have larger farms and be active owner-operators. Lynch and Lovell (2003) found growing crops, owning more acres, earning a high percentage of family income from farming, and having a child who plans to continue farming increased enrollment in preservation. The motivation for selling CEs revealed a difference between owners shoring up the financial viability of their operation and others who seem to be on firmer financial footing, which helps motivate the profitability hypotheses. For instance, in Delaware 44% reported considering relief from the pressure of debt, and 38% considered reinvesting in the operation when deciding to sell CEs; that said, 65% ended up reinvesting CE payments (Duke and Ilvento 2004). Ohio was similar, where Clark (2010) found that 25% sought to "generate income" and 11% wanted to purchase more land. Duke and Ilvento (2004) also found that half the owners (51%) said the preservation program "provided critical funding to improve the financial viability of my operation," while the other half (49%) disagreed. In Maryland, Lynch (2007) found 42% enrolled for money to reinvest in their farm operation.

The surveys reveal how CE payments were used. Some owners used payments in ways that did not reinvest in the farm economy—termed "personal needs". In Delaware, 54% reported savings and investments, 4% reported educational purposes, and 1% reported a non-farm business. In Ohio, Clark (2010) found that about 1% of CE payments went to education and travel, 20% to general savings (including trusts and retirement funds).[5] Esseks, Nelson, and Stroe (2006) and Esseks and Schilling (2013) report 52% and 69%, respectively, spent some CE payments on personal needs. Similarly, Lynch (2007) found that farmers saved (28%), financed retirement (12%), used for family needs (8%), and remodeled their homes (11%).

In contrast, many reported that they used some CE payments for reinvesting in agriculture. Esseks and Schilling (2013) found 84% of FRPP participants allocated some of the payments to agricultural purposes. Duke and Ilvento (2004) found that Delaware farmers decreased mortgage debt (33%), decreased operational loan debt (19%), and purchased another farm parcel (15%) or farm equipment (15%). In Ohio, 16% of CE payments went to

[5]*Clark found that 35% of CE payments went to debts or taxes, but it is unclear whether this is reinvestment. Also, many use payments to establish conservation practices, but it is unclear whether this increases farm profitability.*

buying more land, 15% to buildings and equipment, and 4% to farm expenses (Clark 2010). Also in Ohio, owners reported plans to diversify (27%) or establish new farm practices (34%) in the future (Clark 2010). Esseks, Nelson, and Stroe (2006) found that 55% reduced mortgage debt and 58% improved the farm operation (equipment, buildings, land, etc.). Esseks and Schilling (2013) reported that 48% reinvested some money into buildings and structures, 37% repaid loans on agricultural land, 28% bought equipment, and 18% bought more land. Lynch (2007) found that Maryland farmers used CE payments to reduce debt (35%), finance their farming operations (18%), buy more land (11%), and purchase equipment (8%). Lynch (2007) also found that preserved farm owners differed from nonpreserved farm owners in their investment patterns; preserved farm owners were more likely to reinvest (66%) than nonpreserved farm owners (55%). Preserved farm owners were also more likely to invest in human capital by attending workshops to learn new technologies and enhance their farming skills (60%) compared to nonpreserved farm owners (38%).

In sum, although some farmers use CE payments for personal needs, many are reinvesting—either to improve the profitability or financial health of the farm operation. These data are consistent with the narrative that, for some farmers, lending-market opportunities may be inadequate. Yet these studies do not reveal ownership or profitability patterns, which might further support this narrative and thereby provide evidence that CEs are saving some farms that would otherwise exit. Still, some owners likely perceive CE payments to be just another form of liquid capital, and in this case CEs may not provide indirect efficiency. These two purposes are operationalized as extracting capital hypotheses versus reinvestment hypotheses.[6]

Sampling and Data

A random sample, by state, was drawn from the entire population of owners of farmland preserved through state-level CE programs in Delaware, Maryland, and New Jersey. Owners with multiple properties appear once. Sampling was proportionate to the population in each program and was drawn from 5,319 owners of farmland preserved through the following organizations: Delaware Agricultural Land Preservation Foundation; Maryland Agricultural Land Preservation Foundation; Maryland Environmental Trust; Maryland Rural Legacy Program; and New Jersey Farmland Preservation Program. There were 507 completed phone interviews, averaging 31.7 minutes, and a response rate of 53.8%. Schilling et al. (2015) provide further details on the sample and specify the ways in which the sample closely matches the population.

Not all of the 507 surveyed owners of restricted farmland received CE payments. Termed "first-generation" owners, one sub-sample is 346 owners (68%) who made the decision to preserve—323 received CE payments and 23 donated easements. Another 113 were exclusively "second-generation" in that they owned preserved land but did not make the decision to preserve

[6]*A qualification is that some farmers might extract capital and this still promotes indirect efficiency. If one extracts capital for retirement, then the farm is not sold to finance retirement. This in turn may allow an heir to farm or another farmer to buy it. So indirect efficiency could come from both making the farm more profitable and from preventing the sale for personal needs. However, the data cannot isolate these final purposes associated with extracting capital, so the study's framing is more conservative.*

it and therefore received no CE payments—that is, they bought restricted land or inherited it. Two owners were excluded because of missing information. A surprisingly high number of owners (n = 46) satisfied the definition of both first- and second-generation owner. The analyses start with the 346 first-generation farmers and then explore a combined sample that also includes the 113 second-generation owners. However, the final dataset is smaller (n = 424) in the regressions because some first- and second-generation owners had missing data on key investment or owner-type variables.

Hypotheses and Variables

It is very difficult to observe directly if owners used CE payments to extract capital or reinvest for several reasons: 1) CE payments and owners' existing liquid capital are fungible; 2) information asymmetry prevents the researcher from observing directly an owner's private costs and how they affect decision making; and 3) challenges exist in modeling the complex interactions of the agricultural economy, land market, and other markets. Unobservability thus requires a theoretical framework, informed by prior findings, that motivates behavioral differences in the use of CE payments and then uses statistical inference to examine original survey data for systematic behavioral patterns. In other words, we test whether the data reject the exploratory hypotheses about capital extraction and reinvestment and, if so, with respect to what behavioral drivers or purposes for which respondents reported using the CE payments. If evidence cannot reject the exploratory hypothesis, then it warrants future work directed towards overcoming unobservability.

The variables in table 2 measure nine purposes for CE payments as derived from ten survey questions. Each variable is dichotomous, and respondents could dedicate CE payments to multiple categories. When respondents allocate to *Personal* uses, it best accords with a narrative in which owners are using CE to extract capital because, in effect, they are treating the program as an equity loan (but one that is not repaid). In contrast, the other eight purposes are more consistent with the narrative of reinvesting in the agricultural operation. Although a single owner's payments could go towards both personal uses and reinvestments, regressions test for systematic patterns holding all else equal. Explanatory variables explain part of the decision to allocate funds to a purpose, including *Heir-relative* (a relative is expected to take over the farm), *Heir-nonrelative*, *No-succession-plan*, *Direct-Marketing*, *Acres-preserved*, and *Age*. In addition, *Profitable* collapses two measures of profitability into a single indicator: 1) the 32% of farm operators who reported their operation was profitable (specifically, it is an opinion measure about whether operational revenues covered the costs); and 2) the nonoperator owners who believe land costs were covered by rent.[7] Combined, 50% (n = 255) reported profitability.

The main hypotheses are collected in table 3, and multivariate probit models of the various purposes are used to test for patterns in the use of CE

[7] *After 11 questions about the different types of revenue on preserved land, respondents were asked: "Do you think that the total revenues covered the total costs in 2010 of farming (or of owning) your preserved land?" The question focuses on 2010 for concreteness, though it does necessitate qualifications about the measure not necessarily reflecting other years. All but 11 respondents had owned preserved land prior to 2010.*

Table 2 Survey Questions on the Purposes for which Conservation Easement Payments Were Used

Variable	Survey Questions
Personal	Q60: "Have you spent any of the development rights payments on meeting personal or household needs such as for education, health, fixing up your residence, or investing in stocks or other securities?"
Ag-land	Q62: "Any spent on purchasing additional farmland in STATE?" Q63: "Any spent on purchasing farmland in another state?"
EstatePlan	Q68: "Were any of the payments from the sale of development rights used or set aside for transferring ownership of the preserved land to relatives or other persons?"
Debt	Q61: "Were any of the proceeds from selling development rights spent for decreasing debt on farmland you already owned in STATE?"
Ag-financial	Q67: "Any proceeds used for starting or expanding an agriculturally related business on your farmland in STATE?"
Irrigation	Q66: "Any used for constructing or improving irrigation facilities on your farmland in STATE?"
Equipment	Q64: "Any proceeds from the sale of development rights applied to purchasing machinery or equipment to be used on your farmland-preserved or unpreserved in STATE?"
Buildings	Q65: "Any proceeds applied to constructing of renovating buildings or other structures for agricultural purposes on your farmland in STATE?"
Other	Q69: "Any payments from the sale of development rights used for purposes that we've not already covered?"

payments. The first set involves farm profitability. Owners of profitable farms should tend to use CE payments for personal needs, that is, capital extraction because such owners would not need CE payments (and the accompanying restrictions) to reinvest in their already-profitable operation. Similarly, unprofitable farm owners should be more likely than profitable ones to dedicate CE payments to agricultural purposes because they are less likely to be able to bolster their operations using credit markets. In other words, there would tend to be no capital-market failure with the profitable farms because: 1) they already have the needed funds to reinvest; 2) they made the reinvestments in the past, which is why they are now profitable; and/or 3) banks are more likely to be willing to make loans secured by their profitable operations. Other variables should be related to this hypothesis, so the regression controls for larger operations (with *Acres-preserved*) and higher-sales farms.

A second set of hypotheses involves the ownership structure of the preserved farms. *Owner-lifestyle* and *Owner-nonoperator* tend to indicate less direct involvement in farming. But *Owner-lifestyle* still is classified as an operator. This contrasts with *Owner-low-sales* and *Owner-high-sales*, whose primary occupation is farming.[8] The second set of hypotheses is that high-

[8] *Nonoperators own preserved land but are not, as the survey was worded, "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 livestock, and marketing." High sales indicates operators with "total cash receipts from your farm operation" over $250,000 in 2010. Low sales were receipt up to $250,000, but primary occupation was nevertheless "farm operator". Lifestyle farmers were those with receipts up to $250,000, but their primary occupation was an occupation other than farm operator or retired.*

Table 3 Hypotheses on Patterns in the Use of Conservation Easement Payments

Hypothesis	Model	Variable	Sign that Supports Theory	Theory
Profitable owners are more likely to use CE payments for personal purposes.	*Personal*	*Profitable*	+	Extract capital using CE
Unprofitable owners more likely to use CE payments for agricultural purposes.	*Ag-land*	*Profitable*	-	Reinvest CE payments on-farm
	EstatePlan	*Profitable*	-	
	Debt	*Profitable*	-	
	Ag-financial Irrigation	*Profitable*	-	
	Equipment Buildings	*Profitable*	-	
	Other	*Profitable*	-	
		Profitable	-	
		Profitable	-	
Farmers are less likely than nonoperators to use CE payments for personal purposes.	*Personal*	*Owner-lifestyle*	-	Reinvest CE payments on-farm
	Personal	*Owner-low-sales*	-	
	Personal	*Owner-high-sales*	-	
Farmers are more likely than nonoperators to use CE payments for agricultural purposes.	*Ag-land*	For all models:	For all:	Reinvest CE payments on-farm
	EstatePlan	*Owner-lifestyle*	+	
	Debt	*Owner-low-sales*	+	
	Ag-financial Irrigation	*Owner-high-sales*	+	
	Equipment Buildings		+	
	Other		+	
			+	
			+	

Continued

Table 3 *Continued*

Hypothesis	Model	Variable	Sign that Supports Theory	Theory
Profitable first-generation owners have a lower tendency to dedicate CE payments to an agricultural purpose than they would otherwise be to invest in that agricultural purpose.	*Irrigation vs.* Invested in Irrigation *Equipment* vs. *Invested in Equipment* *Buildings* vs. *Invested in Buildings*	*Profitable* *Profitable* *Profitable*	For all: different and lower sign in CE model	Extract capital using CE
Full-time farmers who are first-generation owners have a lower tendency of dedicating CE payments to an agricultural purpose than they would otherwise be to invest in that agricultural purpose.	*Irrigation* *Equipment Buildings*	*Owner-lifestyle* *Owner-low-sales* *Owner-high-sales*	For all: different and lower sign in CE model	Reinvest CE payments on-farm

Note: The theory is that profitable owners and nonoperators extract capital while unprofitable owners and operators are more likely to reinvest. If farm owners cannot borrow against all their land value, then they cannot optimally invest in agriculture. This failure would raise the relative value of development. CEs may overcome this failure by providing liquid capital for development increment.

and low-sales owners should be more likely than lifestyle farmers to reinvest and that lifestyle farmers should be more likely than nonoperators to reinvest. The rationale behind the second set of hypotheses is that nonoperators and to a lesser extent lifestyle farmers are not actively involved in the agriculture operations; and one expects that they are more likely to be optimizing with respect to nonpecuniary values than full-time farmers. If they preserve their farms, they are more likely to be extracting capital but not likely to be reinvesting in their operations. All else being equal, the use of CEs to secure capital for reinvestment suggests a credit-market failure, and the regression examines how different ownership patterns affect reinvestment choices.

The third set of hypotheses compares the tendencies among respondents to: 1) dedicate CE payments to three types of reinvestments; and 2) make any investments from all sources of capital in the same three types at any time "since preservation." Because farmers frequently make reinvestments (in these models, irrigation, equipment, and buildings) and because money is fungible, one cannot definitively know that the CE payments compelled the reinvestments as opposed to investments that would probably have occurred about the same time. In our data, unobservability has no statistical solution. Nevertheless, regression can be used to examine investment patterns, all else being equal. Data were collected on 1) whether first-generation owners put CE payments to the three reinvestments; and 2) whether all first-generation and second-generation owners had made reinvestments in those categories at any time since purchase/inheritance, or preservation. In other words, data were collected on reinvestment using CE payments (first-generation) and any other money since preservation (first- and second-generation). These data show substantial variation.[9] Because the effect of being second-generation can be controlled in the "since preservation" regressions, the coefficients reveal investment patterns among first-generation owners with CE payments and since preservation. Although the coefficient estimates cannot be compared across models because the dependent variables refer to different questions, the models can examine differential reinvestment tendencies (statistical significance and sign), all else being equal.

Results and Discussion

The results support the hypotheses that owners with some characteristics (i.e., profitable, nonoperators) are more likely to report using CE payments for personal needs than owners with other characteristics (i.e., not profitable, operators), who tend to reinvest. The case is built using descriptive statistics, explanatory models of the uses of CE payments, and a comparison of reinvestment behavior by first-generation owners using CE payments to those who were first-generation but donated easements, and those who were

[9]Consider investment in irrigation. Second-generation owners only had the opportunity to invest "since preservation" because they received no CE payments, and 20 invested in irrigation and 84 did not. However, first-generation owners had the ability to invest using CE, non-CE funds, or both sources, and 276 did not invest in irrigation. Of the 71 who did invest, 30 reported using CE payments and investing "since preservation" – it is unknown if the 30 contributed additional money to the CE payments. The approach provides insight, however, because 41 first-generation owners reported investing in irrigation "since preservation" but not with CE payments. In sum, respondents are reporting data that reveal distinct sources and, coupled with first- and second-generation controls, can be used in a regression to describe investment tendencies in observable and reported variables.

second-generation. Collectively, the evidence supports the theory that CE payments can have an indirect efficiency effect, overcoming the illiquidity of land appreciation and a related credit-market failure for some farm owners.

How First-generation Owners Spent CE Payments

The descriptive results (based on the final regression sample) show that the most commonly reported purpose (64%) was *Personal*, which was similar to the 54% in Duke and Ilvento (2004) and 59% in Lynch (2007). Among the reinvestment categories, five exceeded 10%: *Equipment* (40%); *Debt* (36%); *Ag-financial* (48%); *Buildings* (36%); and *Ag-Land* (20% with 17% in state and 3% out of state). Although asked in slightly different ways from prior surveys, the results generally match those from the Delaware, Maryland, and Ohio surveys. For instance, in Delaware 33% and in Maryland 35% decreased mortgage debt. The 20% buying land accords with Delaware (15%), Maryland (11%), and Ohio (16%) (Duke and Ilvento 2004; Clark 2010; Lynch 2007). The biggest difference is with *Buildings* and *Equipment*. The rate for equipment in Delaware (15%) and Maryland (8%) and for buildings and equipment in Ohio (15%) are lower than that reported in this survey (Duke and Ilvento 2004; Clark 2010; Lynch 2007). The survey results reveal relatively low rates for *Irrigation* (10%), *Estate* (9%), and *Other* (8%).

The Relationship between Profitability and Owner-type

In the regression sample, 161 of 346 (47%) first-generation owners were profitable. This differs statistically from the profitability of second-generation farms, which is 65% (72 of 113). Although there is no definitive evidence as to why, it might be that an owner buying or inheriting restricted land tends to be profitable. It may also be a direct result from saving money on land costs. By inheriting or buying lower cost-restricted land, farmers may be able to direct more investment into the operation.

Table 4 shows that among first- and second-generation owners, high-sales farms were by far the most likely to be profitable—only eight were unprofitable (12.5%). Low-sales farms were also likely to be profitable, but only 43% of lifestyle farms (which may not be farmed with a profit motive) and non-operators were profitable, which may suggest low rents or high land costs. A Chi-square test shows that high-sales farms were statistically more likely to be profitable. Sales and profitability vary together, but the regression isolates the effects of each on multiple purposes of spending CE payments.

Explanatory Model of CE Payments Spent by First-generation Owners

Regressions test for patterns in the extraction of capital (*Personal*) and reinvestment categories (the eight ag-related purposes). Each purpose formed one dichotomous dependent variable, and the same independent variables explain all purposes. Table 5 reports a multivariate probit regression for the main eight purposes among first-generation owners; a multivariate probit including the *Other* purpose failed to converge and so this regression is reported as a univariate logit.[10] Although the number of coefficients where

[10] *Prior analysis examined a series of univariate logit models that each individually explained between 10% and 27% of the variation observed in the dependent variables. The multivariate specification is*

Table 4 Survey Results on Profitability by Owner-type

	Profitable	Not Profitable	Total
Owner-nonoperator	86 (41.5%)	121 (58.5%)	207
Owner-lifestyle	50 (42.7%)	67 (57.3%)	117
Owner-low-sales	51 (58.6%)	36 (41.4%)	87
Owner-high-sales	56 (87.5%)	8 (12.5%)	64
Total	243 (48.8%)	232 (51.2%)	475

Note: Includes first- and second-generation owners.

the null hypothesis is rejected is modest, this does not necessarily mean the explanatory power of the model is low; a higher power is not necessarily anticipated because—beyond the hypothesized drivers—it is possible that solely idiosyncratic forces within the farmers' minds determine these allocation decisions. If CE payments and bank loans were interchangeable, then there should be no credit-market failure and no patterns in the drivers of the purposes in the use of CE payments. Therefore, any statistical significance indicates some explained deviation from a purely idiosyncratic pattern. This is the essence of the exploratory hypotheses, and the fact that some significance was observed suggests that the capital extraction and reinvestment theories cannot be rejected. Most of the significant drivers relate to the hypothesized effects.

The regressions show that profitable farms are more likely to use CE payments for personal reasons (an increase at 2% significance level), supporting the hypothesis that profitable farmers extract capital. Among these first-generation farms, profitable and unprofitable farm owners were equally likely to reinvest in land, estate planning, debt, agricultural financial, irrigation, buildings, and other agricultural purposes. The ownership results also reveal systematic patterns. Compared to nonoperators, owners of high-sales farms are much less likely to use CE payments for personal needs (a decrease at 1% significance level) and more likely to use the money for five reinvestments: debt; agricultural financial; irrigation; equipment; and agricultural-other. For high-sales farms, strong support exists for the reinvestment hypothesis and evidence against the extraction of capital.

No evidence was found that the other two owner types (owner-lifestyle and owner-low sales) are more or less likely than nonoperators to target personal needs. Moreover, there are many coefficients that suggest that relative to nonoperators, all operator types have an increased likelihood of targeting several reinvestment categories.[11] Evidence suggests that owners of low-sales farms are more likely than nonoperators to reinvest in five purposes: debt; agricultural financial; irrigation; equipment; and buildings. Even lifestyle farmers are more likely than nonoperators to reinvest in three purposes: agricultural financial; equipment; and agricultural-other. Collectively, this suggests that operators are more likely than nonoperators to reinvest CE payments, and this supports the reinvestment hypothesis.

superior because the unexplained variation between any two models is correlated in many instances (see the statistical evidence in the 28 rhos). Thus, the univariate models would be biased, and 9 of 32 coefficients changed in significance between the estimations. The simulated maximum likelihood method used is available in Stata and was developed by Cappellari and Jenkins (2003).

[11]*This corresponds with Esseks and Schilling (2013), who found that although 84% reported some reinvestment, the rate was 91% among operators and only 68% among nonoperators.*

Table 5 Multivariate Probit Analysis Explaining the Use of Conservation Easement Payments for Different Purposes (first-generation farms only)

Variable	**Non-agricultural Purposes**	**Agricultural Purposes**							
	Personal	*Ag-land*	*EstatePlan*	*Debt*	*Ag-financial*	*Irrigation*	*Equipment*	*Buildings*	*Other (estimated as univariate)*
Intercept	0.79	−0.96	**−2.33*****	−0.25	0.29	**−2.60*****	−0.44	−0.08	**−3.30****
Profitable	**0.39****	0.06	−0.15	0.06	−0.14	−0.07	−0.23	−0.08	−0.50
Heir-relative	−0.12	−0.02	0.38	0.02	0.23	**0.86***	0.03	−0.14	1.26
No-succession-plan	−0.36	−0.27	−4.47	0.08	0.10	0.59	0.01	−0.24	1.09
Directmkt	**−0.39****	0.09	−0.33	0.14	0.09	−0.30	−0.01	0.27	−0.23
Age	0.0003	**−0.01***	0.01	**−0.02****	**−0.02*****	0.01	−0.004	−0.005	−0.03
Expand	0.12	0.17	−0.15	0.31	0.15	−0.05	0.36	0.16	−0.37
Liveonfarm	0.09	0.35	0.44	0.13	0.03	−0.01	**0.41****	0.12	0.11
Timeowned	**−0.02****	0.01	−0.01	0.01	0.0005	−0.02	**−0.02****	−0.01	**0.05****
Acrespreserved	−0.0001	**0.002*****	0.00002	−0.00004	−0.0004	−0.0001	0.0001	0.00002	−0.002
Newhouses	−0.0001	−0.0004	−0.002	−0.00002	−0.0001	−0.0002	**−0.0004*****	−0.0001	0.00003
Owner-lifestyle	−0.05	0.02	0.44	0.15	**0.47*****	−0.04	**0.67*****	0.26	**1.54****
Owner-low-sales	−0.17	0.16	0.26	**0.62*****	**0.81*****	**0.85*****	**0.72*****	**0.46****	0.65
Owner-high-sales	**−0.86*****	0.26	0.59	**0.81*****	**1.24*****	**1.24*****	**0.65*****	0.04	**1.91*****
Conserve	−0.02	0.22	0.11	**0.56*****	**0.54*****	0.26	0.08	0.05	0.48
rho with model 2	**−0.24****								
rho with model 3	0.10	−0.05							
rho with model 4	**−0.19****	0.12	0.11						
rho with model 5	−0.09	0.13	**0.43*****	**0.92*****					
rho with model 6	−0.18	**0.45*****	0.07	0.13	0.11				
rho with model 7	**0.39*****	0.05	0.07	0.06	**0.16***	**0.42*****			
rho with model 8	**0.24*****	0.06	0.12	**0.17****	**0.23*****	**0.38*****	**0.71*****		
% reporting^	64.0%	20.0%	9.1%	36.2%	48.0%	9.7%	39.9%	36.0%	7.7%,
Max rescaled R^2									0.15

Note: Asterisks represent the following:= 10%,**= 5%,***= 1%. First eight models are from a simulated maximum likelihood estimation of a multivariate probit model following Cappellari and Jenkins (2003). Ninth model from a univariate logit. Probit fit statistics are: Log likelihood=-1022.0377, Wald $chi^2(112)=216.30$, Prob>$chi^2=0.0000$. Reserve categories of the indicator variables in all models are:* Owner-nonoperator, Heir-nonrelative. *Earlier regressions included a variable on crops, but this was dropped because it was not significant and likely collinear with included variables such as acres preserved and owner-operators. A variable measuring whether the owner had always lived on the farm was dropped because it was highly correlated with whether they currently live on the farm.^indicates the percentage reporting "yes" to the purposes, but the final regression may be slightly different because of missing values across the multivariate model. In probit models, the simulation was fed with N = 303 observations; in the logit model, N = 310.*

Although not central to the key hypotheses, evidence emerged that other characteristics have systematic effects. For instance, direct-marketers are less likely than those who do not direct market to extract capital, as are those who owned their land longer. Also, owners living on their farms are more likely to reinvest in equipment. Farmers who owned their land longer are less likely to use CE payments for personal needs and equipment. These results are not inconsistent with the key hypotheses. In contrast, it was unanticipated that those with a relative who would inherit the farm showed no greater likelihood to extract capital (i.e., split the value of the estate with relatives); this group, however, was more likely to invest in irrigation. There was also some evidence that older farmers are less likely to reinvest in three purposes: agricultural land; debt; and agricultural financial.

Collectively, the evidence supports the reinvestment theory for high-sales farms and, to a lesser extent, owner-operators in general. This tendency attenuates for owners of profitable farms, who tend to extract capital, all else being equal. The characteristics of high-sales farms and owner-operators probably are what legislators and agencies had in mind when they designed the programs. Although it is unlikely this was considered during the design of preservation programs, this analysis suggests that CE payments may also be attenuating a credit-market failure. Not all participants reinvest. Profitable and nonoperator farms appear to be extracting capital but these farms still provide external benefits.

Farming Reinvestments: First-generation Investment Patterns

The models in table 6 compare three reinvestments using first generation farms and their "only CE payments" (columns 1, 3, 5), and those "since preservation "(columns 2, 4, and 6) in which the first-generation sellers of easements could have used CE payments but did not necessarily do so. The three "only CE payment" models are reproduced from table 5, while the "since preservation" models come from a new trivariate probit estimated in Stata using the Cappellari and Jenkins (2003) simulated maximum likelihood method. Importantly, a prior regression of the since-preservation models showed that the choices of second-generation farmers are not statistically different than those of first-generation and, further, there are no significant interactions of one generation and the explanatory variables.[12] It is important to reiterate that the "since preservation" decisions are based on separate survey questions than the "only CE payments". All six models therefore have coefficients that reflect the reinvestment tendencies of first-generation owners, and the results help reveal whether the CE payments are essential reinvestment drivers or whether those investments tended to happen anyways.

The since-preservation results show that profitable farmers are more likely than unprofitable farm owners to have invested in irrigation (positive coefficient at the 5% level) and less likely to have invested in buildings since the time of preservation (negative coefficient at the 5% level). However, the corresponding CE payments models found no effects for profitability—that is, owners of profitable and unprofitable farms are equally likely to use CE payments for irrigation and buildings. Comparing the tendencies shows

[12]*We attempted to perform the test using a multivariate probit model of the three investment equations; however, the multivariate probit model failed to converge to a solution for the second-generation owners due to the small sample size. As a result, we report results of a univariate test in the appendix.*

Table 6 Comparison of Three Investments Purposes for Sub-sample of First-generation Owners to Full Sample of All Owners of Preserved Land

Variable	Model 1 *Irrigation* (1^{st} Gen.)	Model 2 Invested in Irrigation (All Farms)	Model 3 *Equipment* (1^{st} Gen.)	Model 4 Invested in Equipment (All Farms)	Model 5 *Buildings* (1^{st} Gen.)	Model 6 Invested in Buildings (All Farms)
Intercept	**−2.60*****	**−1.98*****	−0.44	−0.18	−0.08	−0.05
Profitable	−0.07	**0.42*****	−0.23	0.04	−0.08	**−0.31****
Heir-relative	**0.86***	−0.05	0.03	−0.04	−0.14	**−0.41***
No-succession-plan	0.59	0.06	0.01	−0.25	−0.24	−0.40
		0.18		0.16		−0.04
Directmkt	−0.30	**0.37****	−0.01	0.24	0.27	**0.48*****
Age	0.01	0.01	−0.004	−0.01	−0.005	−0.003
Expand	−0.05	**0.87*****	0.36	0.11	0.16	**0.66***
Liveonfarm	−0.01	−0.13	**0.41****	0.22	0.12	0.19
Timeowned	−0.02	−0.002	**−0.02****	**0.03*****	−0.01	**0.02*****
Acrespreserved	−0.0001	**0.0004****	0.0001	0.00002	0.00002	0.00002
Newhouses	−0.0002	0.0001	**−0.0004*****	0.00002	−0.0001	0.0001
Owner-lifestyle	−0.04	0.21	**0.67*****	**1.04*****	0.26	**0.34****
Owner-low-sales	**0.85*****	0.08	**0.72*****	**1.43*****	**0.46****	**0.60*****
Owner-high-sales	**1.24*****	**0.70*****	**0.65*****	**1.14*****	0.04	**0.72*****
Conserve	0.26	0.13	0.08	**0.36****	0.05	**0.37*****
rho with *Equipment* (model +2)	**0.42*****	**0.19****				
rho with *Buildings* (model +2 and +4)	**0.38*****	**0.18****	**0.71*****	**0.24*****		
Percentage reporting^		83/424		292/424		249/424

Note: Asterisks represent the following:= 10%,**= 5%,***= 1%. Models 1, 3, and 5 from the MVP in table 5. Models 2, 4, and 6 from a trivariate probit estimated from N = 430; the broader sample was N = 479 but there were missing values. The trivate probit has fit statistics: Log likelihood=-628.94025, Wald chi^2(45)=206.52, Prob > chi^2=0.0000. Related to Models 2, 4, and 6 was 4-variate probit (with some different variables), which was previously reported in Gottlieb et al. (2015), but the results were not compared to the three other regressions as they were herein. Reserve categories of the indicator variables in all models are:* Owner-nonoperator, Heir-nonrelative. *Starting sample includes 484, rather than 507, because 23 farmers were not involved "in agriculture".^indicates that percentage reporting "yes" to the purposes. The three regressions with 424 observations were Survey questions: Q84: What year did you first own farmland in STATE preserved through a conservation easement?Q85: Since YEAR OF Q84, have you purchased equipment or machinery for use on any of the preserved farmland you own…?Q86: Since the year you first owned preserved farmland, have you done any construction or renovation of buildings or other structures for agricultural purposes on your preserved land?Q87: Since YEAR OF Q84, have you constructed or improved irrigation facilities on any of the preserved farmland you own…?*

that, among profitable farm owners, CE payments have a greater tendency to be used for buildings and a lower tendency to be used on irrigation than typical operating funds. For unprofitable farm owners the tendencies are the same, regardless of whether the money could have come from CE or not.

Asymmetric tendencies also emerge among owner types. High-sales farmers are more likely than nonoperators to invest in irrigation and equipment, regardless of whether they received money from CE payments. Moreover, high-sales farmers tend to invest in buildings more than nonoperators do (positive coefficient at the 1% level), again with no effect found with CE payments. On the other hand, our analysis found that high-sales farmers have a lower tendency to invest CE money into buildings than they have for investment in buildings in general (since preservation regression). For this category, the data suggest CE payments are not providing critical funding to high-sales farmers, all else being equal. Asymmetric tendencies were also found for low-sales farms. Low-sales farms did not show a tendency to invest in irrigation since preservation—it was only when the money source could have been CE payments that low-sales farms invested. This comparison suggests that CE payments may provide critical funding for reinvestment because they are associated with a greater tendency for low-sales farms to install or improve irrigation.

Unsurprisingly, regardless of whether the money source is CE payments or not, lifestyle farms and nonoperators have similar tendencies when investing in irrigation (no significant tendency) and different when investing in equipment (lifestyle farmers are more likely to do so, at the 1% level). However, an asymmetric pattern emerges with building investment. Lifestyle farmers are more likely than nonoperators to invest in buildings since preservation (positive coefficient at 5% level), but this tendency does not hold for CE payments. Comparing the two results suggests that lifestyle farmers have a lower tendency to use CE payments for buildings than they would otherwise have. Asymmetric tendencies were found with other drivers. The tendency to use CE payments for irrigation is lower than since-preservation investments for direct marketers, farms that expanded, and those with larger acres preserved—though the opposite was found for those whose heir is a relative. The tendency to use CE payments for equipment and buildings is lower for those owning longer, while the tendency to use CE payments for buildings is lower than typical for farms that expanded. Collectively, for some farm types, the evidence suggests that CE payments are not being reinvested with the same tendency as these types of owners would typically exhibit toward reinvestment. Only those owners who live on their farm have a greater tendency to use their CE payments towards equipment reinvestments.

This subsection draws limited comparisons of signs and significance in light of the unobservability problem. However, additional insight is offered by a more complete assessment of how first-generation owners used CE payments for reinvestment relative to their pre-existing tendencies in terms of ownership, profitability, or other characteristics. Asymmetric tendencies do not imply that the CE money was not reinvested—the preceding subsection clarifies the many drivers of CE payments being reinvested. Rather, this subsection helps to build a more complete answer about where CE payments made a critical difference for reinvestment in the agricultural economy. Alternately, where did CE payments allow an owner to reinvest when that owner, given his or her characteristics, would have been unlikely to reinvest otherwise? Despite the unobservability problem, the results as a whole begin to provide an answer. The model shows that only in four cases did CE payments increase the tendency that a reinvestment would be made: 1) low-sales farmers invested CE in irrigation; 2) farms with an heir who is a relative invested CE in irrigation; 3) owners living on the farm invested CE in equipment; and 4) profitable farms invested in buildings.

Conclusion

This paper used original survey data to investigate exploratory hypotheses about whether land preservation might lead some owners to reinvest in their agricultural operations. If they do, the theoretical argument offered herein suggests that CE programs could be having additional, indirect efficiency impacts by allowing farmers to (1) overcome a credit-market failure and access their land-appreciation capital, and (2) do so in areas under development pressure without having to sell their land to the highest bidder (preserving positive externalities of agricultural land use). This is a controversial theory, for capital markets ought to be efficient and owners should be able to access this development increment without having to resort to CEs. Furthermore, if owners do not reinvest CE payments and used CE for personal, nonfarming use, then CE programs simply provide a way to extract capital without using a bank. Such behavior provides the positive externality but no indirect efficiency enhancement associated with agricultural credit, the competition between agricultural and development for land, and the economies of reinvesting to sustain agriculture.

The data were analyzed to test whether there were systematic patterns in the use of CE payments. An absence of patterns suggests the data do not match the theory supported by the exploratory hypotheses—in this case we could conclude that CE payments and landed capital are costlessly fungible and there is no evidence of a credit-market failure—for CE payments would be no more likely than other money (savings or yearly profits) to be reinvested or extracted. Yet, the analysis found systematic investment patterns in terms of a farm's profitability, ownership pattern, and other characteristics. Unprofitable nonoperators exhibit few systematic patterns of reinvestment or extraction. Given that these owners tended not to reinvest all else the same, they probably view all money as fungible. Profitable nonoperators tended to use CE as a bank, extracting capital for personal use but likely intending to maintain ownership of this profitable resource. Operators with higher sales had an increased likelihood of reinvestment. Profitable operators like the nonoperators tended to extract capital. We also used the survey data to examine if those farmers reinvesting in their operations with CE payments were already more likely to do so. Although unobservability complicates assessment, the analysis identified relationships for a few farm characteristics (low-sales farmers and those with heirs who are relatives invested more on irrigation, owners living on the farm invested more on equipment, and profitable farms invested more in buildings) where there was the most evidence that CE payments increased reinvestment. In sum, the analysis suggests that, for some owners, CE payments might facilitate reinvestment rather than extracting capital. In these cases, the evidence suggests that CE payments may indeed be used to circumvent credit-market failures, creating an indirect efficiency enhancement. Thus, this paper suggests an important new area of study and warrants new data collection—possibly using behavioral economics—that seeks to improve our understanding of why certain types of farmers seek CE payments and whether CE programs might be redesigned to target those owners that will trigger the largest efficiency gains, all else being equal.

It must be emphasized that this paper is exploratory; the data collected cannot overcome unobservability and show under what conditions CE payments resolve illiquidity. Instead, this paper establishes an evidentiary basis for future research on illiquidity and CE payments. It is important to note the analytical tension in the exploratory hypotheses: if data were found that did not support the hypotheses, then one would conclude that landed capital is as liquid as CE payments, and thus CE programs have no indirect efficiency impact. This is not shown, and so this paper is suggestive of a new area of research on landed capital credit-market failures and how farmland owners can use policy options to circumvent illiquidity and credit-market failures.

The results suggest that some farmers are credit constrained and they might be using CE programs to achieve liquidity. A future study can test systematically whether farmers' investment and other choices systematically change after enrolling (treatment) or not enrolling (control). Such a study would require data from CE participants and nonparticipants. Based on the results reported here, this study would also have to control for other options for seeking credit, develop an innovative control on the fungibility of illiquid and liquid assets, measure prior efforts to seek credit and their success, develop more precise measures of profitability, and develop exact measures of how much money was allocated to each purpose.

A future study also ought to address a possible limitation of this paper, as noted by a referee. The theory developed here assumes that CE does not change farmer wealth; instead, it is a question of accessing the wealth. This is only true if CEs are valued correctly through an appraisal or program mechanism and not sold at a discount/premium. Evidence suggests that preserved farms sell for more than the development-rights appraisal would suggest, and relatively close to the price of unpreserved farms (see Nickerson and Lynch 2001; Lynch, Gray, and Geoghegan 2007; Lynch, Gray, and Geoghegan 2010; Anderson and Weinhold 2008). The absence of a large diminution in value may arise from residual development options (Schilling, Sullivan, and Duke 2013). If farm owners use CEs to increase wealth, then the story about credit constraints might be confounded. Conversely, farmers may accept a discounted CE payment relative to the program's estimated value at the time of the easement to increase the probability of participating (Horowitz, Lynch and Stocking 2009). Some of this discounting may reflect owners' awareness of the true value of their equity. Alternatively, some farm owners may sell CEs at a large discount under duress (say, a "fire sale"). In this case, the theory ought to involve timing as well as liquidity. These issues could be measured and controlled in a future study.

In addition, the results suggest that additional research could lead to a more effective preservation policy. One might perceive adverse selection in that profitable farms are extracting capital. With limited budgets to increase the externalities retained, it might be better to target farms for preservation that are on the margins of solvency. Profitable farms are already more likely to persist in the future even with the threat of urbanization. The CE payments to these farms might provide positive externalities in perpetuity—but the opportunity cost is not saving a farm on the margin, which may then be converted to a non-farm use. The analysis in this paper supports targeting marginal farms, not only because it may prevent a conversion but also because they are more likely to reinvest and thus provide the indirect efficiency result.[13] Indeed, the results offer a promising guide to targeting farms for preservation with observable characteristics. The results suggest that some farms (such as unprofitable but high sales farms) are more likely to use CE payments for reinvestment, so CE payments may

[13] *The problem of efficient targeting is complicated by the next-best use. If the marginal farm is simply run by a below-average manager, then new capital will likely lead to future management below the efficient frontier. However, because of the positive externalities from agricultural land use, this is not necessarily a suboptimal outcome. Optimality depends on whether the farm would be converted to a non-farm use or it could transition to a better farmer. The CE payments may not deliver the efficiency result if they prevent transitioning to more profitable farmers.*

actually keep them in business. These funds allow improvements, which in turn increase the likelihood that they will persist. Beyond efficiency, some programs may seek to keep the dollars allocated to preservation in the same jurisdiction. This is more likely to be the case when development-increment equity is reinvested in value-added activities in the state or location funding preservation. Future research may want to assess whether this happens and whether it has the net effect of lowering the fiscal costs of preservation.

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Appendix

This appendix summarizes preliminary work to test structural stability in the model reported in table 6. Pooling the data (i.e., combining first- and second-generation owners) when modeling imposes the restriction that an independent variable has the same effect on the dependent variable for both first- and second-generation owners, but this may not be true. To test whether the models' predictors are significantly different for first- and second-generation owners, we use a Model Likelihood Ratio test. The test statistic is the Likelihood Ratio chi-square statistic $G^2 = -2(l_p - l_1 - l_2)$, where l_p is the maximum of the log-likelihood function for the model on the pooled data, l_1 is the maximum of the log-likelihood function for the model on first-generation landowners, and l_2 is the maximum of the log-likelihood function for the model on second-generation landowners. In other words, we fit the same model in each subsample; the unrestricted log likelihood is the sum of the subsample log likelihoods. Then we pool the subsamples and fit the model to the pooled sample; the restricted log likelihood is from this pooled sample. Under the null hypothesis, the statistic G^2 has a chi-square distribution with d.f. = 15 (number of predictors plus 1). See test details below.

H_0: $B_t = B$ for all $t > 1$ subgroups (in other words, the investment behavior for 1st and 2nd generation owners is statistically equivalent).
H_A: Not all subgroup betas are equal (i.e., there is a structural break, investment behavior is different for 1st and 2nd generation owners).

We reject the null hypothesis if $G^2 > X^2_{15,\ .05} = 25.0$. The table below shows LL tests of three investment models. The results show that the models' coefficients are not statistically different between first- and second-generation owners.

	-LL2			
Investment Model	**First Generation**	**Second Generation**	**Pooled**	**LL Statistic**
Irrigation Model	267.67	72.05	357.72	18.00
Building Model	386.33	88.89	497.13	21.91
Equipment Model	316.26	59.84	397.54	21.44