Do agricultural conservation easements promote farm investment?

Daniel P. Bigelow, Oregon State University, E-mail: daniel.bigelow@oregonstate.edu
Conner J. McCollum, Montana State University

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Conner J. McCollum

Daniel P. Bigelow

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Abstract

Conservation easements have become an increasingly popular tool for safeguarding agricultural land from development. To the extent that capitalized future development returns embodied in the value of farmland are illiquid, or inaccessible to the landowner for farm financing purposes, easements may also promote on-farm investment. In this paper, we conduct an observational empirical study of the association between county-level easement activity and various farm investment outcomes. We first show that there is a robust and negative within-state correlation between farmland debt-to-asset ratios and two measures of urban pressure, which is consistent with our premise that capitalized future net returns to development are illiquid for farm-related loan collateral purposes. In our primary analysis, we consider investment outcomes related to land tenure and ownership, borrowing behavior, and machinery and labor use. Preliminary results suggest that easements are, somewhat inconsistently, associated with a reduced reliance on rented land. Greater easement activity has a stronger positive association with more borrowing (through higher interest expenses), tractor use, and hired farm workers. Overall, our results provide suggestive evidence that easements may promote on-farm investment.

Keywords: land conservation, conservation easement, farmland tenure and ownership

1 Introduction

Over the past several decades, conservation easements have emerged as the primary tool for permanently protecting private farmland from irreversible development. With easements, landowners forego the right to develop their land but often still retain the ability to use it for agricultural purposes. There are several reasons why landowners would elect to conserve their land through an easement, including environmental concerns and issues involving family farm succession. In terms of more tangible economic motivations, provisions in the Federal income tax code, as well as the income tax codes for many states, treat conservation easements as charitable donations, which can provide substantial financial benefits to donating landowners (Parker and Thurman, 2018). Easements may also be purchased outright for cash, but budget constraints of potential easement holders (typically land trusts) make this a less common form of easement acquisition.[1] Regardless of how they are established, easements require landowners to irreversibly give up a valuable property right, which suggests that the financial incentives for farmland owners to engage in this form of private land conservation may be considerable.

A crucial, yet poorly understood, aspect of how economic incentives shape private conservation decisions has to do with the lending practices of farm financial institutions. Land is the largest asset held by most farm operations and often used as collateral in securing farm-related loans. As has been documented in numerous prior studies (Plantinga et al., 2002; Livanis et al., 2006; Borchers et al., 2014), farmland under development pressure is valued at a premium corresponding to the discounted future returns associated with converting the land out of agricultural use. However, for reasons stemming from borrower default risk and housing market volatility, traditional agricultural lenders may be reluctant to allow producers to borrow against the full market value of their land. This creates a form of illiquid land capital which, absent a land sale, producers are unable to tap into to finance investments in their operation (Duke et al., 2016). In this way, conservation easements may provide an important channel through which producers may extract the financial capital required to make farm investments.

[1] It is also not uncommon for an easement to be established through a combination of direct cash payment (known as a bargain sale) and charitable donation.

In this paper, we contribute the first observational analysis of the association between easements and farm investment decisions. Using comprehensive national panel data on easements and investment, we build on and extend prior work in this area, which studied how easements affect investment behavior using surveys administered in relatively narrow geographic regions. We first show that there is a robust negative correlation between urban pressure and farm real estate debt-to-asset ratios, which is consistent with the idea that producers in development-prone areas may face a credit constraint that hinders their ability to fully exploit their land-related wealth to finance farm investments. The second part of our paper relies on variation in the timing of easement activity across counties to measure the relationship between easement activity and a range of investment outcomes, including those related to land ownership and tenure, debt finance and borrowing behavior, and the use of machinery and labor.

Several prior works have examined the extent to which easements are used to finance farm investments (Maynard et al., 1998; Duke and Ilvento, 2004; Lynch, 2007; Esseks and Schilling, 2013; Duke et al., 2016; Seidl et al., 2018). All of these studies derive their findings from original survey work where participating landowners, generally in a relatively narrowly defined geographic area, are asked to report on their motivations for easement use, with variation in findings/implications due to differences in the populations surveyed, survey design, and research objectives. A common theme of these studies, however, is that a substantial fraction of respondents report using easement proceeds to finance some aspect of their operation, such as land purchase/consolidation, debt service, equipment/machinery purchase, and general farm investment. Many of the same studies also document the importance of non-financial motivations in easement adoption, such as farm succession and other bequest-oriented factors. Overall, it is reasonable to assume that easement decisions are motivated by both private financial benefits and other non-financial rationales that may impact the utility landowners derive from conservation. Our paper focuses on the importance of the private financial benefits of easements, as revealed through post-easement investment activity.

Understanding the extent to which easements are used to finance agricultural investments is important for several reasons. For one, concerns over the trend and pattern of US farmland conversion

has continued, despite the fact that current rates of land development pale in comparison to those from the late 1990s (Bigelow et al., 2022). A primary reason behind public perceptions of farmland conversion patterns likely stems from both its irreversibility and the general salience of farmland loss in rural communities. Although the voluntary nature of conservation easements makes them popular among land policy groups, their widespread use to protect land has also been met with controversy due to concerns about the objectives of land trusts; allowed uses of land with an easement; long-term effects on local public goods provision stemming from a potential loss of future property tax revenue; easement valuation issues stemming from the rise of syndicated easements, among other things (Parker and Thurman, 2019); and the appropriate role of the federal government in matching easement funding from land trusts (Eitel, 2003). If easements promote farm investment, they have the potential to both conserve land and improve the resilience and vitality of farming communities in peri-urban areas, a combination that is likely to garner a greater degree of public support for their continued prominence in future land policy discussions.

2 Conceptual model of financial motives of easement donation

There are several potential reasons why an agricultural landowner may put a conservation easement on their land. For one, many owner-operators (i.e., landowners who produce farm outputs using land they own) are concerned about intergenerational farm succession. With an easement, landowners are assured their land will remain in agricultural use in perpetuity and, consequently, will gain any associated bequest utility from the certainty that it will not be purchased by a developer and converted to a non-agricultural use.[2] In addition, landowners may have a financial motivation to put an easement on their land. The potential financial benefits of easements come about through federal and state income tax incentives that treat an easement's value as a charitable donation or, less commonly, the lump-sum cash transfer occurring if the land's development rights are directly purchased by a land trust. To simplify the exposition of the conceptual model, we

[2] A potential downside to this bequest motivation is that it can dramatically reduce the wealth that can be inherited from the original landowner. Land with development potential under easement will have a lower market value than otherwise similar land without the easement. If, as is common in family farming enterprises, the current owner plans to transfer the land to a related heir upon retirement or death, the easement may substantially reduce the financial value of the land asset if the inheritor does not wish to continue farming and instead plans to sell the land.

focus on donated easements and ignore the state income tax implications of easement donation covered in detail in Parker and Thurman (2018). The general implications of state tax provisions are briefly discussed further below.

We first provide a conceptual model of the value of a conservation easement. To begin, we lay out a simplified discrete-time representation of the standard model of agricultural land values (as in, e.g., Capozza and Helsley (1989)):

$$V = \frac{A}{r} + (1+r)^{(1-t^*)}\frac{D}{r} \tag{1}$$

In equation (1), the value of farmland, V, is determined by the net income accruing from both agricultural and future potential non-agricultural uses (e.g., conversion to development). The value of the land if it were to stay in perpetual agricultural use is given by the first term on the right-hand side, $\frac{A}{r}$, where A is the constant annual net return from agricultural production and r is the annual discount rate. If the land will be irreversibly converted to some non-agricultural use in future year t^*, assumed to be known with certainty, the market value of the land increases by $(1+r)^{(1-t^*)}\frac{D}{r}$, which represents the capitalized value of future income increases accruing to the landowner after the land is developed. In this setup, D is the constant annual increase in the net returns to the landowner from development, above and beyond the returns from agricultural production, A.

Under the assumption of perfect information regarding the timing of future development, the value of a conservation easement that permanently prohibits development is exactly equal to the capitalized future increases to the land's net returns after development.[3] Once the easement is in place, assuming current agricultural practices are allowed to continue, the market value of the land becomes $\frac{A}{r}$. To reduce notation, let the capitalized future net-return increases from development in equation 1 be denoted by $\tilde{D}$. Assuming that the landowner is an agricultural producer who quali-

[3]Of course, in practice future development timing is not known with certainty and easements are generally valued using models based on comparable sales of similar parcels within a given locality. Although these realities are ignored in the present treatment, the fact that development is irreversible and its optimal timing is uncertain suggests that there are option values associated with both development and easement donation decisions. See Capozza and Helsley (1990) for an extension of the basic agricultural land value model laid out in equation (1) that incorporates option values.

fies to deduct from their taxable income the full value of the easement as a charitable donation, the potential value of the easement to the landowner is given by $\tau\tilde{D}$, where τ is the marginal income tax rate faced by the producer.[4]

Although the value of $\tau\tilde{D}$ is potentially quite large, the key financial reason behind why landowners would be incentivized to place an easement on their land has more to do with the nature of agricultural financial lending institutions. Agricultural producers rely on credit to finance various purchases made for their operations, including seasonal production expenses, farm machinery and equipment, and land. When a producer applies for credit, the amount and interest rate at which they are able to borrow will depend in part on their collateral, which often primarily consists of land, as it is the most prominent store of wealth for producers in the U.S. farm sector. In determining a producer's borrowing capacity, the agricultural lending appraiser will take full account of the stream of net returns the land would generate in perpetual agricultural use. Future development returns, however, may not be fully taken into account in lending appraisals. To allow for this, we write the lender-appraised value of land as:

$$V^A = \frac{A}{r} + \gamma(1+r)^{1-t^*}\frac{D}{r} \tag{2}$$

In equation (2), $\gamma \in [0,1]$ represents the extent to which lenders account for capitalized future development values in appraising a borrower's land collateral. Why might future development returns not be fully accounted for in lending appraisals? The primary reason has to do with repayment capacity. If the purpose of the loan is for the producer to invest in their farm operation, the annual income used to service the debt is A or, in the best case, some multiple of A that will manifest to the extent that the investment is expected to boost net returns. As a result, allowing the producer to borrow an amount equal to the full market value of the land, V, will entail the lender taking on a considerable risk that the borrower defaults on the loan. Even if the investment increases net returns above A, annual farm-related income is unlikely to approach the annualized value of the

[4]The full deduction allowance for qualifying agricultural producers is the result of a federal income tax code change enacted in 2006.

land in a developed use. If a borrower defaults, the lender will typically liquidate the land collateral in an auction, where the desire to sell the land quickly may lead to them not fully recouping its market value.[5] It is in this sense that, due to the nature of agricultural financial lending practices, capitalized future development returns in the value of farmland can be considered illiquid from the perspective of a producer who wishes to retain their land in its current use. Conservation easements offer a potential way for producers to liquidate this wealth while keeping the land in agricultural use.

Assuming that the producer does not wish to retain their right to develop their land in the future, an easement becomes financially attractive to a producer when $\tau > \gamma$. Furthermore, with an easement on the land, the producer can still borrow in the future against the capitalized agricultural value of the land through traditional agricultural lending channels. The easement donation decision thus depends largely on the producer's future intentions with respect to the disposal of their land, as the easement precludes them from recouping $\tilde{D}$ in a future sale. For states with income tax systems that allow charitable donations to be deducted from state income tax or grant donors a state income tax credit, the financial benefits of easement donation are larger. Generally speaking, these state tax considerations would require financial lenders to take into account a larger fraction of future development returns (i.e., to have a larger γ) in order for an easement to not be worthwhile.

3 Data sources

3.1 National Conservation Easement Database

The primary data source used in this study is the National Conservation Easement Database (NCED). Representing a collaborative effort between land trusts, landowners, and government agencies, the NCED is the most comprehensive source of information on private land conservation available. The easement-level information provided in the NCED includes the year and county in which each easement was established, which we aggregate to create a county-level panel dataset

[5]For this reason, even if a borrower owns land with no development potential as collateral, lenders will often require a collateral-to-loan-value ratio of over 100%, with many requiring at least 150%, as a way to minimize their losses in the event of a potential liquidation (Willoughby and Paynter, 2015).

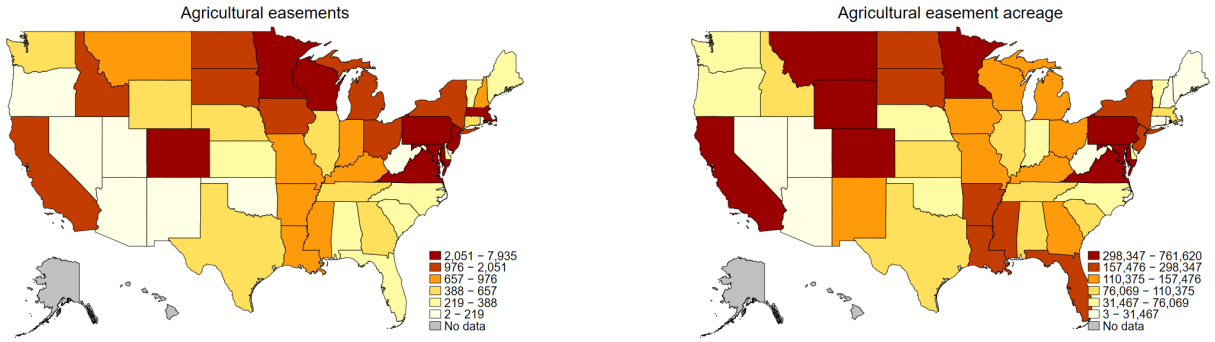
of easement information. Additional NCED variables used in this study include easement acreage, purpose (e.g., whether the easement is specifically in place for farm protection), and owner type (i.e., the type of entity owning the land under easement). In addition to these variables, we also use the geospatial information provided in the NCED easement polygon shapefile, which covers the vast majority of the easements tracked by the NCED. The NCED is updated semi-regularly as new easement information becomes available. Our vintage of the data was updated in August of 2020.

The full NCED contains 191,476 easements, of which 96% have a corresponding polygon in the NCED shapefile. We screen the full NCED as follows to generate a subset of easements representing working agricultural lands. First, using the full non-spatial tabular database, we retain all easements with a stated purpose of farming or ranching on land where the ownership entity is classified as private, non-governmental organization (NGO), tribal, joint (meaning multiple entities), or unknown. This query returns 29,189 easements with an explicit purpose of promoting working agriculture. Note, however, that the purpose field in the NCED is filled out by participants, which are most commonly land trusts. As such, agricultural land may be placed under an easement that allows for continued agricultural use but where the stated purpose of the easement captures to broader goals of the land trust, such as general environmental conservation or the preservation of scenery. Additionally, 24% of easements in the full database have an unknown purpose, meaning that no stated purpose was given by the participating entity.

To determine how many additional easements allow for agricultural use, but do not have a stated farm or ranch protection purpose, we use the easement shapefile to extract land use information from the US Geological Survey's 2012 NAWQA Wall-to-wall Anthropogenic Land Use Trends (NWALT) dataset. The NWALT dataset is a modified version of the 2011 National Land Cover Database that is meant to provide information on land use, as opposed to land cover.[6] We use the NWALT data to extract the proportion of each easement covered by crop production, pasture/hay production, or grazing potential. In our baseline sample, we retain all easements where at least 20% of the easement is classified as having one or more of these agriculture-oriented uses and is

[6]For more information on the NWALT data, see Falcone (2015).

owned under one of the same ownership types used to screen the easements with a stated farming or ranching purpose. This yields an additional 59,700 easements, bringing the total to 88,889. After removing the 338 easements with erroneous county information and the 21,269 easements with a missing establishment year, we are left with a cleaned dataset containing 67,282 agricultural easements based on our screening parameters.



(a) Count of easements by state

(b) Acreage of easements by state

Figure 1: Distribution of agricultural easements across states

In the cleaned baseline agricultural easement database, 85% of easements are owned by a private entity, 11% are owned by an unknown owner type, and the remainder is split among NGO (2%), joint (2%), and tribal (<1%) owners. The most common stated purposes of the easements are general environmental conservation (42%), farming/ranching (31%), unknown (13%), and other (6%), with the purposes for the remainder split among forest open space (3%), recreation (2%), historical preservation (1%), and general scenic value (1%). Agricultural easements are concentrated in the Mid-Atlantic/Northeast and Great Lakes regions of the US (Fig. 1a), with California and Colorado also having relatively large numbers of agricultural easements. On an acreage basis, Florida, Montana, and several other states in the Plains/Mountain west and Mississippi Delta regions also have relatively large amounts of land with an agricultural easement (Fig. 1b). In terms of the timing of easement establishment, the overwhelming majority of agricultural easements were established between 1980 and 2020, with roughly 45% originating in the 2000-2010 decade (Fig. 2).

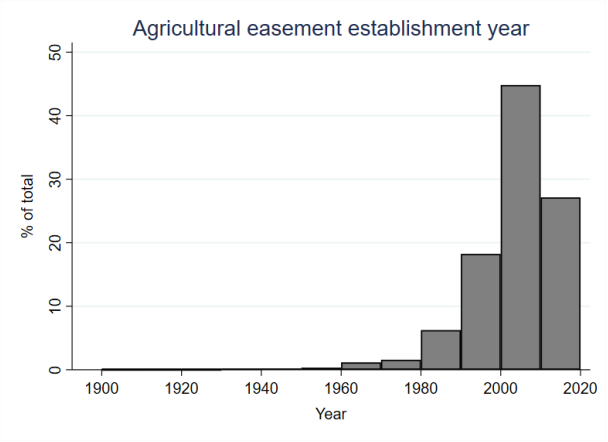


Figure 2: Distribution of agricultural easement establishment years

3.2 Other data sources

There are two complementary empirical goals of our analysis. First, to shed light on the validity of the paper's premise, we assess whether producers in more development-prone areas have a lower propensity to borrow against the full market value of their land. To accomplish this, we use county-level data on per-acre farm real estate values, farm acreage, and interest expenses on debt secured by real estate. These variables are collected from the quinquennial Census of Agriculture conducted by the U.S. Department of Agriculture over the years 2002-2017. To measure development pressure, we compile county-level data on farmland conversions from the US Department of Agriculture Natural Resource Conservation Service's 2017 National Resources Inventory (NRI) and population density using data on total population and land area from the decennial Census of Population.

Our primary goal is to measure the extent to which easement activity is associated with increased farm investment. To measure farm investment, we collect several county-level variables from the same four years (2002-2017) of the Census of Agriculture. First, we collect and assemble three variables related to land tenure and ownership: % of farmland owned in part-owner farms, % of total farm expenses consisting of cash rent expenses, and % of total farm expenses consisting of property tax payments.[7] These variables are used to examine the extent to which easements are

[7]Part-owner farm operations are those consisting of a mixture of owned and rented land. Such land tenure arrangements represent the majority of land in commercial farm operations.

used by producers to expand their operations by purchasing additional farmland (or decrease their reliance on rented land). Second, to test whether farm operators are using the financial benefits brought about by easements to pay down existing debt or take on new debt, we consider the % of total farm expenses consisting of interest payments. Third, to gauge if easements are used to invest in on-farm capital and labor, we look at two variables: the number of tractors and the number of farm workers hired in the county.

In our sample of counties used as a baseline in both components of our analysis, we drop any counties with any missing values over 2002-2017 for any of the following major agricultural variables: farmland acres, number of farms, total land area, and total farm production expenses. We also drop from all estimations any counties that appear to undergo a major change in county acreage between 1997 and 2017. Specifically, we remove counties if the reported farmland acreage is at least 5% greater than the reported total county acreage or if the difference between the minimum and maximum total county acreage is greater than 5%. Lastly, we remove from all estimation samples any county that does not have at least 10% of its total area in farmland for all four years of the 2002-2017 study period.

4 Suggestive evidence of borrowing constraints in development-prone areas

In this section, we present findings pertaining to the fundamental motivation of the paper, namely that producers in areas subject to development pressure are less likely to borrow against the full market value of their land. To do this, we create a debt-to-asset ratio focused exclusively on farm real estate assets. Ideally, we would construct this variable using a direct measure of debt secured by real estate. However, this is not explicitly tracked in the Census of Agriculture. As a workaround, we take the interest expenses paid on debt secured by real estate and divide by 0.05 (i.e., a 5% interest rate). We then divide this constructed debt measure by the total value of farm real estate in the county, which we create by multiplying the per-acre value of farm real estate by the total acres in farm operations. We create separate county-level farm real estate debt-to-asset

ratio variables for each of the four Census years in our study.[8]

To gauge whether producers subject to development pressure face a potential borrowing constraint, in this preliminary effort we conduct separate cross-sectional regressions for each of the four Census years over 2002-2017. Specifically, we estimate separate regressions of farm real estate debt-to-asset ratios on our two measures of development pressure: the % of farmland developed in recent history (1982-2000) and population density. Both sets of regressions include state dummy variables, so the correlations are estimated using within-state variation in development pressure. There are 46 states represented in the sample. Standard errors are clustered by state. Summary statistics for the variables used in this portion of the analysis are shown in Appendix Table A1. Note that we treat the farmland conversion variable as a static measure computed over 1982-2000. For a given study year, population density is computed using the most recent previous decennial Census value (i.e., 2000 for study years 2002 and 2007 and 2010 for study years 2012 and 2017).

Results are shown in Table 1. Note that each table entry corresponds to a separate regression model based on a specific year and development pressure variable. Overall, the results point to a clear and consistent negative correlation between farm real estate debt-to-asset ratios and development pressure. In most cases the correlation is negative and significant at the 1% level, with the exception being 2002, where the correlation with % of farmland developed is significant at the 10% level and population density at the 5% level. As our working hypothesis suggests, the amount that producers borrow against their land assets declines with development pressure. While this is consistent with there being a borrowing constraint stemming from illiquid land capital in more development-prone areas, we caution that it could also be the case that producers do not need or want to borrow against the full market value of their real estate holdings, particularly if they plan to develop their land in the near future. We therefore interpret these results as evidence that is consistent with the underlying premise of the paper concerning the role of conservation easements, but cannot rule out alternative channels.

[8]Note that the conversion from interest expenses secured by real estate to debt secured by real estate is made purely for interpretation purposes. Future versions of this work will incorporate time variation in farm interest rates, but we emphasize that this will only affect the scaling of the coefficients, not the sign or significance of the correlations. To the extent that interest rates vary cross-sectionally, our debt-to-asset ratio will be mismeasured. However, we are unaware of any available sources of consistent panel data on farm mortgage interest rates.

Table 1: Correlation between farm real estate debt-asset ratio and development pressure

	2002	2007	2012	2017
% of farmland developed	-0.281	-0.051	-0.106	-0.103
	(0.049)***	(0.026)*	(0.024)***	(0.021)***
Population density	-2.648	-0.663	-1.024	-1.122
	(0.559)***	(0.275)**	(0.228)***	(0.199)***

Notes: Each table entry represents a coefficient and corresponding standard error from a separate cross-sectional regression. Standard errors are clustered by state and shown in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

5 Empirical framework: Conservation easement activity and farm investment

In this section we outline our estimation strategy for measuring the relationship between conservation easement donation and farm investment behavior. We estimate a set of distributed lag specifications of the following form:

$$I_{c,t} = \sum_{j \in J} (\beta_j \Delta Easement_{c,t-1-j}) + \alpha_c + \phi_t + \varepsilon_{ct} \tag{3}$$

The dependent variable in equation (3) represents one of several possible measures of farm investment from the Census of Agriculture for county c in year t. The agricultural easement variables of interest are given by $\Delta Easement_{c,t-1-j}$, which are measured as lagged changes in the percentage (0-100 scale) of county c's farmland (fixed at its baseline 2002 level) with an agricultural easement over the five years leading up to year $t-1-j$. These agricultural easement variables are developed using the easement-level database described in Section 3 and total farmland acres from the 2002 Census of Agriculture. In our baseline specification we set $J = \{0, 5, 10\}$, meaning there are three easement regressors included in the model. As an example of how the specification is constructed, consider an investment outcome pertaining to the year 2002. In this case, β_0 represents the effect of the change in the percentage of the county's farmland with easements between years 1996 and 2001 (i.e., $t-1-0$), β_5 denotes the effect of the change over 1991-1996, and β_{10} measures the effect of the change over 1986-1991. Other terms in the equation represent county fixed effects

(α_c), year fixed effects (ϕ_t), and the model error term (ε_{ct}).

The easement variables in equation (3) are lagged to account for the natural timing of how easements would be expected to affect farm investment behavior. Since most easements are not purchased but are rather "paid out" over a maximum of 15 years through federal income tax deductions and, in some states, state income tax credits, it could take landowners several years to build up the financial capital needed to make a desired easement-funded investment. Our specification permits investment decisions to be affected by easements established up to 16 years prior to the year in which the investment variable is measured.

We consider six investment-related outcomes: (1) % of land owned in part-owner operations, (2) % of expenses on cash rent, (3) % of expenses on property taxes, (4) % of expenses on interest, (5) number of tractors, and (6) number of hired labor workers. Variables (5) and (6) are used in natural log form to account for right-skewness in their respective distributions, while all other variables are included as percentage levels (0-100 scale). For each outcome $I_{c,t}$, equation (3) is estimated using a balanced panel covering the four Censuses of Agriculture for the years 2002, 2007, 2012, and 2017. Counties are dropped from the sample for a particular variable if $I_{c,t}$ is missing in any of the four years of the panel. The sample size for each investment outcome varies according to the extent of missingness for that variable. Standard errors in all estimations are clustered by state. Summary statistics for each investment outcome variable are presented in Appendix Table A2. For ease of interpretation, the summary statistics for the numbers of tractors and hired labor workers are presented in levels in the summary statistics, but we again note that they are used in natural log form in the model specifications. In Appendix Table A3, we present summary statistics for the lagged easement variables. Since the samples vary by the investment outcome being considered, the easement variable summary statistics are based on a larger sample containing all counties that are included in any of the investment-specific models.

6 Preliminary main results

This section presents preliminary regression results based on equation (3) defined in the previous section. Estimates are shown in Table 2. The subscripts on the $\Delta Easement$ variables denote lags over a five year change window, such that $\Delta Easement_0$ represents new easement acreage over years $(t-6)-(t-1)$ with respect to the year when the outcome variable is measured, $\Delta Easement_5$ represents new easement acreage over the years $(t-11)-(t-6)$, and $\Delta Easement_{10}$ represents new easement acreage over years $(t-16)-(t-11)$, all as a % of county farmland area. Throughout the discussion of the results, we interpret the parameter estimates as representing the association between the outcome and a one percentage point (pp.) increase in the % of farmland in the county with an easement. It bears keeping in mind that a one pp. increase represents a fairly large change. For example, the average value of $\Delta Easement_0$ across the whole study period and all sample counties is 0.35, with year-specific means of 0.28 (2002), 0.40 (2007), 0.46 (2012), and 0.28 (2017) (Appendix Table A3). Under the coefficient estimates for the individual lagged variables, we present the sum of the lag coefficients and its corresponding standard error. These should be interpreted as the combined effect of a one pp. change in easement % in each of the three lagged periods. With our current research design, these preliminary estimates should be interpreted as associations conditioned on time-invariant unobservables and common time-varying unobservables, as opposed to causal effects.

In the baseline model specification, a one pp. increase in easement acreage has a positive association with the % of land owned in part-owner operations (col. (1)), but the effects are not precisely estimated. For two of the lags, increases in easement acreage are associated with reductions in the percentage of total expenses coming from cash rent payments (col. (2)), which is consistent with the idea that producers may be decreasing their reliance on rented land as more easements are put in place. The sum of the lags corresponds to a 0.26 pp. reduction in rent expenses given a one pp. increase in easements over each of the three lagged periods. In col. (3), we do not find a detectable or consistent association between easement activity and percentage of expenses spent on property taxes. The two longer lags have the expected positive sign, but the most recent lag is negative.

Table 2: Relationship between easements and farm investment outcomes

	% land owned (1)	Rent (% expenses) (2)	Property tax (% expenses) (3)	Interest (% expenses) (4)	Tractors (5)	Hired workers (6)
$\Delta Easement_0$	0.030	-0.084	-0.018	0.097	0.005	0.005
	(0.112)	(0.033)**	(0.015)	(0.049)*	(0.003)*	(0.003)**
$\Delta Easement_5$	0.089	-0.053	0.018	0.011	0.008	0.009
	(0.143)	(0.037)	(0.019)	(0.029)	(0.003)***	(0.005)*
$\Delta Easement_{10}$	0.070	-0.119	0.031	0.074	0.002	0.008
	(0.099)	(0.027)***	(0.021)	(0.035)**	(0.003)	(0.005)
Sum of lags	0.190	-0.256	0.031	0.182	0.015	0.022
	(0.208)	(0.068)***	(0.034)	(0.078)**	(0.007)**	(0.010)**
R-squared	0.853	0.893	0.877	0.749	0.983	0.947
Number of obs.	10,172	10,380	10,416	10,400	10,500	10,452
Counties	2,543	2,595	2,604	2,600	2,625	2,613

Notes: Each column shows results from a panel data regression with county and year fixed effects. All of the explanatory variables are measured as percentage changes on a 0-100 scale. The dependent variables in columns (1)-(4) are measured in percentage terms on a 0-100 scale. Dependent variables in columns (5) and (6) are log-transformed. Standard errors are clustered by state and shown in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

As for the extent to which easement proceeds are used to pay down existing debt or take out new loans to support farm investment, in col. (4) we estimate the effects of easement acreage on the percentage of expenses spent on interest payments. The results indicate that interest expenses generally rise with prior easement donations with two of the effects being significant at the 10% level or better. Overall, this translates to a 0.18 pp. increase in interest expenses given a one pp. increase in easements in each lagged period. This suggests that easements are associated with putting producers in a position to take on more debt to invest in their operation. In col. (5) we test if easements may be used to fund the purchase of new equipment by considering the number of tractors in use. All of the easement lags yield positive effects, with the first and second being significant at the 10% level or better. Given the log transformation on this outcome, the cumulative effect is interpreted as a roughly 1.5% increase in tractors used given a uniform one pp. increase in the three easement variables. Lastly, col. (6) assesses if easements are correlated with more labor usage. We again find consistent positive effects that are at least marginally significant for the first two lags. This outcome is also log-transformed, so the cumulative effect is interpreted as an approximate 2.2% increase in hired workers given a uniform one pp. increase in easement activity.

7 Discussion and conclusions

Overall, our preliminary results provide suggestive evidence on the extent to which easement donations are used to finance farm investments. The results for land ownership, as measured by the percentage of land owned or the percentage of expenses spent on property tax payments, do not yield a detectable relationship between easements and land purchases. We find the strongest evidence for land tenure-related investment when considering cash rent expenses, which generally decline with easement donation. While this could be interpreted as being indicative of a rise in land ownership, it is also consistent with a reduced need to rent land in order to achieve a desired level of net farm income. Take, for example, a given farm operation comprising a mix of owner-operated and rented land. If the benefits of an easement placed on the owner-operated land are put towards investments in that land, which raises the per-acre net returns it produces, then it may no longer be necessary for the producer to operate the land they were previously renting. Our results suggest that easements put producers in a position to take on more debt to finance their operations, as evidenced by a rise in interest expenses. A rise in interest expenses could be indicative of loans for land purchase or new equipment, which we find support for in the form of increased tractor usage with more easement activity. We also find that easements are associated with more labor use on farms, which points to another way that easements may allow producers to expand or invest in their operations.

While the analysis presented here is an important first step in studying how agricultural easements affect farm investment behavior, several caveats bear mentioning. For one, we have not incorporated any additional control variables that could affect investment outcomes. Future versions will include in the specifications a set of county-level control variables derived from the Census of Agriculture and other sources. We also plan to explore the sensitivity of our results to the completeness of the NCED data for different states, which is publicly available and posted to the NCED website. We will also explore variation in the estimates across broad geographic regions. The Northeast and Mid-Atlantic regions, for instance, are where agricultural easement activity is concentrated and where easements make up a larger fraction of the agricultural land base. Perhaps

most importantly, the research design adopted does not lend itself to a causal interpretation of the impacts of easements on investment. Rather, our results are interpreted as associations conditioned on time-constant county-level factors and common temporal effects. To the extent that other factors driving time-varying county-level investment behavior changes systematically with easement adoption, our estimates will be biased accordingly. A potentially promising area to assemble a research design that permits causal identification of the impact of easements concerns the adoption of state income tax credits in the 11 states that adopted such provisions between 1983 and 2011. Parker and Thurman (2018) show that easement donation increases with reductions in the price of conservation and can vary considerably across states that differ in how easement donations are treated. This presents an opportunity to exploit changes in donation prices over time as a way to generate more plausibly exogenous variation in easement activity and study its relationship with farm investment.

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Appendix

Table A1: Summary statistics (mean and standard deviation), urban pressure and real estate-secured borrowing

	Real estate debt-asset ratio	% of farmland developed (1982-2000)	Population density (people per acre)
2002	11.74	1.86	0.16
	(6.06)	(3.14)	(0.32)
2007	8.19	1.86	0.16
	(3.80)	(3.14)	(0.32)
2012	7.92	1.86	0.18
	(3.93)	(3.14)	(0.35)
2017	6.74	1.86	0.18
	(3.34)	(3.14)	(0.35)
Total	8.65	1.86	0.17
	(4.79)	(3.14)	(0.34)
Counties	2,600	2,600	2,600

Table A2: Summary statistics (mean and standard deviation), investment variables

	% land owned (1)	Rent (% expenses) (2)	Property tax (% expenses) (3)	Interest (% expenses) (4)	Tractors (5)	Hired workers (6)
2002	44.53	5.50	4.42	6.87	1650.26	1026.35
	(11.19)	(4.28)	(2.67)	(3.06)	(1240.56)	(2818.01)
2007	44.36	5.88	3.93	5.90	1577.36	890.90
	(11.03)	(4.31)	(2.53)	(2.54)	(1148.33)	(2486.90)
2012	44.26	6.58	3.39	4.88	1500.82	930.42
	(11.02)	(4.57)	(2.26)	(2.29)	(1116.46)	(2664.75)
2017	44.72	6.36	4.35	4.80	1449.88	820.19
	(11.34)	(4.82)	(2.96)	(2.08)	(1060.56)	(2243.39)
Total	44.47	6.08	4.02	5.61	1544.58	916.97
	(11.15)	(4.52)	(2.65)	(2.66)	(1145.71)	(2562.92)
Counties	2,543	2,595	2,604	2,600	2,625	2,613

Table A3: Summary statistics (mean and standard deviation), easement variables

	$\Delta Easement_0$	$\Delta Easement_5$	$\Delta Easement_{10}$
2002	0.28	0.11	0.06
	(1.02)	(0.53)	(0.46)
2007	0.40	0.28	0.11
	(1.30)	(1.02)	(0.53)
2012	0.46	0.40	0.28
	(1.59)	(1.30)	(1.02)
2017	0.28	0.46	0.40
	(0.89)	(1.59)	(1.30)
Total	0.35	0.31	0.21
	(1.23)	(1.19)	(0.91)
Counties	2,641	2,641	2,641