Contract Non-compliance and Moral Hazard: Evidence From Cost-share Programs in Louisiana, USA

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Abstract

Cost-share contracts, offered by the Natural Resources Conservation Service through working lands programs, have been instrumental in addressing environmental concerns arising from resource-intensive agricultural production practices. However, the persistent trend of non-compliance with cost-share contractual obligations has become a problem for funding agencies and policymakers. This paper aims to study contract non-compliance within working lands programs using annual county-level panel data (1997-2019) from Louisiana. The results show that there is a significant incentive effect of cost-share payment obligations and contract acreage on the compliance rate. Furthermore, the differential effect of market and non-market factors on the non-compliance rate implies that moral hazard is present in a cost-share contractual relationship. These findings provide useful insights for enhancing cost-share program efficiency and achieving environmental conservation goals.

Keywords: contracts, cost-share, moral hazard, non-compliance

JEL Classification: Q15, Q58, D82

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1. Introduction

Cost-share subsidies in working lands programs have been an attractive policy option in abating agricultural impacts on natural resources, especially soil and water, and achieving environmental conservation goals (Claassen et al., 2008; Lichtenberg, 2019). Working lands programs such as the Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP) offer cost-share options to encourage the adoption of environment-friendly and sustainable agricultural production practices. The inherent aim of working lands programs is to incentivize farmers to indirectly improve soil and water quality by altering production practices. Cost-sharing provision is appealing to farmers as it reduces the financial load of implementing conservation practices. Conservation practices offset environmental externalities from agriculture along with economic benefits to farms (Park et al., 2022), thus are being increasingly prioritized through the US Farm Bill.

The 1996 Farm Bill established working lands programs emphasizing conservation initiatives without halting agricultural production. Agricultural cost-share programs utilize federal, state, or local funding pools to provide financial incentives to the farmers through conservation contracts. Cost-share contracts are allocated through a competitive selection[1] process based on natural resource concerns in a given area. The cost-share contracting scheme has been instrumental in managing resources and addressing environmental concerns (Liu et al., 2022). However, programs involving cost-share contracting are not without problems. For instance, breaking contractual obligations leading to non-compliance has become a pressing issue. Non-compliance occurs when a participating farmer opts out of the contract either through

[1] On average, only one out of three applicants are awarded cost-share contracts. This figure may be even lower for major US agricultural states (https://www.iatp.org/documents/closed-out-how-us-farmers-are-denied-access-conservation-programs).

the cancellation or termination option. Due to non-compliance, prospects for private and societal benefits from conservation practices are diminished (Sawadgo and Plastina, 2022). Therefore, overlooking the non-compliance problem over the long term could also exacerbate complications for conservation programs. Moreover, anecdotal evidence of moral hazard abounds in cost-share programs. Moral hazard is a situation in which risk-sharing individuals' private actions alter the probability distribution of the program outcome (Holmström, 1979). These issues provide impetus to empirically investigate three major research questions in this study: (1) What is the level of non-compliance in cost-share programs? (2) What factors affect contract non-compliance? (3) Does empirical evidence support the presence of moral hazard in cost-share programs?

Cost-share programs are essential to generate ecosystem services, but attention to non-compliance and moral hazard issues in such programs have been limited in previous literature. This article focuses on existing contract non-compliance issues in two working lands programs, EQIP and CSP, and attempts to investigate the presence of moral hazard in these programs and employ two strategies to do so. First, we identify a county-level data set that includes both contract compliance and non-compliance information. Second, we use two econometric strategies to draw inferences. We specify a linear fixed effects model and non-linear fractional outcome model to draw inferences. This article contributes to three strands of literature. First, to the literature on cost-share contracts and more broadly, on working lands programs. Second, we study the incentive effect of payment obligations and contract acreage on non-compliance rate. Third, this article relates to the literature on moral hazard under the domain of US agricultural conservation programs.

This article adds to the existing literature on contract non-compliance and moral hazard by Ozanne et al. (2001), Cattaneo (2003), Giannakas and Kaplan (2005), Yano and Blandford (2009), Wallander et al. (2019), and Pates and Hendricks (2020). Our findings provide valuable insights to both economists and policymakers regarding factors influencing compliance in cost-share programs because, despite the government's effort to address technicalities behind non-compliance and reduce distortions, non-compliance remained steady over past two decades.

The following section provides an overview of cost-share contracts in working lands programs. Section 3 presents the theoretical framework of the study. Section 4 deals with data and methods. Section 5 presents results and discussion. Section 6 concludes the paper with directions for future research.

2. Cost-share contracts: an overview

In this study, we presume that the conservation practice adoption decision is subjected to the classical principal-agent problem whereby the Natural Resources Conservation Service (NRCS) is the principal that cannot perfectly observe conservation practice implementation and the farmer is the agent of the decision. NRCS and farmers write contracts to overcome possible inefficiencies arising from asymmetric information. In cost-share programs, the NRCS (principal) writes a contract for a farmer (agent) such that mutual payoff depends on an outcome that is contingent on the agent's commitment. The cost-share contracts generally reimburse ~75% of the conservation practice(s) implementation costs.[2] The remaining portion is due in part to farmers so that they have some incentives to take care of practices being implemented on their land. However, there is variability in expected output during contract implementation across both spatial and temporal dimensions. In addition, if the market and environmental conditions change

[2] This number can be as high as 90% for historically underserved farmers.

favorably, the opportunity cost of complying with contractual obligations might be very high. Thus non-compliance could be triggered as a part of adaptive management to respond to unexpected circumstances beyond the participant's control or due to unrevealed private benefits to farmers and unbeknown to NRCS (Wallander et al., 2019).

Four things need to be understood regarding program characteristics before the formal analysis: First, there is 'exclusivity' and 'semi-commitment' in the working lands contracts. This implies that farmers can't have cost-share contracts with multiple federal agencies at once in a given period. Second, 'Conservation Assessment Ranking Tool (CART)'[3] ranks contracts based on current fiscal year criteria and the applicant's eligibility before beginning a contractual relationship. This mechanism is uniform across contracts. Third, contract participation and continuation are voluntary. Lastly, terminations and cancellations occur for the whole contract in its entirety and do not apply to specific management practice(s).

3. Theoretical framework

Our theoretical framework is influenced by the works of Grossman and Hart (1983) and Gow et al. (2000). Consider two parties (NRCS and producer) interacting with each other, directly or indirectly, about the possible mutual contractual relationship at some initial date 0. At date 1, the agency makes a contingent promise to invest on a shared basis for the implementation of conservation practice(s) and writes a contract for duration $t \in [0, T]$ with a cost-share rate, $\zeta \in (0, 1)$, which necessitates producer's approval. The conservation practice implementation is expected to cost c_e, provide private benefit π_e, and generate the utility of u_e. However, the agency's initial projection about associated costs and potential benefits is only realized at date 2 by the farmer. The realized costs and benefits depend on the farmers' investment, commitment

[3] CART was known as Application Evaluation and Ranking Tool (AERT) before the 2018 Farm Bill.

level, and ex-post realization of perceived uncertainties ex-ante. If utility at t, $u_t > u_e$, producers continue to comply with the contractual agreement and complete the contract. However, if utility at t, $u_t < u_e$, then producers have the incentive to not comply with the contract. This occurs due to three-fold costs that fall on the producer's part due to compliance. First, compliance would involve income forgone (φ) from short-term production losses because on- and off-farm benefits from conservation practices occur mostly in the long-term. That is, the opportunity cost of additional investment is very high at least in the short term. Second, the operational cost (υ) must be borne by the producer that involves due changes in production and management activities which involves time, record-keeping, and monetary expenses. This additional cost burden fosters disutility for a producer from continuing to implement conservation practice(s). The incentive to be non-compliant occurs when $\pi_a - (1 - \zeta)\, c_a - \varphi < 0$ in actual settings.

Conservation program contract guidelines explicitly mention three choices for farmers after signing the contract: (i) compliance: completes all contractual obligations, (ii) cancellation: a contract is ended by the agreement by both parties and mostly initiated by producers, and (iii) termination: mostly initiated by the NRCS due to violations of contractual terms and conditions at a varying degree by the producer. The expected payoff under each choice is given by:

$$E(\pi_i^{comply}) = \pi_i^a - (1 - \zeta_i)\, c_i^a + p\tilde{y}_i \quad (1)$$

$$E(\pi_i^{cancel}) = \pi_i^a - (1 - \zeta_i)\, c_i^a + py_i \quad (2)$$

$$E(\pi_i^{terminate}) = py_i - F \quad (3)$$

where p is the output price, $\tilde{y}$ is output for compliant farmers, y is output under non-compliance, i indexes farmers, F is liquidated damages costs, superscript a denotes actual realized value, and E is the expectation operator. Producers choose the option that provides the highest payoff during the practice implementation phase which determines the county-level (non)compliance rate.

4. Data and methods

4.1 Data

The dependent variable in this study is the rate of non-compliance. We construct this variable by taking the ratio of the sum of cancelled and terminated contracts to the total number of contracts allocated in each county. The annual data on contract status was obtained from the NRCS Resource Economics, Analysis, and Policy (REAP) Division for the 1997-2020 funding years for Louisiana. This dataset contained information about contract status, acres, obligations, and payment by contract, county, and year. Figure 1 shows cost-share contract allocations across different parishes in Louisiana.

[Figure 1 about here]

We did not use data for the funding year 2020 during the final analysis because most of the contracts were marked active for that year. In addition, we limit our study to only two working lands programs, EQIP and CSP, which constitute a major share of the working lands program budget with the budget authority of $36.6 billion from 2019 to 2029 (Farm Bureau, 2019). Both of these programs are administered by the NRCS under the US Department of Agriculture.

Besides data on non-compliance rate, payment obligations, and planned acres, additional data were collected for variables such as farm income and earnings, expenses, land values, loss ratio, debt-income ratio, heating degree days (HDD), and land retirement payments. The county-level farm income, earnings, and production expenses data were obtained from the Bureau of Economic Analysis (BEA, 2021). Farmland values were obtained from the USDA National Agricultural Statistics Service (USDA-NASS, 2020). Loss ratio data was obtained from the USDA Risk Management Agency Summary of Business (USDA-RMA, 2021). County-level debt-to-income ratio data was obtained from the Federal Reserve System (FRS, 2021).

Furthermore, conservation reserve program (CRP) payment data was obtained from the USDA Farm Service Agency (USDA-FSA, 2021). Finally, HDD data was obtained from the PRISM Climate Group (2021) database. Before the formal analysis, we dropped all counties that had less than 10 observations on the values of the dependent variable.

4.2 Model specification and estimation strategy

We estimate the effect of payment obligations, enrolled acreage, and other related variables on county-level contract non-compliance rate using the following empirical specification:

$$y_{it} = \alpha_i + \beta \boldsymbol{x}'_{it} + \delta t + \varepsilon_{it} \qquad (4)$$

where y_{it} is the value of the dependent variable – that is, contract non-compliance rate – for county *i* during crop year *t*, $\boldsymbol{x}$ is the vector of explanatory variables, α_i denotes county fixed effects, *t* denotes linear time trend, and ε_{it} denotes error term. β is a set of parameters to be estimated.

Besides contract payment data, the vector $\boldsymbol{x}_{it}$ in equation (4) includes control variables for farm income, production expenses, land values, loss ratio, and CRP payments because of their likely influence on contract compliance level at the county level. Given that our dataset is panel-type, we first employ a traditional linear fixed effects (FE) model to estimate equation (4). The linear panel fixed-effects model controls for unobserved heterogeneity due to time-invariant unobservables. All time-invariant observables are absorbed by the county fixed-effects in the specification. Moreover, the inclusion of time trend controls for time-variant shocks such as technological change or macroeconomic shocks that affect all the counties similarly. Besides that, the error term is likely to be correlated over time for a given county, so the assumption that regression errors are independently and identically distributed (*i.i.d*) may not hold in our case.

Therefore, we use cluster-robust standard errors that cluster on the county. Addressing all these possible issues during estimation allow for better identification of the effect of independent variables and provides robust evidence of associated incentive effect and moral hazard in the conservation program.

Despite the promising properties of the FE model in our panel data framework, it may not adequately account for the fractional nature of our dependent variable. The non-compliance level in our model is a proportion that is bounded between 0 to 1, with both extreme bounds included. This makes our specification in equation (4) non-linear. Therefore, we use the fractional response model developed by Papke and Wooldridge (2008) for panel data and extended by Ramalho et al. (2018) and Wooldridge (2019) for the unbalanced panel. The panel fractional response model that we employ in this study is also known as the correlated random effects (CRE) model and can be specified as (Papke and Wooldridge, 2008):

$$\mathbb{E}(y_{it}|\boldsymbol{x}_{it}, \alpha_i) = \Phi(\boldsymbol{x}_{it}\beta + \alpha_i), \quad t = 1, \ldots, \mathrm{T} \tag{5}$$

where $\boldsymbol{x}$ is the vector of explanatory variables discussed above, α_i denotes county-specific characteristics, and $\Phi(.)$ is a nonlinear probit link function satisfying $0 \leq \Phi(z) \leq 1$ for all $z \in \mathbb{R}$. The CRE model addresses likely endogeneity from unobserved heterogeneity in the model specification and exploits variation in contract payment obligations and enrolled acreage while also accounting for the non-linearity of the dependent variable using the quasi-maximum likelihood technique for estimation (Wooldridge, 2019).

5. Results and discussion

The descriptive statistics of variables included in the study are presented in Table 1. A total of 22,735 cost-share contracts were awarded in Louisiana between 1997 and 2019 at the rate of 988 contracts per year and around 13 contracts per county. The non-compliance rate is

21%. The standard deviation of the non-compliance ratio appears higher implying that non-compliance varied significantly across counties and over time. This may be due to the differential impact of climatic and market factors during the contract period across Louisiana. The non-compliant acres account for 19.7% (i.e., 742,328 acres) of total cost-share acres. Among the non-compliant contracts, ~6% belonged to the terminated category, while the remaining 15% is attributed to the cancellation category.

[Table 1 about here]

The non-compliance resulted in a sunken cost of roughly ~$0.87 million each year, including 10% administrative costs, to funding agencies in Louisiana. The social cost might be even higher. The substantial cost of non-compliance is a useful proxy to gauge program efficiency level, or lack thereof, on working lands. The distribution of cost-share contracts in Louisiana is presented in Figure 2.

[Figure 2 about here]

Although the non-compliance rate may appear low at first glance, the wide and consistent discrepancy between cancellation and termination rates is worth noting (Figure 3). During the 1996 Farm Bill period (1996-2002), non-compliance was attributed more to the termination phenomenon. However, since the 2002 Farm Bill, the cancellation rate has remained consistently higher than the termination rate. The higher termination rate at the beginning of the working lands program may be due to the convex learning curve of farmers where they were not adequately familiar with the consequences of their adverse actions including assessment of liquidated damages for cost recovery by the NRCS following contract termination. The persistent trend of higher cancellation and lower termination rates may be due to the strategic advantage offered by the cancellation option that includes non-assessment of liquidated damages and forfeiture only to remaining monetary obligations.

[Figure 3 about here]

According to Conservation Program Contracting guidelines[4], cancellations are a mutual agreement between the NRCS and the contract participant to end the contract for reasons beyond the participant's control. The reason could be related to land ownership, natural disasters, environmental and archaeological concerns, or economic and personal hardships. Cancellations are not considered adverse actions and do not count against participants in future program participation. Unlike cancellations, terminations are when NRCS unilaterally ends the contractual agreement due to breaching of the contract terms and conditions by the farmer. This is considered an adverse action and participants may have to pay liquidated damages or return payments previously issued from the contract. NRCS in Louisiana deducts points from applicants' screening and ranking if they have had a contract terminated within the past 3 years. While this does not prevent participants with terminations from applying or potentially receiving another contract, it does place them in a "low" priority category and could reduce their chance of funding for the next 3 years.[5] These provisions in contract guidelines favor farmers who can identify reasons to proceed with cancellation and have a strategic advantage that does not have a bearing on future program eligibility.

In general, the contract compliance rate and average farm income level follow a distinct and visible pattern, whereby they show a negative association – that is, as farm income level rises, compliance rate goes down and vice versa (Figure 3). This resembles 'opportunistic adoption' (Pannell and Claassen, 2020) and indicates that producers may be participating in cost-

[4] https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=40459.wba

[5] We thank Louisiana NRCS officials for providing us with the information about this provision.

share programs more as a safety net to their farm income level more so than the concern for environmental conservation. This might also be due to farmers being cash-strapped by implementing conservation practices because there is some time lag in reimbursement of incurred investment. Other reasons for non-compliance may be due to the expensiveness, complexity, and potential risks about expected benefits with some conservation practices whose benefits accrue mostly beyond farms (Baylis et al., 2022). Breaching contracts during good times and complying with them during bad times could hinder the goals of conservation programs with significant costs involved and merely any environmental benefits (Sawadgo and Plastina, 2022). This further indicates that cost-share contract guidelines necessitate revisiting to address the influence of aggregate farm income on compliance rate and to engender environmental public goods. However, participating farmers are selected through a competitive selection procedure and the intention to breach is mostly triggered by secondary factors such as time discounting (present bias) and non-aligning expectations regarding productivity, costs, and returns with ground reality after conservation adoption (Trujillo-Barrera et al., 2016; Duquette et al., 2012). Therefore, non-complying farmers may still need to be cajoled instead of using stick, i.e., stringent measures.

The scatter plots of variation in cancellation and termination of contracts are presented in Figure 4. This figure further underscores that cancellation and termination phenomena in contractual relationships follow opposite trends. However, there is wide heterogeneity in the rate at which contracts remain non-compliant in a given county and year.

[Figure 4 about here]

Regarding the payment level, payment obligations per acre in working lands programs have remained consistent over the years, mostly after the 2008 Farm Bill (Figure 5). The mean nominal payment obligations per cost-share contract in Louisiana is ~$19,880; however, the median obligations is only ~$10,368. Similarly, the mean (median) obligations per acre is $183.15 ($76.67).

[Figure 5 about here]

We find a difference in average obligations for compliant and non-compliant contracts by >45% (Figure 6). There also exists a discrepancy in the median acres in both compliant and non-compliant categories (Figure 6). The median acres under completed contracts are 137 acres, while that for cancelled and terminated contracts are 100 acres and 101 acres, respectively, which insinuates that contracts enrolling larger acres are the ones that reach completion. McWherter et al. (2022) also report positive relation between contract acres and compliance level. This may be due to the higher liability threats with a bigger contract size, thus providing a higher incentive to be in the program. Furthermore, larger contracts mostly emanate from larger farms that are mostly family-run, corporately organized, and might possess intergenerational motives (Featherstone and Goodwin, 1993) to comply with contractual obligations, besides long-term profitability and cost-share reimbursements from the side of the government.

[Figure 6 about here]

We further investigated if there is any spatial distribution regarding non-compliance levels in Louisiana during the study period and found visible spatial clusters for cancellation and termination rates as shown in Figure 7. Panels (a) and (b) of Figure 7 show that cancellation is mostly prevalent in the state's rice- and sugarcane-dominant southern region whereas termination is widespread in the cotton- and soybean-dominant northern region. In general, non-compliance seems to be clustered around the Mississippi River basin and the Red River basin. A few reasons might have influenced this spatial cluster formation. First, the Mississippi

River alluvial plain and the Red River basin comprise predominantly irrigation acres – mostly soybeans, corn, and cotton. Increasing acreage allocation for these crops around the major river basins is to maximize profit. This means farmers always weigh several options that increase their profit level which has relation to being (non)compliant with cost-share contracts awarded to them. Second, part-owners and tenant farmers run ~32% of Louisiana farms and cultivate ~68% of the acres in Louisiana. Initially, they have a positive outlook on the prospects of conservation practices because of the likely changes in input usage and profit margins from implementing best management practices. However, it is challenging for them to achieve conflicting dual objectives of short-run profit maximization and generation of public goods within a limited timeframe. Furthermore, the existence of (non)compliance clusters could be due to a neighborhood effect in (non)compliance with contractual obligations at the county level.

[Figure 7 about here]

We proceed further with the results obtained from econometric models. The parameter estimates from the linear panel FE model and CRE model are presented in Table 2. We provide separate results for overall non-compliance, cancellation, and termination rates in Table 2 to examine if the effect of covariates is uniform or varying for cancelled and terminated contracts.

[Table 2 about here]

The results show that payment obligations is an important determinant of compliance. Based on estimates from the FE model, a one percentage point increase in contract obligations level reduces the overall non-compliance rate by ~0.07 percentage points at the county level. The results are consistent with findings by Benítez et al. (2006), Gramig and Widmar (2018), and Park et al. (2022) that increasing monetary incentives could motivate farmers to remain in cost-share programs. The incentive effect of monetary payment is positive for all models and across both non-compliance categories: cancellation and termination.

To aid in comprehension of the magnitude of the incentive effect, we conducted a simple calculation using the data in hand. The available data from NRCS shows that total non-compliance amounts to ~$20 million in Louisiana. An increase in payment per contract by one percentage point would be equivalent to ~0.2 million. Similarly, the number of non-compliant contracts was 3,878 during the 1997-2019 period. Hence based on our estimated effect of payment from the FE model, a one percentage point increase in payment per contract will lead to compliance of additional 310 contracts (i.e., $3878 \times 0.08 = 310$) that roughly implements conservation practice in ~78,740 acres generating remarkable off-farm and on-farm benefits. These numbers provide an inkling that the incentive effect of payment obligations to reduce contract non-compliance is substantial and economically meaningful. Despite this significant ballpark figure, it is worth noting that the magnitude of the payment effect needs to be further investigated.

Furthermore, we are interested in examining whether the common reasons mentioned in non-compliant contracts (e.g., environmental calamities, unforeseen expenses, and debts) hold, at least at the county level. We find a consistent and significant influence of these variables. We find that rise in the expenditure-income ratio is positively associated with non-compliance. Interestingly, we also find additional variables – HDD and debt-income ratio – that are significant and influence contract non-compliance. Examining the influence of variables other than contract payment and associated production expenses is necessary because the objective of cost-share programs is to lift the cost burden of practice implementation and achieve conservation goals. However, if producers can respond to a favorable environment (e.g., increase in earnings) and an unfavorable environment (e.g., increase in loss ratio) differently but to their own advantage rather than fostering goals of cost-share contracts (e.g., production sustainability and environmental conservation), moral hazard exists. Therefore, the additional statistically significant variables such as land value, HDD, CRP payment, and debt-income ratio in Table 2 indicate the presence of moral hazard in cost-share programs. Due to moral hazard, there is an uneven influence of significant variables in contract termination and cancellation rate. Moreover, evidence of moral hazard suggests that an increase in farm operators' earnings increases the termination rate in cost-share programs. Similarly, an increase in loss ratio provides incentives to the farmers to remain compliant, thus reducing non-compliance. The influence of loss ratio is not significant; however, it is consistently negative across all models (Table 2). Wallander et al. (2019) mention that several contract modifications occur in cost-share programs for reasons including, but not limited to, natural disaster or severe illness; however, actual reasons are unclear. Such trend also insinuates that some intrinsic motivations might be incentivizing farmers to act strategically.

We extend our analysis with 2-way FE model to provide validity to the results presented in Table 2. The incentive effect of contract payment obligations and contract acreage still holds (Table 3). The influence of expenditure-income ratio, loss ratio, debt-income ratio, HDD, and CRP payment are still consistent. Similarly, the uneven influence of the aforementioned variables in cancellation and termination rates is still prevalent, underscoring the presence of moral hazard.

[Table 3 about here]

The presence of moral hazard calls forth for the introduction of additional incentive systems that could offset opportunity costs of compliance such as compliance rewards (Yano and

Blandford, 2009) and conservation credit policy (Langpap and Wu, 2017) or nudges like empathy nudges (Czap et al., 2019) and green nudges (Carlsson et al., 2021) or revisiting existing flexible guidelines for contract participants choosing a cancellation option. As previously mentioned, combating moral hazard would also include considering aggregate farm income changes in a way that farmers will utilize cost-share incentives not only for private benefits but also to generate ecosystem services – one of the main focuses of working lands programs. In addition, using the 'fail-fast' approach during program planning and implementation could also enhance overall program processes fostering both agricultural sustainability and environmental quality (Wardropper et al., 2022).

There are a few limitations that might restrict the generalization of results obtained from this study. The aggregation of the data to county-level could have masked the contract-level behavior. Despite the novelty of this study, results are confined to only one state because data was obtained only for Louisiana. Nevertheless, the framework of this article can be extended to different regions of the US for increasing validity and investigating the presence of regional heterogeneity in incentive effect and moral hazard, if any. In addition, we conduct this analysis by combining data on both EQIP and CSP contracts and assuming that they are similar. However, some differences exist between these two programs; EQIP focuses on practice implementation in a narrow time frame (mostly 3 years) while CSP fosters practice continuation over a longer time horizon (up to 10 years). Moreover, we assume that contract payment obligations are exogenous because they are pre-determined and based on natural resource concerns in a given county which are further ranked using the CART ranking tool. Regarding unobserved and uncontrolled variables, we believe that the inclusion of time trends or two-way fixed effects along with controls for both monetary and non-monetary factors that likely affect compliance level almost suffices to draw out useful inferences. However, we cannot completely rule out the presence of residual endogeneity, thus requiring further investigation of this aspect in cost-share contract allocations.

6. Conclusion

Contract non-compliance has been a challenging issue for the cost-share programs leading to efficiency loss and increased program expenditures. Contract non-compliance has been studied for at least more than a decade concerning working lands programs, but the literature on this topic is very sparse. This paper explores the non-compliance issue in cost-share contracts using historical county-level data of contract allocations in EQIP and CSP programs in Louisiana. The results show that contract cancellation and termination rates follow an opposite but persistent trend. We find a significant incentive effect of payment obligations and contract acreage with the contract compliance rate at the county level. The presence of spatial clusters of (non)compliance provides insights for future cost-share contract allocations. Moreover, we present evidence of the presence of moral hazard whereby farmers' decisions about compliance with cost-share contracts at the county level are influenced by the level of farm income, land value, and debt-income ratio. These results could serve as a useful reference to future cost-share program planning to improve the compliance rate for generating ecosystem services. Despite some limitations, this study provides avenues for future research by investigating relatively less explored topics such as incentive effect and moral hazard concerning US agricultural conservation programs. Another area of future research in this line would be incorporating farmers' risk aversion and intergenerational motives in determining (non)compliance levels along with financial, behavioral, or information nudges to overcome non-compliance, and better align producers' motives with the goals of conservation programs.

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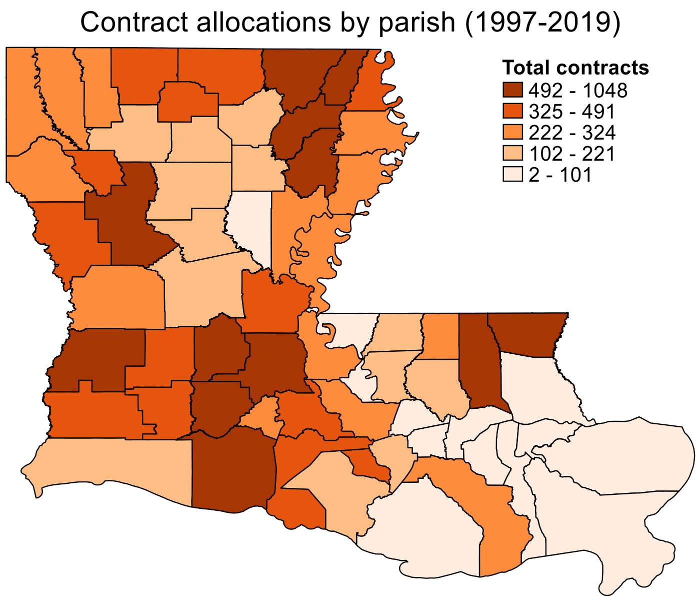


Fig 1. Map of Louisiana showing working lands contract allocations during 1997-2019

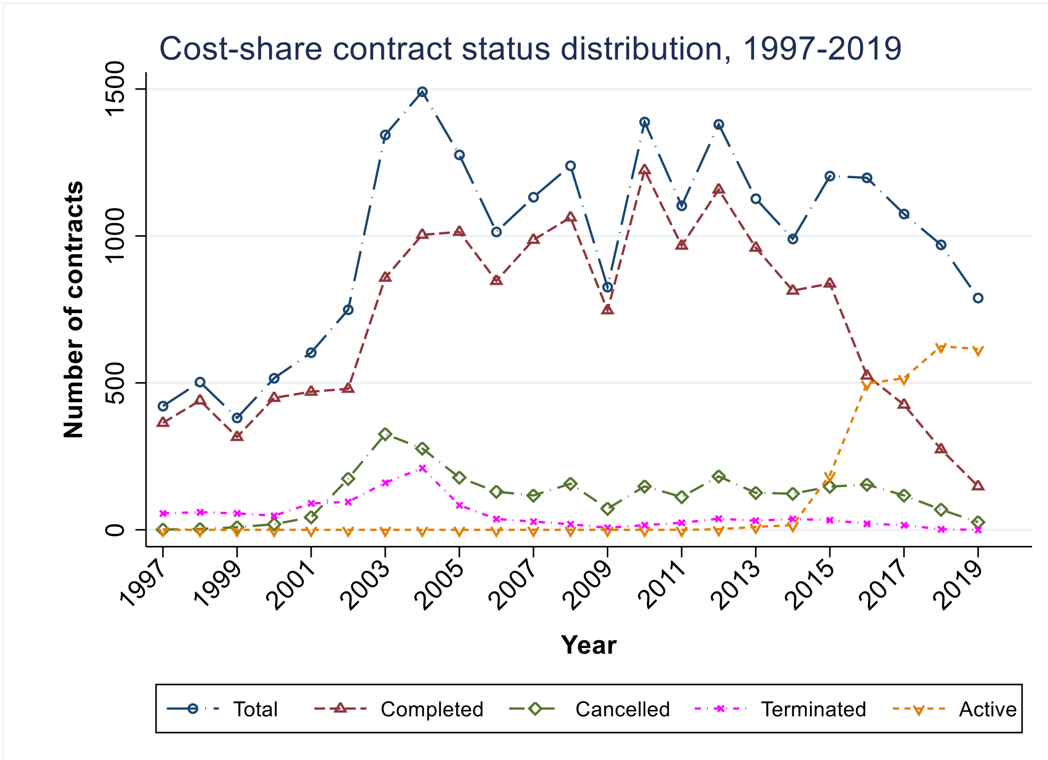


Fig 2. Distribution of cost-share contract status from 1997-2019 in Louisiana

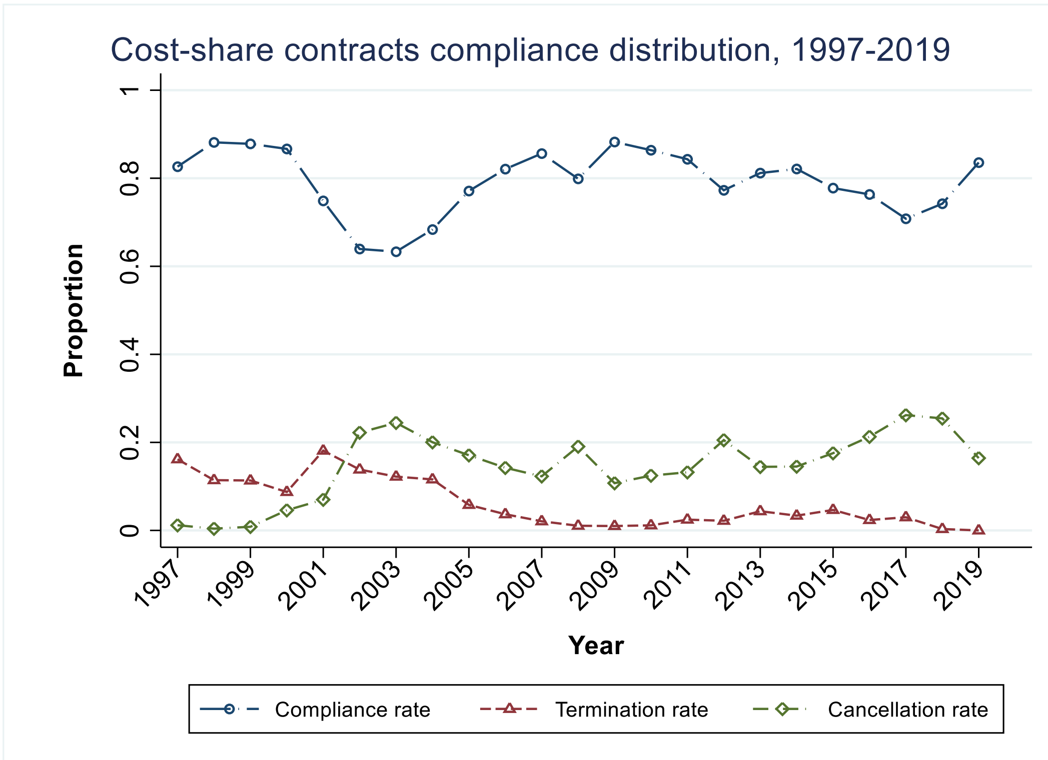
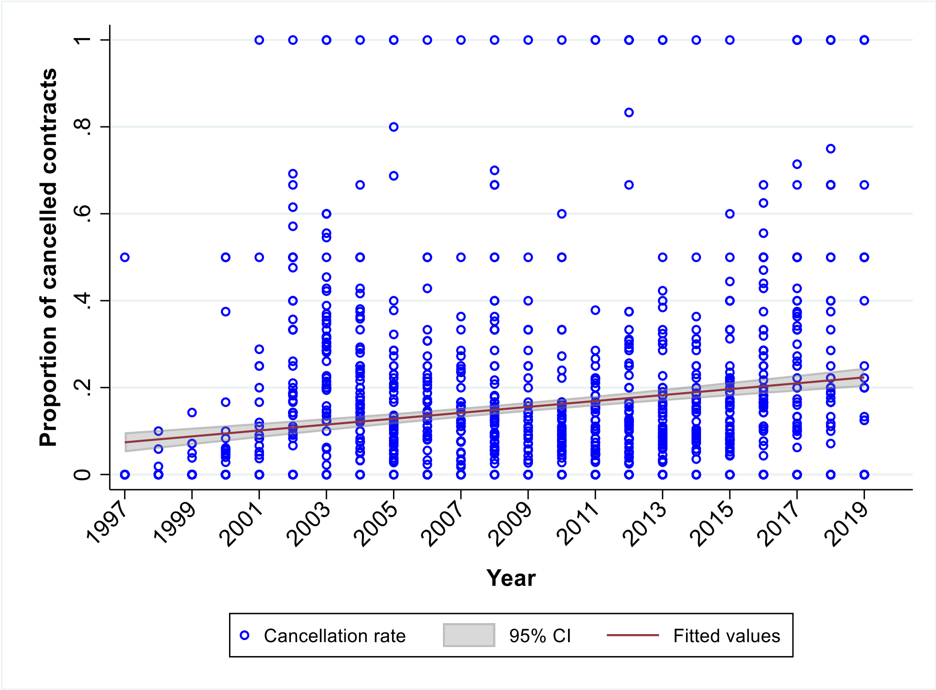
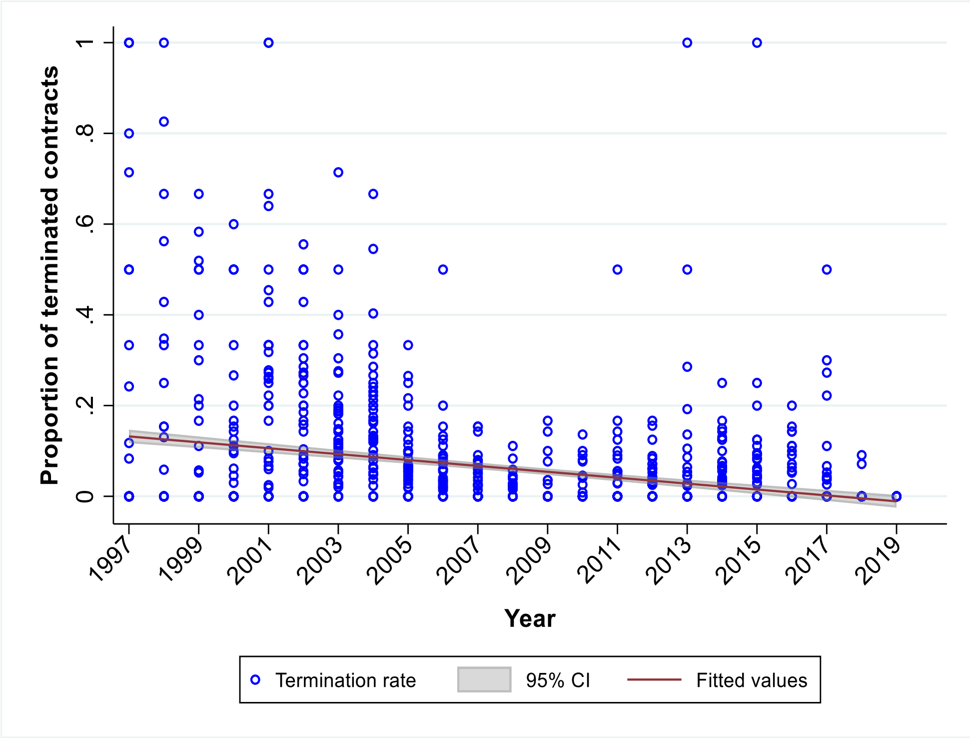


Fig 3. Distribution of compliance rate of cost-share contracts and farm income from 1997-2019



(a)



(b)

Fig 4. Changes in *(a)* cancellation rate and *(b)* termination rate of cost-share contracts in Louisiana, USA

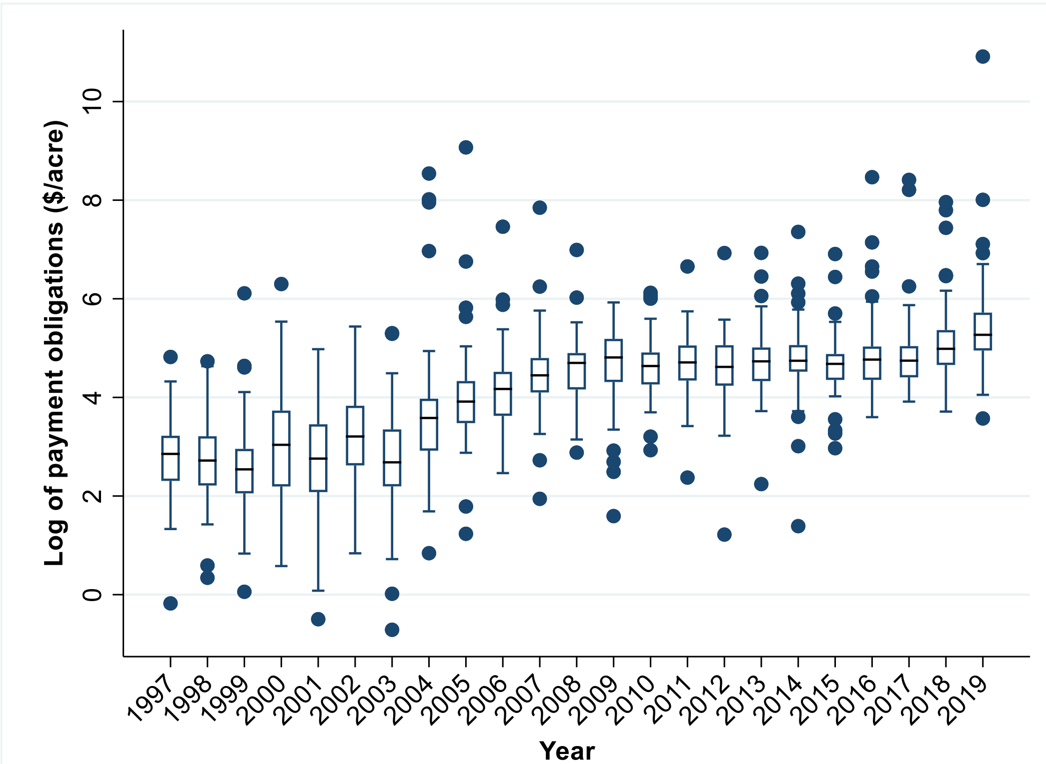
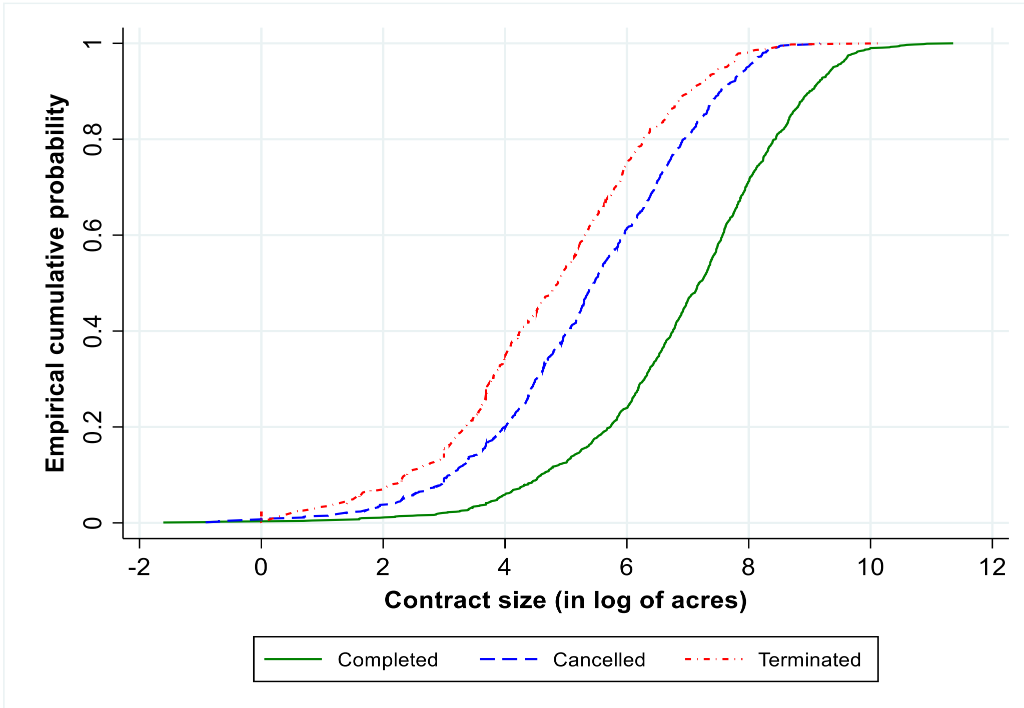
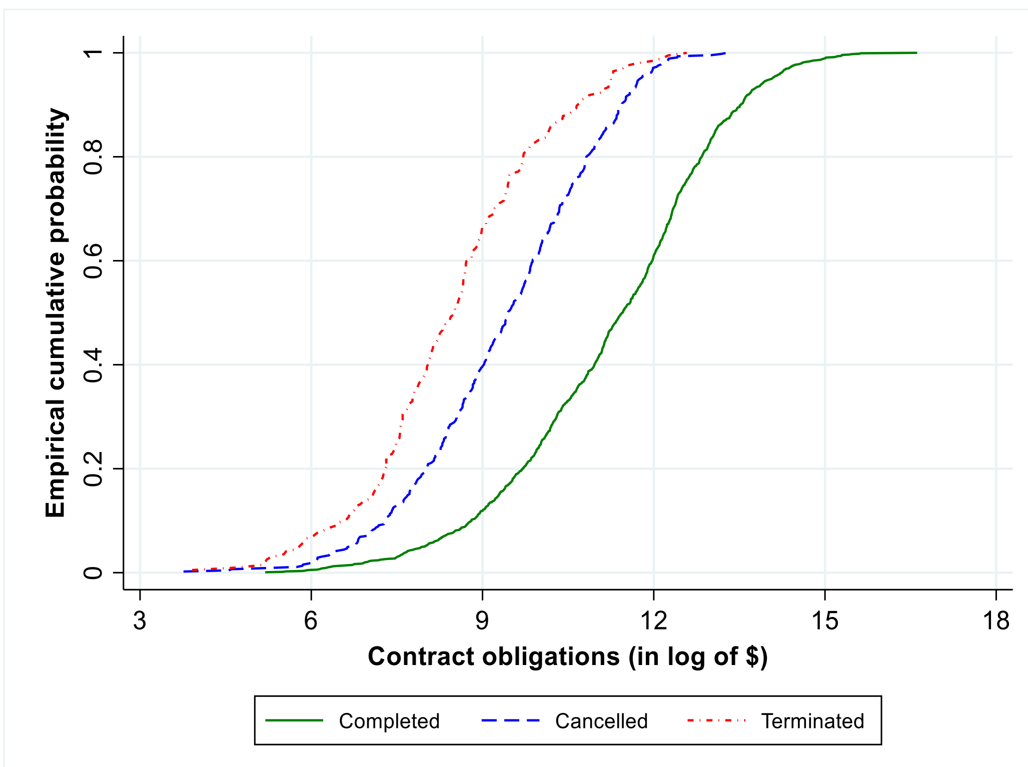


Fig 5. Changes in payment obligations per acre from 1997-2019

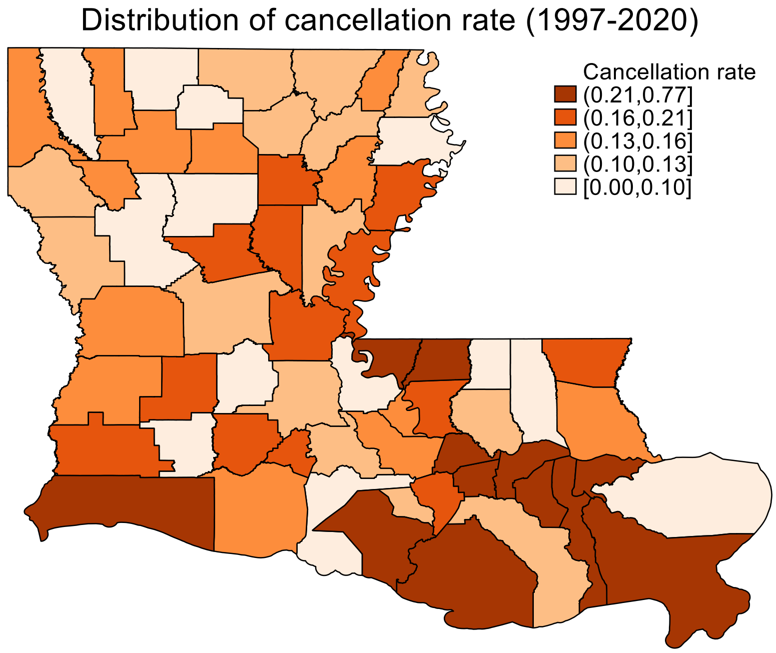


(a)

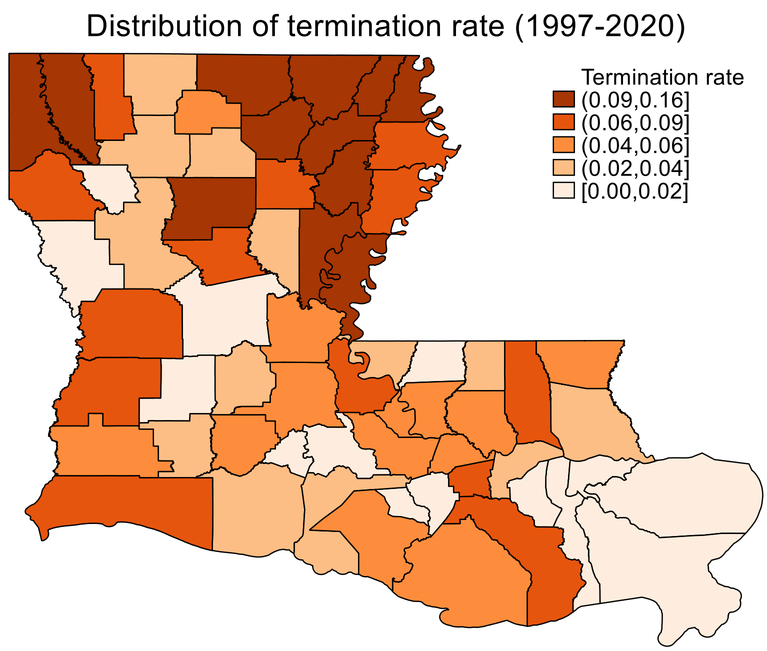


(b)

Fig 6. Empirical cumulative distribution function of *(a)* contract size and *(b)* payment obligations under different contract categories.



(a)



(b)

Fig 7. Spatial distribution of *(a)* cancellation, and *(b)* termination rates in cost-share programs in Louisiana

Table 1. Descriptive statistics of variables

Variable	**Mean**	**SD**
Non-compliance rate	0.21	0.24
Cancellation rate	0.15	0.21
Termination rate	0.06	0.14
Payment obligations per acre ($/acre)	183.15	1584.87
Expenditure-income ratio	1.02	0.31
Farm earnings ($)	11818.40	14399.22
Land value ($/acre)	2434.01	1122.17
CRP payment ($/acre)	33.03	28.47
Loss ratio	0.71	0.98
Heating degree days (>32 °C)	36.27	24.44

Notes: SD denotes standard deviation. CRP denotes Conservation Reserve Program. Loss ratio is the ratio of indemnity paid to the amount of premium received. These values are annual county-level averages of 22,735 contracts during the contract year 1997-2019.

Table 2. Main results: estimated coefficients from linear fixed effects (FE) and fractional regression models

Variables	**Overall non-compliance rate**		**Cancellation rate**		**Termination rate**	
	(1) **1W-FE**	**(2)** **CRE**	**(1)** **1W-FE**	**(2)** **CRE**	**(1)** **1W-FE**	**(2)** **CRE**
Payment obligations ($/acre)	-0.074***	-0.299***	-0.053***	-0.182***	-0.021***	-0.130**
	(0.004)	(0.033)	(0.006)	(0.027)	(0.007)	(0.053)
Contract acreage (acre)	-0.041***	-0.185***	-0.017	-0.038	-0.024**	-0.169**
	(0.008)	(0.047)	(0.011)	(0.053)	(0.012)	(0.082)
Loss ratio	-0.006	-0.025	-0.001	-0.006	-0.005	-0.041
	(0.006)	(0.035)	(0.004)	(0.023)	(0.003)	(0.036)
Land value ($/acre)	-0.011	-0.026	0.118**	0.624*	-0.129***	-0.718**
	(0.046)	(0.203)	(0.051)	(0.366)	(0.042)	(0.357)
Farm earnings ($)	0.004	0.003	-0.002	-0.007	0.006	0.060
	(0.010)	(0.045)	(0.010)	(0.049)	(0.008)	(0.071)
Expenditure-income ratio	0.053	0.202	0.026	0.189	0.028	0.229
	(0.047)	(0.173)	(0.047)	(0.267)	(0.037)	(0.207)
Heating degree days (>32 °C)	-0.068***	-0.269***	-0.040***	-0.214***	-0.028***	-0.294***
	(0.009)	(0.039)	(0.008)	(0.041)	(0.006)	(0.061)
Debt-income ratio	0.068**	0.227**	0.071***	0.388***	-0.003	0.050
	(0.028)	(0.108)	(0.020)	(0.109)	(0.020)	(0.137)
CRP payment ($/acre)	0.007**	0.029*	0.004	0.016	0.003**	0.031*
	(0.003)	(0.015)	(0.003)	(0.016)	(0.001)	(0.017)
Year trend	0.009***	0.040***	0.007**	0.024	0.002	-0.013
	(0.002)	(0.009)	(0.003)	(0.018)	(0.003)	(0.024)
Constant	0.704*	-	-0.546	-	1.250***	-
	(0.353)		(0.433)		(0.393)	
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No
R^2	0.37	-	0.33	-	0.26	-
p-value	0.000	-	0.000	-	0.000	-
No. of counties	59	59	59	59	59	59
N	1139	1139	1139	1139	1139	1139

Notes: Cluster-robust standard errors in parentheses. 1W-FE = One-way Fixed-Effects; CRE = Correlated Random Effect; CRP = Conservation Reserve Program. Loss ratio is the ratio of indemnity paid to the premium collected. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3. Robustness checks: coefficients from linear fixed effects and fractional regression with two-way fixed effects

Variables	**Overall non-compliance rate**		**Cancellation rate**		**Termination rate**	
	(1) 2W-FE	**(2) CRE**	**(1) 2W-FE**	**(2) CRE**	**(1) 2W-FE**	**(2) CRE**
Payment obligations ($/acre)	-0.073***	-0.302***	-0.054***	-0.199***	-0.019***	-0.113***
	(0.004)	(0.036)	(0.006)	(0.021)	(0.007)	(0.041)
Contract acreage (acre)	-0.051***	-0.237***	-0.019	-0.047	-0.032***	-0.219***
	(0.009)	(0.040)	(0.011)	(0.065)	(0.012)	(0.062)
Loss ratio	-0.003	-0.012	0.002	0.012	-0.004	-0.046
	(0.006)	(0.021)	(0.004)	(0.024)	(0.003)	(0.052)
Land value ($/acre)	-0.001	-0.008	0.100**	0.471*	-0.101**	-0.487
	(0.044)	(0.225)	(0.050)	(0.243)	(0.040)	(0.385)
Farm earnings ($)	0.012	0.032	0.009	0.048	0.004	0.039
	(0.010)	(0.032)	(0.010)	(0.055)	(0.008)	(0.094)
Expenditure-income ratio	0.065	0.265	0.055	0.391*	0.010	0.061
	(0.043)	(0.164)	(0.045)	(0.231)	(0.039)	(0.387)
Heating degree days (>32 °C)	-0.048*	-0.186**	-0.023	-0.079	-0.025	-0.259*
	(0.026)	(0.081)	(0.028)	(0.131)	(0.018)	(0.146)
Debt-income ratio	0.028	0.064	0.023	0.088	0.005	0.075
	(0.030)	(0.089)	(0.022)	(0.101)	(0.021)	(0.207)
CRP payment ($/acre)	0.007**	0.029*	0.003	0.008	0.004***	0.038***
	(0.003)	(0.013)	(0.003)	(0.013)	(0.001)	(0.014)
Constant	0.686*	-	-0.417	-	1.103***	-
	(0.374)		(0.450)		(0.376)	
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.42	-	0.39	-	0.29	-
p-value	0.000		0.000		0.006	
No of counties	59	59	59	59	59	59
N	1139	1139	1139	1139	1139	1139

Notes: Cluster-robust standard errors in parentheses. 2W-FE = Two-way Fixed Effects; CRE = Correlated Random Effect; CRP = Conservation Reserve Program. Loss ratio is the ratio of indemnity paid to the premium collected. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.