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# Do Tax Incentives for Farmland Leases Increase Farm Supply? Evidence From Iowa's Beginning Farmer Tax Credit

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## ABSTRACT

In recent decades, agriculture has become increasingly concentrated through horizontal mergers and acquisitions via corporate entities, and policy makers are concerned this will be exacerbated by the aging population of farm operators. To reduce market concentration in agriculture, many states have enacted policies to entice new prospective entrepreneurs into farming. Among these are tax credits for existing farm owners who lease or sell farmland to "beginning farmers." These subsidies aim to compensate the lessor for the additional risk associated with leasing land to a new farming enterprise. This paper investigates the effect of Iowa's Beginning Farmer Tax Credit program on land leased to farmers, farm operators' average age, and various metrics of non-corporate farm operations. Our point estimates suggest very small effects of the program on Iowa's prevailing farm trajectories with a budgetary cost of more than $100,000 per added independent farm.

**JEL Classification:** H25, Q12, Q15, L26

## 1 | Introduction

Like much of the American economy, farming in the 20th century experienced industrialization and productivity growth. As Figure 1 demonstrates, this was especially pronounced in the first half of the century, as the declining number of farms, which has fallen to nearly 30% of 1920 levels, greatly outpaced the reduction in agricultural acres and exhibited an increase in the average size of farms. Additionally, there is concern that the demographics of farmers will perpetuate this trend in the coming years. Average farm operator age has increased by roughly 10 years of age since 1940, and as Figure 2 demonstrates, in many counties the average age of farm operators exceeds 60 years, which is well above the peak productivity age of farm operators (Tauer 2019).[1] Farming is seen as a particularly difficult economic activity for people to enter into due to high costs of entry, considerable learning challenges and stiff competition from larger, established and "corporate" farms.[2] Consequently, there is considerable interest from politicians in policies that can increase or preserve some semblance of a traditional economic organizational model for farms as individual or family-owned forms. This paper investigates evidence on such a policy and its ability to increase the supply of farm organization, which we will describe this as "independent farms" to contrast with the corporation-owned farms.

One policy approach adopted in a growing number of states is the Beginning Farmer Tax Credit (BFTC). Beginning Farmer Tax Credits are varied in their design particulars but have the feature of offering subsidies to farm owners who lease land to a farmer who satisfies some criteria of being "new" to the industry. There is more than just an esthetic preference over the composition of farm supply, however, as these policies are also often thought to counter other US agricultural, property, and tax policies that directly disincentivize farm owners from leasing, and especially selling, their landholdings and other agricultural assets to young, incoming farmers (Valliant et al. 2024).[3] Indeed, federal policy encourages owners to hold onto assets until the

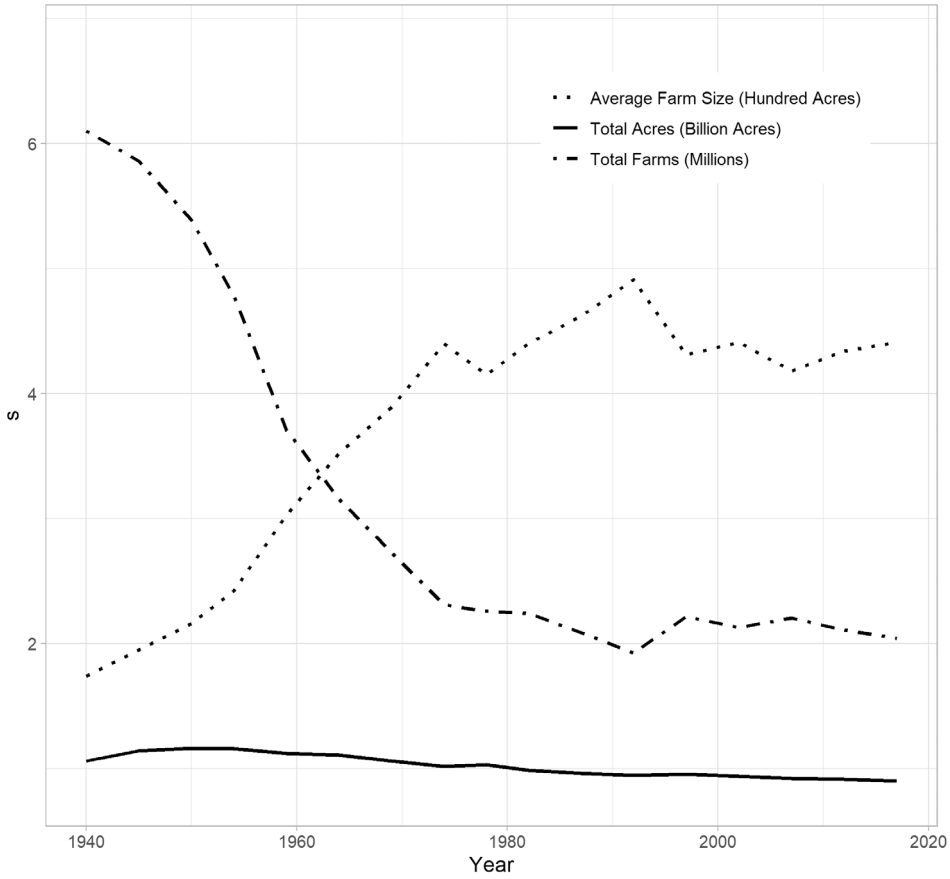


**FIGURE 1** | Trends in farm consolidations, 1940–2019. *Source:* Author's compilation using data from U.S. Census of Agriculture.

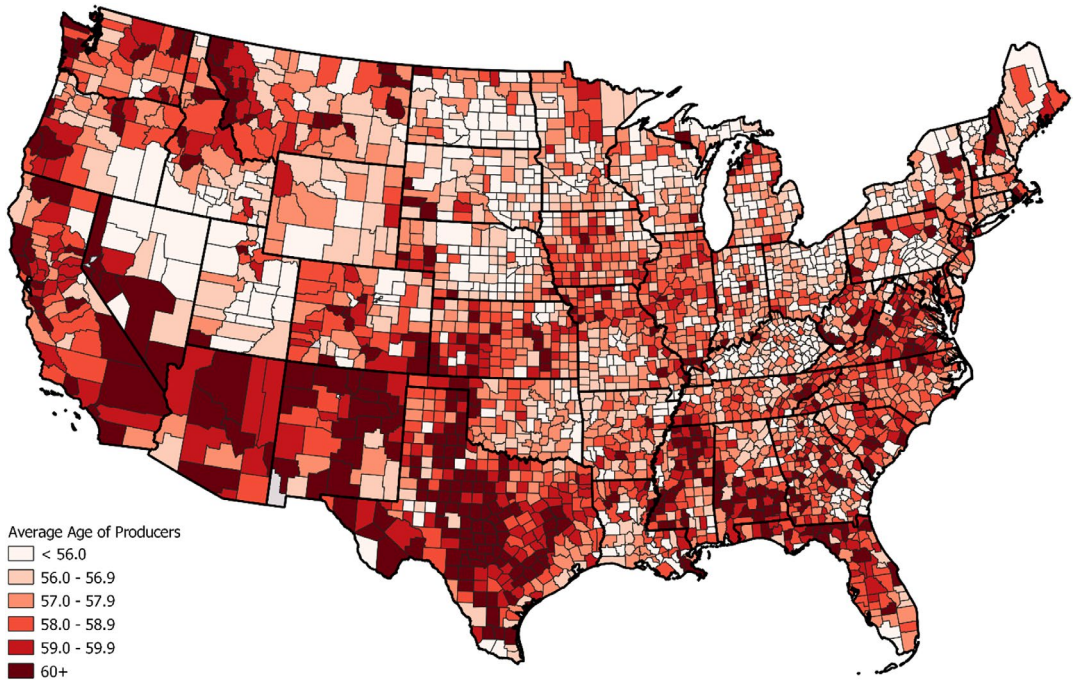


**FIGURE 2** | Average age of farmers by County, 2017. *Source:* Authors' compilation from the U.S. Census of Agriculture.

end of life, to transfer them at that point to heirs through their estate.[4] Consequently, young farmers cite land access as the top barrier to farming, with one convenience survey estimating that 45% of beginning farmers face an extreme challenge accessing land and 59% face affordability challenges when they can find it (Ackoff et al. 2022). In offering a countervailing incentive, BFTCs could aid in increasing a state's supply of farms held by non-corporate owners.

Beginning Farmer Tax Credits are interestingly designed in the landscape of tax credits for new business formation that may increase the total number of firms or overall employment. Most business tax credits and subsidies are directed at the entrepreneurial start-up: special designation zones or "hubs" that provide a favorable regulatory or tax environment, tax credits for location or employment choices, or just outright direct subsidies. Similarly, federal support for beginning farmers typically provides preferential access to loans and some other federal programs, as well as technical assistance (Dodson and Ahrendsen 2016; Key 2022a). BFTCs, by contrast, go to existing firms and offer them subsidies for sharing their assets with other firms in the same industry. In essence, the policy rationale is that BFTCs make it easier for a new prospective farmer to not just acquire land, but to gain access to a landowner with a financial stake in seeing them succeed. In other words, the BFTCs are a subsidy to compensate the experienced lessor for assuming the risk of leasing to an upstart farmer. Where the lessor is an experienced farmer, the BFTC may connect the beginning farmer to a mentor, a source of advice and guidance. Even when the farmland owner is not a farmer, as is common in agriculture (ERS 2024; Tong and Zhang 2023), the BFTCs tap into a value shared among landowners to see the next generation of farmers be able to enter and succeed (Calo 2020; Valliant et al. 2022). Since Nebraska started the first BFTC in 2001 and Iowa followed in 2008, four states (Kentucky, Minnesota, Pennsylvania, and Ohio) adopted BFTCs since 2018, and at least another six states (Colorado, Indiana, Missouri, New York, Oregon, and Wisconsin) have recently proposed or piloted a BFTC. Advocacy coalitions were preparing the U.S. Congress to introduce a federal BFTC in 2025 (National Young Farmers Coalition 2025; US Senate Committee on Agriculture, Nutrition, and Forestry 2025; POLITICO Playbook 2025).

This study examines whether BFTCs have successfully increased the number of independent farms and whether this has led to a measurably younger supply of farm operators. This result would occur if new farm entrants would not otherwise enter the market and there is less than perfect crowd out of other non-BFTC farmers. Furthermore, the subsidy to the lessor might encourage them to choose to remain a farm owner leasing out the acreage to beginning farmers, rather than selling land for commercial or residential development opportunities. If the policy just becomes a rent, or those who benefit from the BFTC ultimately displace other farmers in the marketplace, then the policy would have no effect. A worst-case scenario for the policy would be that it acts as a rent to the lessors, displaces other established farmers already with experience who would be more likely to persist in operation over time. This paper investigates the 2008 adoption of a BFTC in Iowa, often held as the model program for other states. To provide evidence on the effectiveness of the Iowa BFTC, this study employs data from two data sources of state variation: annual data on farm income reported to the IRS from 1997 to 2017 and survey data from the Census of Agriculture conducted every 5 years from 1982 to 2017. The synthetic differences-in-differences estimator of Arkhangelsky et al. (2021) is employed to construct synthetic treated cases with pre-trends matching Iowa. We find little to no effect of the BFTC on measures of total independent farms, with Iowa tracking its post-adoption synthetic counterfactual closely on a variety of policy targets.

In the broadest sense, this paper represents a contribution to the enormous literature on the effectiveness of business tax incentives designed to increase entrepreneurship and business activity. However, there is very little research on the effect of tax incentives in the agricultural sector of the economy, and even less work on BFTCs or other programs aimed at improving land access. This oversight of agriculture in the tax policy literature is unfortunate given the considerable public policy interest in the sector.

The next section of the paper will provide a brief review of the broader research on tax policy incentives on the establishment of firms, followed by a more targeted review of research in taxation and agriculture with a special emphasis on work on the BFTC. Section 3 will introduce the conceptual model, the Iowa case, and the empirical methodology. Section 4 will summarize the results and Section 5 concludes.

## 2 | Previous Research

In this literature review, we first summarize the state of knowledge on tax policy incentives on business formation. We then review the previous research on tax policy incentives on business formation. We then proceed to a review of the extant research on tax policy's influence on economic decisions on farms, and lastly the literature on BFTC programs.

### 2.1 | Tax Policy Incentives and Business Formation

There is a substantial and still growing body of research on the effect of tax policy on business activity. The research of this paper is most closely related to those focusing on state tax policy, the effect on particular organizational forms, and on targeted business incentives.

The long-standing interest of the effect of subnational tax policy on business expansion applies to this study. Examples of fairly recent contributions include Serrato and Zidar (2016) research on state corporate income tax rates and business establishments, Fuest et al. (2018) labor market effects of corporate income taxes in Germany, and Foster's (2014) study of sales tax rates on out-of-state business purchases. Following the efforts of tax policy design over the last 20 years, there has been a substantial research interest investigating the ability of tax policy incentives to favor particular organizational forms of business. In particular, tax policy's ability to encourage entrepreneurship, self-employment, or other non-c corporate activity has seen considerable recent work, no doubt motivated by the policy interest seen in the U.S. and the growth of pass through businesses (see DeBacker and Prisinzano 2015; Gale et al. 2024; Goodman et al. 2025).[5] This literature is relevant because most farmers are organized for pass through income as well, and policy makers often are interested in the independent or family-owned farm as an idealized form of farm supply over the corporate structure.

Recent literature has investigated preferential tax treatment policies toward different pass through tax filing entities that policy makers use to represent business entity concepts like "entrepreneur", "small business", or "self-employed". The

effect of tax policy on sole proprietorships is generally filled with mixed findings and results (e.g., see Blau 1987; Fairlie and Meyer 1999; LaLumia 2009; Robert L. Moore 1983; Kevin Moore 2004; Parker 2003; Schuetze 2000). Giroud and Rauh (2019) finds that pass through entities are less tax responsive to income tax changes than are c-corporations. DeBacker et al. (2018) study the effects of Kansas' elimination of personal income taxes on pass through income by examining entity-level tax returns for partnerships and s-corporations, finding no significant effects of the reform on gross receipts, investment expenses, or employment expenses, but large changes in guaranteed partner income payments in response to the policy's later repeal. Similarly, DeBacker et al. (2019) study the effect of the same policy on sole proprietors, finding that the policy primarily induced income recharacterization from wage payments to contract income with little to no effect on real economic activity.

The above-mentioned studies are largely examining responsiveness to broad tax policies that intend to alter the organizational forms of business activity, but there is a substantial literature on targeted tax incentives that better resemble the design of Beginning Farmer Tax Credit incentives. This is likewise a large and nuanced literature with mixed findings, and recent studies with good reviews on the subject can be found in Bartik (2018, 2019) and Partridge et al. (2020). A reasonable summary of this literature is that targeted tax incentives often influence the specific activities they subsidize, but evidence supporting their success in achieving their broader policy objectives is limited.[6] For instance, Harger and Ross (2016) study census tracts eligible for the New Markets Tax Credit program in a regression discontinuity design, and find that industry sorting across these jurisdictions occurred so that retail and manufacturing gains were offset by losses in other industries. Likewise, Hanson and Rohlin (2010) find that the federal Empowerment Zone wage tax credit attracted new establishments in retail and services, but experienced reductions in other industries. Fazio et al. (2020) find that state research and development tax credits increase the quantity and quality of new business start-ups, but that state investment credits generally had no impact on quantity and a reduction in quality. These investigations track closely with the aim of this research, which will investigate the effect of the BFTC on the directly subsidized activity (land leases by farmers) and then subsequently the goals of the program to reduce the average age of farm operators and increase the supply of individual and family-owned farmers.

## 2.2 | Tax Policy and Economic Decision Making on Farms

There is an absence of research on classical applied public finance questions as they pertain to the agricultural sector.[7] This is perhaps surprising given the importance of the sector as an organized interest group with significant annual influence on tax policy in state legislatures and the U.S. Congress. Some of this absence is likely due to agriculture's declining share of economic output, making it less attractive as a topic for study relative to other industrial sectors. Furthermore, classic public finance research questions of broader tax policy impacts on outcomes like commodity prices or employment that were common in the earlier literature were less likely to be constructively studied in the case of agriculture. Since farm products are overwhelmingly sold on national and international markets, it is not likely that state or local tax policy could impact these prices, making them unappealing subjects for study. Likewise, historical data on farm employment and wages has been a notoriously difficult subject to measure in economic data where there are large regional seasonal variations in migrant labor that exists in the "shadow" economy.

Some studies of the farmer tax environment give insight into farmer behavioral incentives and how those policies impact the farmland markets, particularly for new farmers. State farmland taxes impact agricultural land values and these costs can be passed on in part to renters (Dinterman and Katchova 2020), a widespread scenario that affects the cost of entry for beginning farmers across the half of Midwestern farmlands that are rented out (Bigelow et al. 2016). Section 1031 is a tax-deferred exchange provision that allows the deferral of capital gains tax from exchange of like-kind property, providing an incentive for farmers to transfer land hereditarily and lease land instead of selling it. Dillard et al. (2013) found that 1031 exchange is associated with a 1.32% land price premium due to deferred tax payments, or a total impact of 9.96% when accounting for spatial spillovers, that plausibly raises the buy-in costs for new farmers. In addition to increasing land prices, this provision incentivizes farmers to exchange rather than sell farmland, which provides an additional barrier of land access for beginning farmers who may have small, lower-quality land or no owned land at all (Katchova and Ahearn 2016).

Farmers also benefit from a variety of subsidy programs that have been subjects of studies. Kirwan and Roberts (2016) provide a robust assessment of decoupled subsidy incidence on rental prices. Drawing on 2006–2007 ARMS field-level data for US farmers and correcting for field-specific productivity and rental versus owned acres, the authors estimate that 20%–28% of subsidies are captured by rent prices. This incidence is reduced by 5–15 points for rental plots with double the number of production acres and is reduced by 0.1–0.8 points for each additional contract year. This study implies that tenants have bargaining power and a potential monopsony that scales with size, a benefit likely more relevant for established tenants than beginning farmers. It also implies some land lease capitalization for a policy like the BFTC. Breustedt and Habermann (2011) provide a similar analysis for the incidence of subsidies on rental prices in the German state of Lower Saxony, finding that a 1 euro raise in subsidy is associated with a 0.38 euro raise in rental price.

## 2.3 | Beginning Farmer Tax Credits

To the best of our knowledge, there are only two studies of BFTC program effectiveness. Montgomery (2020) provides the most recent and rigorous study of a BFTC to update a prior evaluation of the Iowa Department of Revenue (Girardi 2015). Utilizing a matching technique, this study selected a sample of Iowa beginning farmers who participated in the state BFTC program and compared them with a matched set of others who did not participate and assessed differences in farming outcomes up to 2019. The study found that the 114 selected participant

beginning farmers between 2007 and 2009 had roughly $20,000 in higher net farm income and a 10.25 percentage point greater farming retention compared to non-participant beginning farmers. While these estimates are not precisely estimated and do not illustrate a mechanism, they demonstrate a nontrivial positive revenue effect and greater farm survival rate for program participants. This finding does not necessarily imply that the number of new farmers increased Iowa's total supply of farms, however, as they could displace non-participants in the BFTC. Alternatively, it could be a lower bound of effectiveness on impact as it does not account for whether the credit induced the lessor, that is, the actual credit recipient, to become more likely to remain a farm operator.

Using Agricultural Resource Management Survey (ARMS) data from the USDA, Williamson and Girardi (2016) attempt to answer whether BFTC policies increase the proportion of beginning farmers in Iowa, Nebraska, and Wisconsin from 2003 to 2014.[8] Their results find that a 10% increase in the crop share tax credit was associated with a 0.4% increase in beginning farmer observations. However, the ARMS data is a non-random repeated cross-sectional sample; thus, it lacks the ability to reliably infer trend line changes from policy interventions. Rather, the ARMS survey is meant to be weighted to be nationally representative, and weights presuppose a demographic balance which interacts with the demographic outcome. Furthermore, the study cannot show if the BFTC program helps graduate beginning farmers to non-beginning farmers; thus, it misses a potential positive impact of the program that would bias results toward zero. As a consequence, it remains an open question whether BFTC programs affect outcomes beyond the higher survival rate demonstrated in Montgomery (2020).

## 3 | Conceptual Model and Empirical Strategy

This paper aims to evaluate the effectiveness of BFTC programs in achieving their intended policy goals. Namely, to increase the number of independent farms by targeting incentivizing existing farm owners to lease land to beginning farmers. The outcomes investigated in this research include measures of individual or family-owned farms, acres of land owned by family-owned farms, the share of the total farms and farmland occupied by family-owned farms, the number of farms leasing land, the amount of land leased to other farmers, and the average age of farm operators.

### 3.1 | Conceptual Model

Fairly standard economic models of portfolio choice produce the prediction that more investment in risky assets will occur when the acquisition of risky assets is subsidized (e.g., Stiglitz 1969; Bulow and Summers 1984). In the context of this study, a lessor receives the BFTC when they lease land to a qualified "beginning" farmer. The conceptual framework for anticipating tax incentive impacts on market level outcomes is illustrated in the familiar supply and demand illustrations in Figure 3. Panel A of the figure illustrates the market where the intervention is directly imposed with subsidies to leases made to beginning farmers, and panel B depicts the intended impact of increasing the overall prevalence of independent farmers as a type of land use.

Starting with panel A of Figure 3, tax equivalence allows us to depict the tax credit as an increase in ability to pay from new beginning farmer's that raises their demand from Dn to Dn′

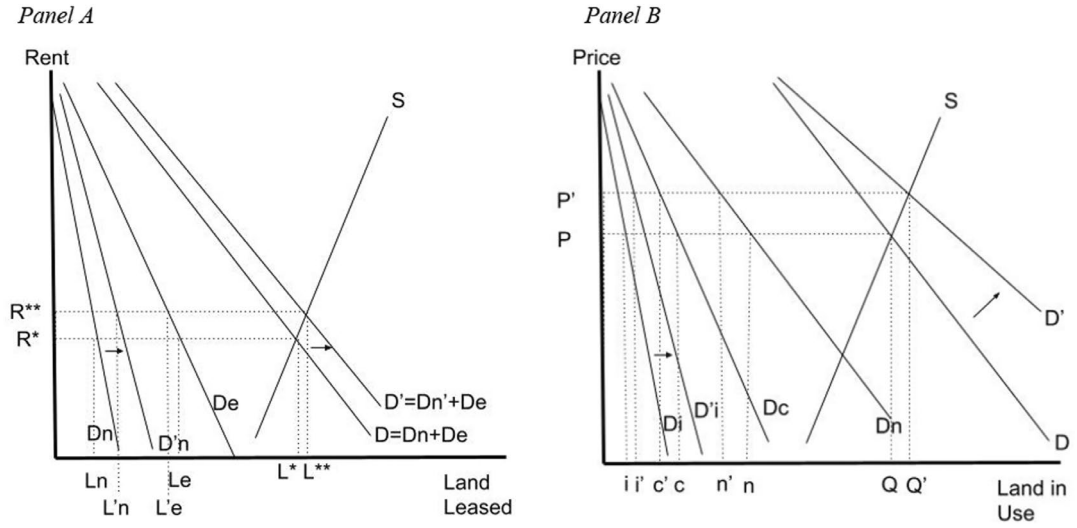


**FIGURE 3** | Stylized impacts of BFTC on supply and demand equilibrium. Panel A: Farmland Lease Market. Panel B: Market for Land Use. *Source:* Rent (R) is the market rate per unit of land leased (L). Market equilibriums before and after the BFTC credit indicated by * and **, respectively. Market demand (D) is depicted to arise from the horizontal summation of beginning farmers that are new to the market (Dn) and existing farmers (De). The quantity of lease land demanded by beginning farmers increases due to higher demand after accounting for higher possible prices is L'n less Ln. The crowd out of the existing farmers due to the BFTC induced increase in price in market land is depicted by the decline from Le to L'e. Figures not to scale for visual clarity. Price is the price per unit of land. Demand curves depicted for independent farmer (Di), corporate farmer (Dc), and nonfarm user (Dn). Curves for market demand (D) and supply (S) establish market clearing price (P) and quantity (Q) in use. Without BFTC, at market clearing price the independent farms, corporate farms, and nonfarm users demand i, c, and n units respectively for a total of Q. After the BFTC policy increase demand by independent farmers to curve D'i, and correspondingly revise market price to P′. Land for use by independent farmers increases to i', with other users crowded out with declines to c′ and n′. Figures not to scale for visual clarity.

that consequently moves the market demand from D to D′. This drives up the market price on land leases while lowering the effective rent for the new beginning farmers, but which crowds out to some degree the unsubsidized group of alternative uses of the farmland, which for simplicity we will refer to as other existing farmers. The additional land leased to beginning new farmers (L'n less Ln) is supplied by some mix of new land brought to the market for leasing (L** less L*) and the land that would otherwise been leased to other existing farmers (Le less L'e). The actual magnitudes of any of these changes depends on the price elasticities of the various groups, which of course depends on the familiar determinants of elasticities such as the ability to substitute to alternatives or forward shift costs onto their own consumers. As usual, the incidence of the tax credit flows to the most inelastic group. If market supply of leasable land is perfectly inelastic while demands remain price sensitive, then perfect crowd-out occurs with all leases to new farmers coming from existing. If the design of the tax credit is somehow non-influential in decision making, then there will be no change in demand from Dn to Dn', and market outcomes remain unchanged.

To the extent that the BFTC succeeds as a subsidy for the independent farmers, lease or lessor, it positively shifts the demand for land use in farming that is illustrated in the market of Panel B in Figure 3. The goal of the policy in essence is to raise the equilibrium quantity of independent farming from i to i′, or perhaps to increase the market share of independent farming.[9] To the extent that this raises the overall market price for land, alternative users in corporate farming (curve Dc) and nonfarm users (Dn) reduce their quantity demanded. Again, the specific quantities of adjustment throughout these markets depend on their absolute and relative elasticities that channel the incidence of the tax credits.

This simple framework encapsulates, but can be further colored in by, policy discussion surrounding BFTC programs. The incidence of the tax credit may lower effective land rental prices for beginning farmers and make their lease bid more attractive to lessors at the margin (Valliant et al. 2024). Farm owners lease to new market entrants instead of existing established farmers, potentially growing the number of farms. Furthermore, the BFTC also incentivizes farm owners to lease land, rather than engage in direct cultivation, sell, or leave idle. Therefore, even if the BFTC is fully capitalized into the price of the lease and providing no advantage to start-up costs, the policy could still work to increase the number of farm entities by incentivizing farm owners to remain a going concern rather than divest or sell to a corporate entity. In this way, risk mitigation and/or lower rental prices are mechanisms by which the BFTC could increase the total number of farm operations.

There are also several mechanisms which could put downwards pressure on the BFTC effect. First, the policy could effectively subsidize existing leases to beginning farmers. This trend could create a crowding-out effect if the subsidy effect overpowers the risk mitigation effect and leads to an increase in land available for more established farmers who fit the state's definition of beginning farmer, relative to qualifying farmers who would be starting a new operation. We expect the risk mitigation effect to be smaller as risk is predominantly borne by the renter under fixed or flexible cash leases, which accounted for 76% of national leases in 2014 (Bigelow et al. 2016). Second, if lease turnover and renegotiation are slow, this effect would put significant downwards pressure on the BFTC's ability to induce new contracts. Third, because beginning farmers face lower operation survival rates (estimated at 43.5% to 54.1% for small and large operations respectively), the effect of the BFTC on new farmer operations will be attenuated by the short- and long-term success of those operations (Key 2022b).

### 3.2 | The Beginning Farmer Tax Credit and the Case of Iowa

The BFTCs studied provide a farm owner with a state income tax credit equivalent to a proportion of the annual income earned through a lease agreement to the beginning farmer. For example, Iowa and Nebraska's credit rates ranged from 5%–15% over the years studied (2007 to 2017), with levels varied according to statute and the type of lease agreement contracted. To illustrate the tax credit's value to a farm owner, consider the scenario of renting an 80-acre field to a beginning farmer where the BFTC credit rate is 10%. If that owner charges a rent of $200 per acre (the mean land rent according to NASS 2024), then 10% of the owner's $16,000 in annual revenue would qualify for a state tax credit of $1600. Since Nebraska's BFTC is refundable, the state would pay the full credit even if the owner's tax liability is less than $1600. In Iowa, the BFTC is not refundable, but can carry forward to affect the owner's future tax liabilities for up to a decade. To put the size of this subsidy in perspective, the Census of Agriculture estimates that the average net cash income per farm was nominally $33,827, $43,750, and $43,053 in census years 2007, 2012, and 2017 respectively, with equivalent average governmental payments of $9523, $9925 and $13,906. Table 1 provides some estimates of the credit per contract for states in 2019, the last year before the COVID pandemic. Iowa's average expenditure on the BFTC per contract was about $5000, or about 11% of the average American net cash farm income in 2017. Obviously, the actual credit amount depends positively on the amount charged and total land leased.

Compared to other states, Iowa is the most aggressive model and the most prolific awarder of BFTC credits, as demonstrated by Figure 4 listing the contracts by year. Whereas other states have typically awarded land access incentives to only a fraction of 1% of their unique farming operations, Iowa regularly provides credits to potentially nearly 2% of the state's unique farming operations with an average credit around $5000 (see Table 1). Iowa accomplishes this in part by having more inclusive terms than other states' BFTCs. Iowa defines a beginning farmer more broadly by placing no cap on a "beginner's" number of years of experience in agriculture, which is how other institutions define a beginning farmer.[10] Iowa also permits "beginning" farmers to possess a higher net worth than some other states, and, unlike other states, it allows related parties to co-enroll in the BFTC, thus incentivizing farm owners to lease to their younger family members. A survey suggests that 50% of Iowa's BFTC participants had enrolled with a family member, more than twice as many as in Nebraska and Minnesota, whose BFTCs restrict agreements between family members ($n = 964$, blinded, forthcoming).

**TABLE 1** | Selected indicators for state land access incentive programs, 2019.

| | State land access incentive expenditures | Contracts, number | Subsidy per contract | Contracts, % of farm returns |
|---|---|---|---|---|
| Nebraska | $1,289,927 | 57 | $22,630 | 0.133% |
| Iowa | $6,407,065 | 1281 | $5002 | 1.663% |
| Maryland | $619,866 | 2 | $309,933 | 0.005% |
| Minnesota | $3,254,656 | 585 | $5564 | 0.894% |
| Delaware | $290,888 | 1 | $290,888 | 0.056% |

*Source:* Collected by authors from varied sources. Title of each state program: Nebraska BFTC, Iowa BFTC, Maryland NextGen, Minnesota BFTC, Delaware Young Farmer Program.

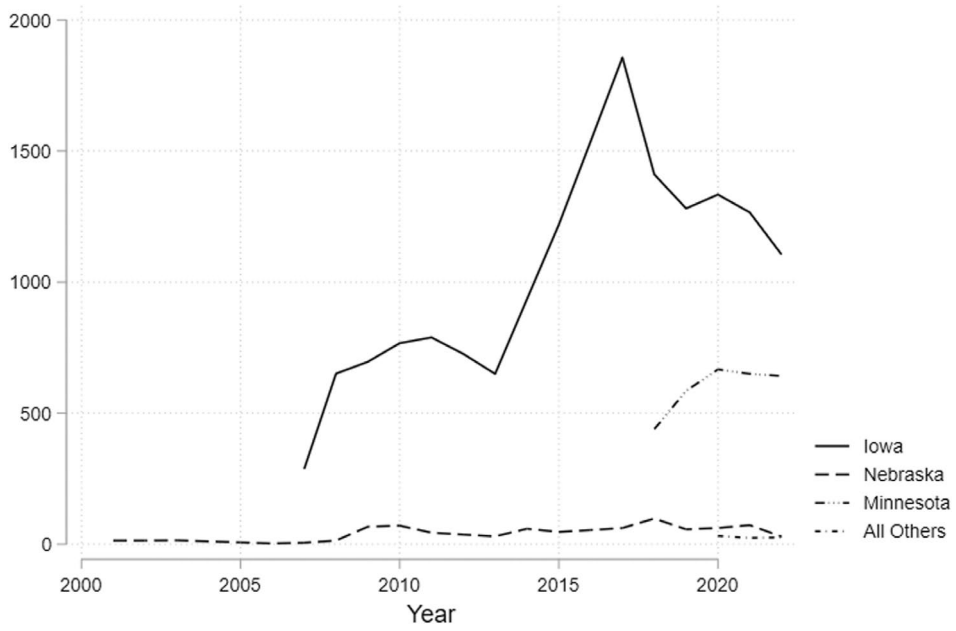


**FIGURE 4** | Number of beginning farmer tax credit contracts awarded by selected states, 2001–2022. *Source:* "All others" includes the sum of Delaware, Kentucky, Maryland, and Pennsylvania. Data is collected by authors from state departmental and legislative reports (full list available by request).

Iowa's BFTC is lastly more aggressive than others by allocating more money than other states for the tax credit. While other states cap their BFTCs at $1 to $6 million per year, Iowa's caps have ranged from $6–$12 million, with annual appropriations that have never been exhausted by the demand for BFTC subsidized contracts. This higher allocation and Iowa's broader terms combine with their administrative strengths in implementing the credit to result in Iowa having the biggest BFTC in the country to date. Iowa has in fact spent more on this one state-level program than the federal government has spent nationwide on all federal Land Access Policy Initiatives (Valliant and Freedgood 2020). However, Iowa's traditionally high-volume BFTC began to downsize in 2023, after Iowa exempted retired farmers aged 55 and over from paying taxes on income from rented farm property (Tidgren 2024). This change, initiated after our period of analysis ends, rendered the BFTC an irrelevant incentive for retired farmers, who own 26% of Iowa's farmland (Tong and Zhang 2023).

In terms of analytical power, Iowa is the only state with sufficient enrollment and a long enough post-period such that we could find a plausible effect on the total supply of independent farmers. Nebraska awarded only 84 contracts from 2001 to 2008. Nebraska initially defined an early version of the BFTC in 2001, but the policy was restrictive in eligibility requirements and lacked sufficient payoff to recruit much of any uptake. Nebraska updated the policy in 2007 legislation to raise the maximum net worth for eligibility and added property tax exemptions to the program (Beck et al. 2018). Although this considerably increased uptake and per contract award amount, as recently as 2023 the program has never exceeded more than 98 contracts in a year in a state with nearly 50,000 independent farms. Only Minnesota has come close to Iowa in program delivery, but their BFTC began in 2018 and thus has few post-period years that include the 2020 Covid pandemic as a potential confounder. Like many business tax credit programs, in the state budgetary accounting system they can be evaluated in terms of contract-years. For instance, a budgetary outlay backing 10 contract years could be allocated to 10 firms for one year, one firm for 10 years, or any mathematical combination of the two. Judging the success of the cohort on the basis of the number of permanent firms induced by 10

contract years supplied by the state is in principle a judgment of how effectively the state structures its tax incentives over time and provides some basis for gaging the program's potential impact. If each contract year succeeded in creating on net one permanently operating farm operator to the state, Iowa's BFTC program would account for approximately 18% of the 2017 population of 71,046 independent farms (as estimated by the 2017 Census of Agriculture). Obviously, a subsidized lease agreement involves at least two parties, the lessee and lessor, both of whom might potentially be retained in the market for the duration of the analysis. However, it is also an overestimate where a contracted relationship extends for multiple years, as is commonly the case. The actual treatment effect of the program could dissipate if program beneficiaries crowd out other prospective independent farmers or else become a rent that does not affect decision making.

### 3.3 | Empirical Model

The measurable outcomes studied in this paper include the average farm operator age, individual and family-owned farms (number and acreage), land leased to other farms (number of farms and acreage), and individual and family-owned farms as a share of total farms (number and acreage). Outcomes that estimate the effect on the number of farms represent extensive margin evidence of take-up, and land acreage represents intensive margin evidence on farmland growth.

Let $y_{it}$ represent the outcome of interest in state $i$ in year $t$. Letting $t=0$ represent Iowa's adoption year (2008) of the BFTC program, the canonical event study framework is

$$y_{it} = \beta_0 + \sum_{t=-11}^{+10} \tau_t \mathrm{BFTC}_{it} + \mu_i + \delta_t + \varepsilon_{it}.$$

Evidence of causal effects arise from the estimation of this model to demonstrate an absence of pre-trends ($\tau_t = 0 \ \forall t = -11, \ldots, -1$). This requires a control set of non-adopting states that follow the same trends in independent farms as Iowa, but estimation of the event study demonstrates that the common trends assumption is violated.[11] This is almost certainly because Iowa differs from non-adopting states in terms of baseline levels of farms, trajectories, and globally-connected farm product markets. In summary, direct estimation of the event-study using all other states as counterfactuals fails to produce estimates with similar pre-trends. Consequently, this study will construct a synthetic control counterfactual to Iowa ("synthetic Iowa") using the estimator in Arkhangelsky et al. (2021). This approach calculates an average treatment on the treated (ATT) value for $\hat{\tau}$ by generating a synthetic control counterfactual from a two-way fixed effect model that places greater weight on the most similar states and periods to the treated state's pre-trend period, improving the precision of the estimate and removing predictable systematic heterogeneity. Iowa and synthetic Iowa are interpreted to have the same data generating process to common structural factors, with Iowa differing in the post period from synthetic Iowa because of the BFTC policy. Thus, the parameter estimates of the model are derived from the optimization of the following:

$$\left(\widehat{\{\tau\}^{\mathrm{sdid}}}, \hat{\beta}, \hat{\mu}, \hat{\delta}\right) = \arg\min_{\tau,\beta,\mu,\delta} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} \left(y_{it} - \beta - \mu_i - \delta_t - \mathrm{BFTC}_{it}\tau\right)^2 \widehat{w_i^{\mathrm{sdid}} \lambda_t^{\mathrm{sdid}}} \right\}$$

The possible donors for the algorithm to consider for the construction of synthetic Iowa include those with complete data and who did not adopt a BFTC during the time period of study. This amounted to excluding Nebraska and another eight states with missing data. The donor pool for constructing synthetic Iowa is listed by state abbreviation in Appendix Table A1 alongside the algorithmically selected weights.

There are limited choices for statistical inference when there are few treated units because most derived methods rely on large asymptotic normality rules that depend on a large number of treated units. Consequently for this research, the standard errors for computing confidence intervals around the parameter estimate are based on a bootstrap procedure in which the donor pool is repeatedly sampled with replacement to create a placebo value of the treatment effect (see Arkhangelsky et al. 2021: algorithm 4).[12] Results across all outcomes presented will use the same number of bootstrap iterations (500) and a common seed (123). We also will present specifications that augment the models to include basic controls for population and per capita personal income for gaging model sensitivity.

### 3.4 | Data and Summary Statistics

Following the conceptual model, the policy goal is to increase the number of independent farmers. However, this is a largely political description of an economic organizational structure, and it is not necessarily consistently or strictly defined. For our empirical analysis, we operationalize this idea with definitions drawn from two primary data sources of dependent variables. The first is derived from Internal Revenue Service data on tax returns, using annual data from 1997 to 2017. The second is the U.S. Census Bureau and Department of Agriculture's (USDA) Census of Agriculture on farm and farm operator characteristics conducted every 5 years, using data from 1982 to 2017. Since other adopters of the BFTC appear in 2018, followed shortly thereafter by the 2020 Covid pandemic, we end the analysis to retain these late adopters as potential control states for Iowa over the earlier time horizon. Nebraska is excluded from the data for having the aforementioned low-uptake BFTC program.

Data on Schedule F income tax returns by state and year are provided by the Internal Revenue Service (IRS) through the agency's Statistics of Income (SOI) program. Schedule F is an attachment for federal individual, sole proprietor, and single-member LLC income tax filers reporting income and expenses from farming activities. Corporate-entity farms file forms other than schedule F's. These corporate entities include the multi-member LLCs, partnerships, S-corps, C-corps, estates, trusts, and non-family farms that represent roughly 25% of U.S. farm entities by number and about 50% of farm production (Burns and MacDonald 2018) so the use of schedule F's understates

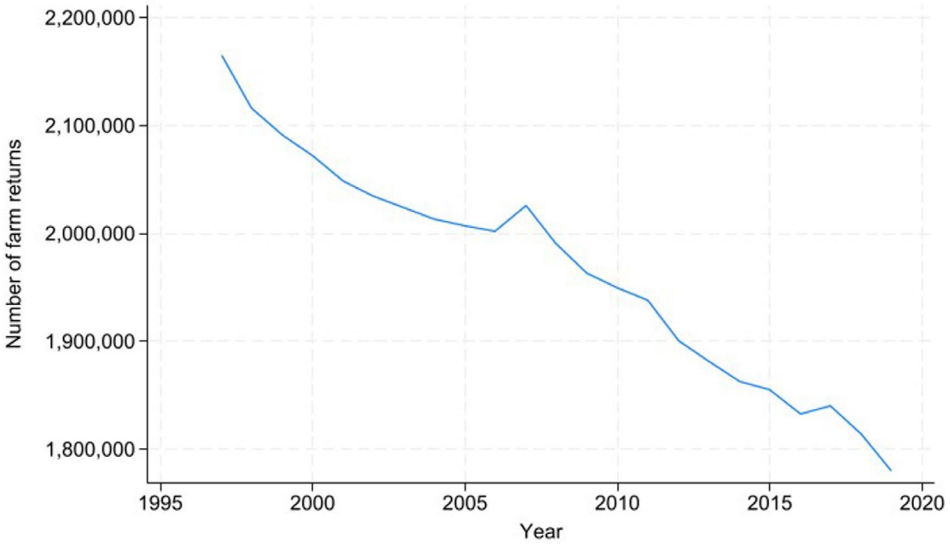


**FIGURE 5** | Number of schedule F's in the United States, 1997–2019. *Source:* Derived from annual reports from U.S. Internal Revenue Service Statistics of Income program.

the number of businesses primarily engaged in farming activities, but it accurately states the number of non-corporate-entity farms. Figure 5 reports the number of Schedule F's filed annually and demonstrates a strong downward national trend, which likely reflects some mix of both movement away from farming as an economic activity and a shift toward farms incorporating, being acquired by, or merging into corporate arrangements (Ashwood et al. 2022).

There are a couple key advantages of the SOI data. Primarily, it is a measure of farm operations that is standardized across states with annual frequency. In addition, it is generated through administrative data. The primary disadvantage of the data is that it is only a measure of the count of these filers by state. In very recent years the SOI also reports aggregate gross income from schedule F by state, but these are primarily during the post-period for our cases of analysis.

The primary limitation is that features of the individual farms themselves are unknown (e.g., age of farm operators, number of acres, etc.). It is also worth bearing in mind that these are the state of origin for federal tax returns, and it is possible that some Schedule F filers might have farming activities and pay taxes in multiple states.[13] This measurement error, presumably uncorrelated with the BFTC treatment, reduces the precision of model estimates.

The Census of Agriculture Data (COA data) is a comprehensive survey conducted every five years by the USDA National Agricultural Statistics Service (NASS). This census collects data on the state of agriculture across the United States, providing detailed statistics on U.S. farming and ranching, including the number and types of farms, farm income, land use, production practices, and characteristics of farm operators. It covers every agricultural operation that produces or sells $1000 or more in agricultural products during the census year.[14] The census gathers information on crop and livestock production, farm acreage, land ownership, operator demographics (age, gender, ethnicity), production expenses, machinery, farm labor, and practices related to conservation and sustainability.

The COA contains descriptive information about farm operators that allows us to count those farms targeted by BFTC policies. This includes the number of farms and land acreage devoted to individual/family-owned farms, farms renting land to others, and the age of the farm operators. In going back to 1982, the COA has older historical data than the IRS, albeit with reduced frequency that is limited to every 5 years, taking place in years ending in ′2 and ′7. Consequently, there are 8 time periods for the 1982 to 2017 difference-in-difference panel, and this might omit short-run responses that will be reflected in the SOI's annual data. Lastly, there are eight states (Alaska, Massachusetts, Maryland, North Dakota, Rhode Island, West Virginia, Wyoming, Wisconsin) dropped from all analyses and donor pools due to some missing or repressed COA data years for some of the selected variables.

Table 2 provides the summary statistics on all variables employed in regressions. The COA and the SOI provide two measures of the policy goal: increasing the number of "family-owned" or "non-corporate" farms. The Census of Agriculture categorizes farm operators into three types: "individual or family owned", "partnerships", and "corporations." A family-owned farm is one where the majority of the business is owned by the producer and individuals related to the producer, including relatives not living in the producer's household. Consequently, some family-owned farms can be organized under a corporate structure of some type. As already described, the count of schedule F filers to the IRS excludes family-owned farms organized under a corporation. Figure 6 demonstrates a scatterplot between the IRS SOI data on schedule F filers and the COA data on individual or family-owned farms in operation by state for years the two data sources have in common (1997, 2002, 2007, 2012, 2017). The correlation between these two measures is extremely high at 0.98. Consequently, outside of source and design (administrative

**TABLE 2** | Summary statistics, variable descriptions, and sources.

| Variable label | *N* | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Number of Schedule F Filers | 882 | 42,718.4 | 41,298.0 | 230.0 | 248,922.0 |
| Average Age | 320 | 54.4 | 2.4 | 47.2 | 60.1 |
| Lessors, Number | 320 | 5905.6 | 5497.9 | 133.0 | 25,711.0 |
| Lessors, Acres (millions) | 320 | 1.49 | 2.30 | 0.01 | 19.70 |
| Family Owned, Number of Farms | 320 | 40,353.5 | 35,139.0 | 1262.0 | 223,284.0 |
| Family Owned, Acres (millions) | 320 | 12.4 | 14.9 | 0.19 | 9.03 |
| Family Farm Share, Number | 320 | 0.85 | 0.06 | 0.03 | 0.95 |
| Family Farm Share, Acres | 320 | 0.64 | 0.15 | 0.02 | 0.85 |
| Population (millions) | 882 | 5.97 | 6.78 | 0.49 | 39.4 |
| Per Capita Personal Income | 882 | 37,109.7 | 9199.5 | 19,219 | 69,146 |

*Note:* Number of Schedule F Filers: Number of individual income tax returns filing schedule F for farm income (IRS Statistics of Income); Average Age: Mean age of farm operators (Census of Agriculture); Lessors, Number: number of farms leasing/renting land to other operators (Census of Agriculture); Lessors, Acres: Acres of farmland in the state being leased/rented to other operators (Census of Agriculture); Family Owned, Number: Number of individual or family owned farms in operation (Census of Agriculture); Family Owned, Acres: Acres of farmland in the state owned by individual or family owned farms (Census of Agriculture); Family Owned Share, Number/Acres: scaled by total farms/farmland in the state (computed from Census of Agriculture). Population: Number of residents in the state (Bureau of Economic Analysis); Per Capita Personal Income: total personal income divided by population (Bureau of Economic Analysis). All statistics calculated from the pooled data of state and year observations. Average age in each year is first calculated and reported by Census of Agriculture before summary statistics.

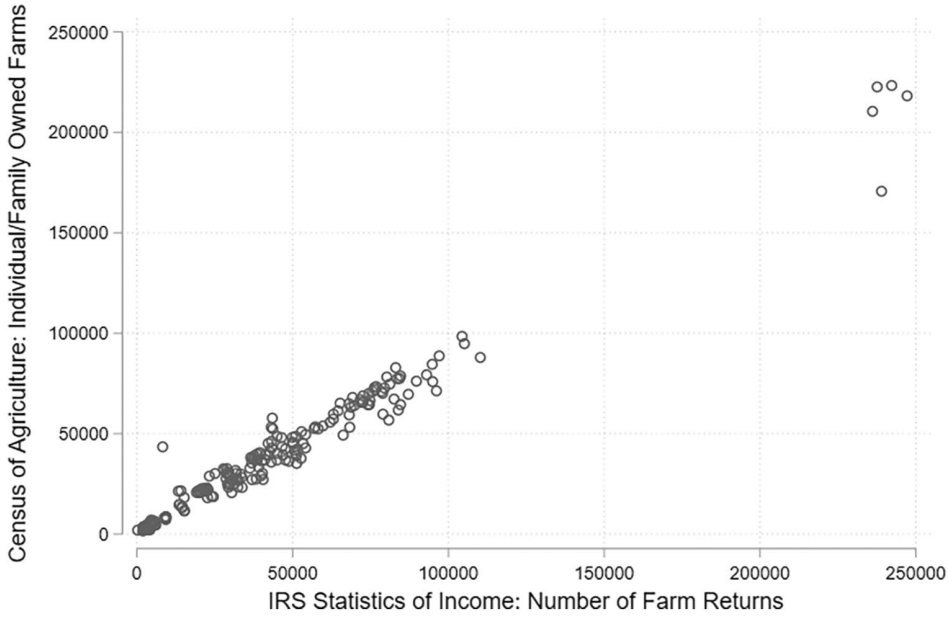


**FIGURE 6** | Comparison of census of agriculture and IRS data on Farms by Common State-Year.

IRS data and survey COA data), the primary difference between the two are period range and frequency.

## 4 | Results

The most direct mechanism for the BFTC program to work is for there to be an increase in land leased/rented to other farmers in the COA from 1982 to 2017. Table 3 reports the estimated average treatment on the treated (ATT) for the BFTC program in Iowa. As discussed in the previous section, states broadly do not provide valid pre-trends for the Iowa program adopted in 2007 and are therefore biased, but Table 3 nevertheless provides TWFE estimates with and without control variables to provide the reader with a sense of the important role the SDID provides in finding a weighted match for a synthetic Iowa. Appendix Table A1 provides a unit fixed effect coefficient from a SDID equivalent weighted OLS regression so that the reader can observe which states are included as donors and providing the most substantive contributions to synthetic Iowa for all results presented in this paper.[15] Plots of the synthetic and actual Iowa for each SDID regression can be found in the appendix, with the (Table 3 results corresponding to Appendix Figure A1 for the number of farm owners leasing land to farmers and the acres of land farm owners leased to farmers, respectively.

Table 3 shows that the Iowa BFTC program increased the number of farm owners leasing land to farmers by about 0.159 log points, approximately a (exp[0.159]−1 =) 17.2% increase, relative to the estimated synthetic Iowa without the BFTC. In the last COA before the BFTC, there were an estimated 17,098 farm owners leasing land to farmers in Iowa, so this point estimate implies were about additional 2565 farm owners leasing land because of the BFTC program over the 2007 through 2017 period. Over the same period, from the data reported in Figure 4, there were 10,114 contract-years cumulatively awarded over the period, implying about 25% of these contract-years induced expansion in the land lessor market from existing farm owners. Furthermore, the amount of land leased to farmers similarly increased by 0.398 log points, or about 49.8%. These are substantive effects, but of course as a case study the precision is low from placebo-generated variance. At its upper bound, the number of farm owners leasing land to farmers increased by as much as (exp [0.159 + 1.96(0.138)]−1=) 53.6%. That large of an effect size would imply an additional 9172 lessors, representing more than 90% of the contracts. Of course, by the same token that variance cannot rule out about a 10% reduction in the number of lessors. Similarly, the results suggest that the acres of land leased to farmers expanded by (exp [0.398]−1=) 48.9%.

Table 3 provides evidence that the BFTC program increased the number of farmers leasing land from 2007 to 2017 and expanded the total leased acreage. But did this increase in leasing actually lead to the policy targets of reducing the average age of and increasing the supply of independent farmers? For these outcomes, we turn to Table 4 where the outcomes studied are the mean age of farm operators along with the logged measures of farms and farmers: schedule F filers, census-reported number of individual or family-owned farms, and acres of family-owned farms. As with Table 3, in Table 4 we focus our discussion on the SDID estimates while providing the biased TWFE for comparison, while figures of the actual and synthetic Iowa for these outcomes can be found in Appendix Figures A2–A4.

The evidence in Table 4 suggests the Iowa BFTC program does not favorably affect policy makers' targeted goals. The average age of farm operators increased by 0.28 years in Iowa relative to synthetic Iowa. Of course, it could be that the policy keeps an older established generation participating in the farming market longer to offset the average to lease out land. However, the other indicators in Table 4 do not suggest an increase in the number of farm operators that would accompany it. The BFTC program increased Schedule F filers in Iowa during the post period by just 0.7% relative to synthetic Iowa. This effect size would represent an additional 567 Schedule F farm returns resulting from 10,114 contract year awards and $58.3 million in budget outlays during the same period. This rate implies that nearly 20 contract years awarded for about $103,000 are needed to statistically expect one more farm tax return. At most, there is about a 2% difference between Iowa and synthetic Iowa in 2016, roughly an amount equal to a single year's BFTC contract years and far short of the 18% of cumulative supply they would represent if each contract year added one permanent farmer to supply. This effect size is very similar to the estimate on the study of BFTC

**TABLE 3** | Effect of Iowa's BFTC on Land Leased to other Farmers.

| | ln (Number of Farms) | | | ln (Acres of Land) | | |
|---|---|---|---|---|---|---|
| | TWFE | TWFE | SDID | TWFE | TWFE | SDID |
| BFTC | 0.271* | 0.267* | 0.159 | 0.492** | 0.517** | 0.398 |
| | (0.146) | (0.147) | (0.136) | (0.242) | (0.243) | (0.396) |
| Controls? | No | Yes | No | No | Yes | No |
| *N* | 320 | 320 | 320 | 320 | 320 | 320 |

*Note:* Standard errors reported in parentheses. BFTC is the treatment dummy variable for Iowa during the post period. TWFE are cluster robust standard errors by state and year, SDID standard errors from 500 placebo randomized treatment tests (seed = 123). All models include year and state fixed effects. Donor pool includes 42 states listed on Appendix Table A1. Years of analysis are those ending in ′2 and ′7 from 1982 to 2017. Controls are population and per capita personal income. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

**TABLE 4** | Effect of Iowa's BFTC on selected policy targets.

| | TWFE w/Controls | | | | Synthetic DID | | | |
|---|---|---|---|---|---|---|---|---|
| | Average Age | ln (Sched F Filers) | ln (Number of Family Owned Farms) | ln (Acres of Family Owned Farms) | Average Age | ln (Sched F Filers) | ln (Number of Family Owned Farms) | ln (Acres of Family Owned Farms) |
| BFTC | 2.043*** | 0.002 | −0.192 | 0.035 | 0.280 | 0.007 | −0.045 | 0.013 |
| | (0.424) | (0.072) | (0.159) | (0.154) | (0.585) | (0.041) | (0.115) | (0.065) |
| *N* | 320 | 882 | 320 | 320 | 320 | 882 | 320 | 320 |

*Note:* All TWFE regressions include population and per capita personal income as controls. Standard errors reported in parentheses. BFTC is the treatment dummy variable for Iowa during the post period. TWFE are cluster robust standard errors by state and year, SDID standard errors from 500 placebo randomized treatment tests (seed = 123). All models include year and state fixed effects. Donor pool includes 42 states listed on Appendix Table A1. Years of analysis are those ending in ′2 and ′7 from 1982 to 2017, except for the schedule F filers where the data is annual from 1997 to 2017. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

beginning farmer retention by Montgomery (2020), suggesting that the effect of the program would be on lessees and not retention of lessors. It is worth noting that the farms enrolling in BFTCs, as multi-generational grain farms of hundreds of acres, may often represent entity types other than sole proprietorships or single-member LLCs, so may file forms other than Schedule F's with the IRS. However, when using the COA number of independent or family-owned farms, the point estimate for the BFTC program is negative (about −4.5%) rather than positive. A negative effect would suggest that the BFTC program brings in lease farmers who are less likely to succeed than the counterfactual farmers they displaced. The effect on land owned by independent or family-owned farmers is a little bit larger at 1.3%, consistent perhaps with farm owners retaining more land to rent out to farmers as per the previous results in Table 3. Once again, the placebo standard errors provide a large confidence interval given a single case study of Iowa, but the overall story seems to be that the program effects have the wrong sign or are close to zero.

Table 5 presents a robustness check by taking a different measure of the market supply of farms. Perhaps the policy has little noticeable effect on the supply of independent or family-owned farms but indirectly gives them an advantage over other types of farm ownership structures, namely corporations. If Iowa's BFTC discouraged expansion of other ownership types, then even with the churn of subsidized farmers not permanently staying there would plausibly still be an effect on the share of the preferred farm operators in the state. In Table 5, the outcome therefore is Iowa's share of individual or family-owned farms out of total farms, and the synthetic plot is in Appendix Figure A5. This share has declined over time, with Iowa being 86.8% in the last pre-treatment census of 2002 and falling to 82.5% by 2017. The ATT estimate difference from Synthetic Iowa hardly differs at all; however, whether measured by number of farmers (0.4%) or by acreage ownership (0.1%).

The safest interpretation is that the BFTC, in the form and at the level of investment it has had to date, produces little-to-no effect over the long run on the number of independent farmers or the age of operators. However, it is important to consider the counterfactual interpretation. Other states undertake many changes in the tax code that influence entrepreneurship or run other programs specifically aimed at farmers (e.g., see Law and Tonon 2006; Anderson 2012; Anderson et al. 2022). A synthetic Iowa may not adopt the BFTC specifically but may make any number of other changes to their policy environment, in which case it is possible that the BFTC is effective but not *uniquely* effective in the landscape of policy changes states undertake. We cannot distinguish between this case and a case where the program is ineffective, but neither scenario lends itself to recommending the current BFTC formulation specifically for increasing the market presence of independent farmers.

**TABLE 5** | Effect of Iowa's BFTC on Family Farm Share of All Farms.

| | TWFE w/Controls | | Synthetic DID | |
|---|---|---|---|---|
| | Number | Acres | Number | Acres |
| BFTC | −0.002 | −0.002 | 0.004 | 0.001 |
| | (0.034) | (0.031) | (0.012) | (0.027) |
| N | 320 | 320 | 320 | 320 |

*Note:* All TWFE regressions include population and per capita income as control variables. Standard errors reported in parentheses. BFTC is the treatment dummy variable for Iowa during the post period. TWFE are cluster robust standard errors by state and year, SDID standard errors from 500 placebo randomized treatment tests (seed = 123). All models include year and state fixed effects. Donor pool includes 42 states listed on Appendix Table A1. Years of analysis are those ending in '2 and '7 from 1982 to 2017. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

## 5 | Conclusion

This paper finds little evidence that the Iowa Beginning Farmer Tax Credit is overcoming the state's prevailing trajectories of falling farm numbers and rising farmer age. This conclusion is the result of a synthetic difference-in-difference analysis of the Iowa BFTC program on the prevalence of individual or family-owned farms, farmland leased out, or the average age of farm operators. Measuring from Schedule F returns, our point estimates imply that one additional Schedule F farm income tax return in the state statistically required about 20 contract years totaling a little over $100,000 during the 2007 to 2017 period. As the state never exceeded its budget authority for the BFTC, at least under its current design, there is little change in the trajectory of the state's measured farm operations that can be attributed to the BFTC program.

BFTC design aspects, all of which could be amended to potentially improve the effectiveness of the BFTC approach, may play into the null findings around farm operation numbers. One feature, shared by all BFTCs, allows pre-existing lessor-lessee pairs to co-enroll in a BFTC. In the perhaps 40% of cases in which established lessor-lessee dyads sign up for a BFTC (blinded, forthcoming), the state does not gain a farming operation. Similarly, Iowa's BFTC may facilitate entry for younger members of the same farming operation by having no restrictions around related parties co-enrolling in the BFTC. Half of the Iowa participants who responded to a survey had enrolled in the BFTC with a family member (blinded, forthcoming), potentially also contributing to farm numbers remaining constant. Even beginning farmers who enroll in the BFTC with a non-relative may be one of multiple operators of an established family farm (Dodson and Ahrendsen 2016), another pattern that would keep farm numbers flat. More broadly, Iowa's BFTC may be distinctive in that its generous definition of a beginning farmer may have the effect of including more existing farming operations, and fewer new farms, compared to the BFTCs of other states. These ties between design and outcomes should be explored to improve the policy incentives. Further, findings around farm numbers should be considered in the context of frequent tax and regulatory changes by state and federal governments aimed at supporting individual and family-owned farm operations. Thus, it can at least be said that the BFTC is not uniquely successful compared to other policy interventions. However, in the 2022 Census of Agriculture survey that took place after the analysis presented here, Iowa became one of only five states to enjoy a net increase in farm numbers (Munch 2024), indication that inquiries into the effects of BFTCs and related incentive mechanisms should continue. The analysis provided is novel because it begins to use major national secondary datasets to examine

effects of states' emerging public investments in agriculture and food systems, through a type of state tax tool that has only been active during the 21st century.

The analysis here does not speak to other outcomes of the BFTC, particularly at the farmer level. For example, the research is unable to investigate if BFTC programs bring in new farmers with less experience. This trend could be particularly important for understanding the performance of the Iowa BFTC, which could be the result of the lack of a cap on years of experience allowing the program to disproportionally subsidize existing farmers. It also does not speak to the total farm productivity or economic product of farmland, which could increase or decrease with the take up of these subsidized leases. Policy makers are also conflicted over a tension of inequality and seek to avoid subsidizing high net worth individuals that seek to enter farming and already have the resources, either independently or within the family, to undertake this venture, and so they set maximum net worth restrictions on the eligibility of the lessee for the BFTC. This net worth limit was so low for Nebraska in 2001 that the program had essentially no uptake until the revision in 2008. It could be that the program displaces higher net wealth farmers in their counterfactual non-adopting state.

The data being analyzed did not allow for much exploration in the way of potential heterogeneity among types of farming operations. The BFTC incentive, as states have structured it thus far, is most relevant to models of agriculture that depend on a larger land base. Correspondingly, in the BFTC's' Midwestern region, nearly every farm enrolled in a BFTC raises grain crops or oilseeds. These crops will generally become feedstocks to feed poultry or livestock, or biofuels, such as ethanol. One survey of BFTC enrollees found that while about 50% of farms in BFTC states produce grains, 96% of BFTC farms produced grains ($n = 905$, blinded, forthcoming). The BFTC farms raised a median and mean of one type of agricultural product, up to four types. Only 2% of respondents had enrolled livestock in a BFTC transaction while 95% had enrolled land. The same survey indicated the scale of farms enrolled in BFTCs. Although the survey occurred an average of 5 years after BFR's' initial enrollment in a BFTC, and did not report on BFR's' earlier farming operation scales in their year of enrollment, by the year of the survey, 1% of BFR respondents were operating farms smaller than 50 acres, 53% were operating farms of between 50 and 500 acres, and 46% were operating farms larger than 500 acres in scale ($n = 335$ BFRs, blinded, forthcoming).

The BFTC approach is currently active in seven states, and six more states have proposed versions of their own that are pending. The U.S. Congress may consider a federal version in the future. These states' BFTCs share core characteristics and their rules and implementation vary. States have amended their BFTCs' terms and allocation levels on a regular basis throughout the 25 years of their existence. The BFTC model provides a dynamic area of policy intervention and a statutory template that is diffused to one-third of the 43 states that levy income taxes. Our analysis did not distinguish an effect of the Iowa BFTC on its policy objectives. At the same time, this research elicited insights into strategies to improve the BFTC approach. More broadly, this study weighs in on the effects to date of one type of policy strategy, among a range of public initiatives to invest in competitiveness and viability within U.S. agriculture and food systems by addressing beginning farmers' prospects. Other innovations within that mosaic whose effects are proving promising under evaluation include numerous approaches to credit and lending tailored to beginning farmers (Jablonski et al. 2022; Dodson and Ahrendsen 2016) and investments to provide technical assistance around farm succession and transfer (Valliant et al. 2019) and address facilitators of beginning farm survival and success beyond land, for example, other types of farm business costs and the corresponding costs of the farm household (Becot and Inwood 2022; Becot et al. 2025). These all represent opportunities for future work with different data or methods to understand the effects of state and federal investments to facilitate new farmers' entry and economic success (Burchfield et al. 2022; Jablonski et al. 2022).


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### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The data that support the findings of this study are openly available in Github at https://github.com/justross08/bftc.

### Endnotes

[1] According to 2017 data from the U.S.D.A. National Agricultural Statistics Service, principal farm operators aged 65 and up outnumber farmers under 35 by six to one (USDA-NASS 2019). Top-heavy numbers in farming contrast to the general workforce (Bigelow et al. 2016). Specifically, among self-employed Americans, only 14% are aged 65 and over (Zulauf 2021).

[2] As is common in the public discourse, there is some vagueness where critical references of "corporate farms" is concerned. Technically speaking, many "family held" farms are organized under a corporate structure in addition to Limited Liability Corporations. We define the terms of measurement relevant for our empirical analysis in our data section.

[3] For instance, the step-up basis for inherited capital gains taxes incentivizes assets owners to transfer their assets at the end of life through their estate.

[4] For other federal tax uniformity issues, empirical investigations can be found in Sisson (1979) and Mills et al. (1994).

[5] The most prominent examples of policy are the famous "Kansas Income Tax Experiment" of 2012 and the subsequent federal Tax Cuts and Jobs Act of 2017, both of which sought to encourage small businesses and entrepreneurship with favorable tax treatment of pass through income.

[6] For an elucidation of this idea, see Chirinko and Wilson (2008) for a study of state investment tax incentives' effect on national investment.

[7] Of course, there are some incidental papers where effects of fiscal policies identify effects on various sectors of the economy, among which sometimes includes agriculture (e.g., see Fisher and Rasche 1984). See Clapp et al. (2018) for an investigation of the reverse, where expansions of alternative sectors have different fiscal impacts on government, and one of the sectors is agriculture.

[8] Wisconsin's three-year BFTC only pertained to leases of machinery, facilities, and equipment, not of land, and was little used (Williamson and Girardi 2016).

[9] Using the notation of Figure 3, the increase in the market share would be the change from i/(i + c) to i'/(i' + c').

[10] Otherwise, the standard definition of "beginning farmer" in LAPI programs is a farmer with 10 or fewer years' experience in farming.

[11] The TWFE event studies with violated pre-trends are not reported in this paper, but are available upon request.

[12] This approach assumes homoskedasticity across the states, given that the variance is based off placebo assignments (Conley and Taber 2011). We log the outcome variable for most of the main results for ease of interpretation, which also likely aids in satisfying the homoskedasticity assumption.

[13] The nexus required for a farmer to be eligible for the BFTC subsidies does necessarily require some tax standing in the state, but states can vary on residency requirements. For instance, Iowa requires the lessor to live in the state and not be a "habitual offender" of state pollution laws, whereas a state like Nebraska only requires ownership of the agricultural asset being leased.

[14] The Census of Agriculture makes considerable effort to obtain data on all farm operators. If farms are not responsive, they follow-up by mail, telephone, and sometimes personal visits to try to get a complete and accurate representation of American agriculture today. While response to the Census of Agriculture is required by law, USDA does not fine a producer who does not return their ag census form.

[15] Whereas more traditional synthetic control approaches (e.g., Abadie et al. 2010) tend to rely upon more sparse weight matrices that rely heavily on a few donor units, the SDID algorithm in fitting pre-trends tends to reward models that are not overly reliant on fewer donors in favor of those with a broader set of donors.

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## APPENDIX A

**TABLE A1** | Synthetic DID unit fixed effects.

| | Land leased to farmers, n | Land leased to farmers, acres | Average age | Schedule F filers | Family farms, number | Family farms, acres | Family farm share, number | Family farm share, acres |
|---|---|---|---|---|---|---|---|---|
| AL | −1.37 | −1.27 | 0.00 | −0.13 | −1.34 | −1.37 | −1.37 | −1.36 |
| AR | 0.00 | 0.00 | 0.00 | −1.80 | 0.00 | 0.00 | 0.00 | 0.00 |
| AZ | 0.60 | 1.07 | 0.00 | 0.28 | 0.72 | 0.58 | 0.59 | 0.64 |
| CA | −1.23 | −0.90 | 0.00 | −0.50 | −1.15 | −1.25 | −1.25 | −1.20 |
| CO | −0.86 | −0.26 | 0.00 | −2.77 | −0.71 | −0.90 | −0.88 | −0.81 |
| CT | 0.00 | 0.00 | 0.00 | −5.23 | 0.00 | 0.00 | 0.00 | 0.00 |
| DC | −1.42 | −1.12 | 0.00 | −3.15 | −1.35 | −1.44 | −1.43 | −1.40 |
| DE | 0.57 | 0.98 | 0.00 | −0.30 | 0.00 | 0.55 | 0.56 | 0.61 |
| FL | 0.10 | 0.47 | −0.50 | −0.03 | 0.20 | 0.08 | 0.09 | 0.14 |
| GA | 0.79 | 0.86 | 0.00 | −2.18 | 0.81 | 0.80 | 0.79 | 0.80 |
| HI | −1.96 | −2.42 | −2.45 | 0.49 | −2.11 | −1.96 | −1.97 | −2.04 |
| ID | −1.98 | −1.71 | 0.00 | −0.86 | −1.91 | −1.99 | −1.99 | −1.95 |
| IL | −1.05 | −1.05 | −1.68 | 0.33 | −1.05 | −1.05 | −1.05 | −1.05 |
| IN | −2.79 | −2.53 | −3.41 | 0.09 | −2.73 | −2.81 | −2.80 | −2.77 |
| KS | −0.35 | −0.31 | −0.97 | 0.17 | −0.34 | −0.34 | −0.35 | −0.34 |
| KY | −1.43 | −1.26 | 0.00 | 0.52 | −1.38 | −1.44 | −1.43 | −1.41 |
| LA | −1.00 | −0.90 | 0.00 | −0.52 | −0.98 | −1.00 | −1.01 | −0.99 |
| ME | −2.13 | −1.33 | 0.00 | −2.37 | −1.93 | −2.18 | −2.16 | −2.06 |
| MI | −1.89 | −1.63 | −2.51 | −0.15 | −1.83 | −1.91 | −1.90 | −1.87 |
| MN | −2.78 | −2.78 | −3.41 | 0.37 | −2.78 | −2.77 | −2.78 | −2.78 |
| MO | −0.58 | −0.45 | −1.20 | 0.70 | −0.55 | −0.59 | −0.58 | −0.57 |
| MS | 0.77 | 0.80 | 0.00 | −0.24 | 0.78 | 0.77 | 0.77 | 0.77 |
| MT | −0.54 | −0.44 | −1.16 | −0.91 | −0.51 | −0.53 | −0.54 | −0.53 |
| NC | −0.29 | −0.03 | 0.00 | −0.06 | −0.23 | −0.31 | −0.30 | −0.27 |
| NH | −1.72 | −1.09 | 0.00 | −3.18 | −1.56 | −1.76 | −1.74 | −1.67 |
| NJ | −0.27 | 0.40 | 0.00 | −1.69 | −0.10 | −0.30 | −0.29 | −0.21 |
| NM | 0.75 | 1.36 | 0.00 | −1.24 | 0.91 | 0.73 | 0.73 | 0.81 |
| NV | −0.36 | 0.04 | 0.00 | −2.61 | −0.26 | −0.38 | −0.37 | −0.32 |
| NY | −2.25 | −1.88 | 0.00 | −0.55 | −2.15 | −2.27 | −2.26 | −2.21 |
| OH | −2.47 | −2.13 | 0.00 | 0.37 | −2.38 | −2.49 | −2.48 | −2.44 |
| OK | −0.61 | −0.34 | 0.00 | 0.46 | −0.54 | −0.63 | −0.62 | −0.59 |
| OR | −0.79 | −0.35 | 0.00 | −0.38 | −0.68 | −0.80 | −0.80 | −0.75 |
| PA | −3.24 | −2.80 | 0.00 | −0.15 | −3.13 | −3.26 | −3.25 | −3.20 |
| SC | 0.40 | 0.77 | 0.00 | −0.84 | 0.50 | 0.38 | 0.39 | 0.44 |
| SD | −2.71 | −2.64 | −3.33 | −0.45 | −2.69 | −2.70 | −2.71 | −2.70 |
| TN | −0.28 | 0.09 | 0.00 | 0.39 | −0.19 | −0.30 | −0.29 | −0.25 |
| TX | 0.78 | 1.25 | 0.00 | 1.57 | 0.90 | 0.76 | 0.77 | 0.83 |

(Continues)

**TABLE A1** | (Continued)

| | Land leased to farmers, n | Land leased to farmers, acres | Average age | Schedule F filers | Family farms, number | Family farms, acres | Family farm share, number | Family farm share, acres |
|---|---|---|---|---|---|---|---|---|
| UT | −1.31 | −0.67 | 0.00 | −1.27 | −1.15 | −1.35 | −1.33 | −1.25 |
| VA | 0.25 | 0.72 | 0.00 | −0.21 | 0.37 | 0.22 | 0.24 | 0.29 |
| VT | −2.21 | −1.91 | −2.82 | −2.46 | −2.13 | −2.22 | −2.22 | −2.18 |
| WA | −0.73 | −0.56 | −1.34 | −0.65 | −0.68 | −0.73 | −0.73 | −0.71 |
| Regression | Table 3 | Table 3 | Table 4 | Table 4 | Table 4 | Table 4 | Table 5 | Table 5 |

*Note:* Unit fixed effects generated by weighted regression procedure described in Clarke et al. (2024: 589–90).

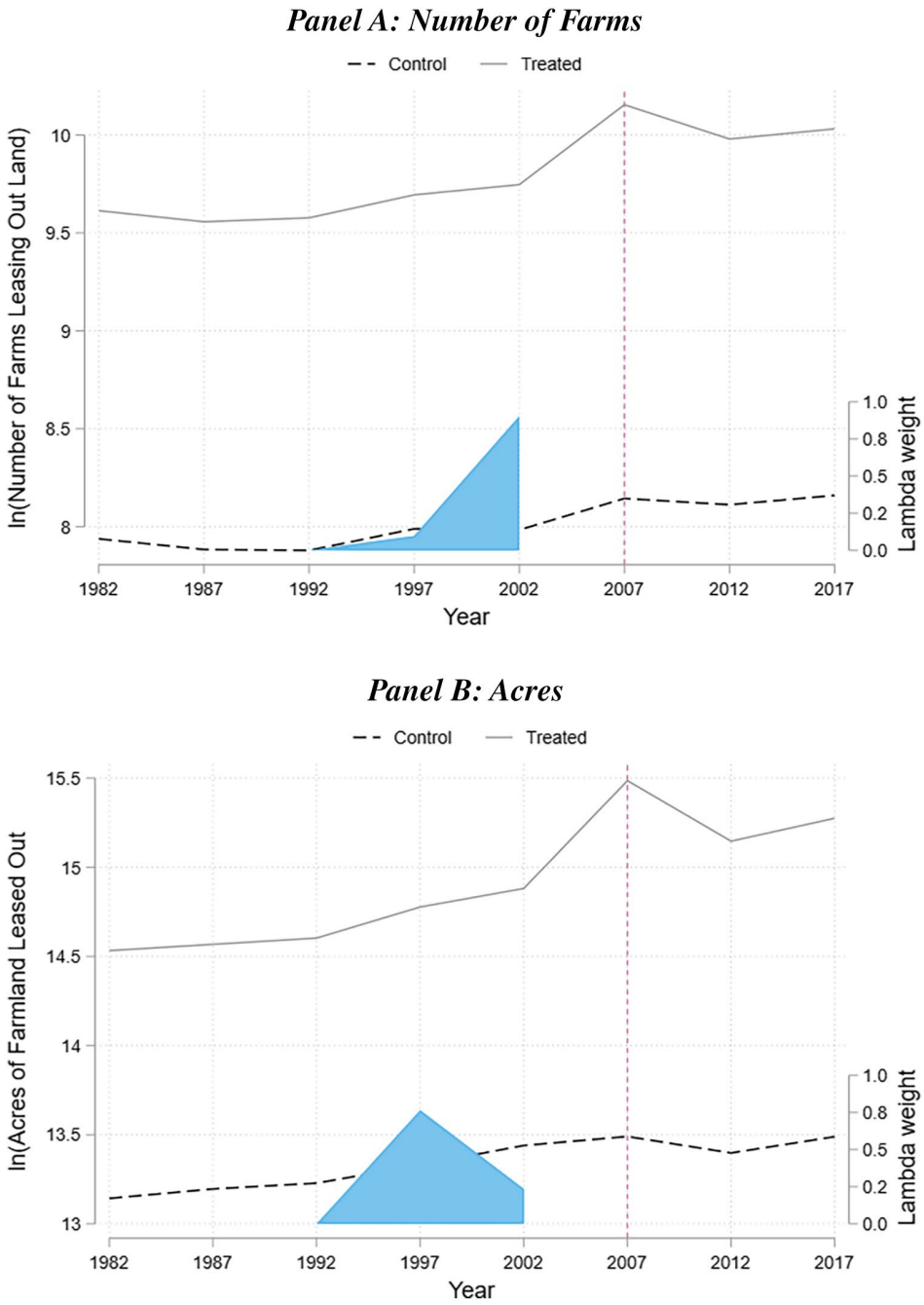


**FIGURE A1** | Actual versus synthetic projections for Table 3 (ln(Lessor)). Panel A: Number of Farms. Panel B: Acres. "Treated" is actual Iowa data, "Control" is synthetic Iowa.

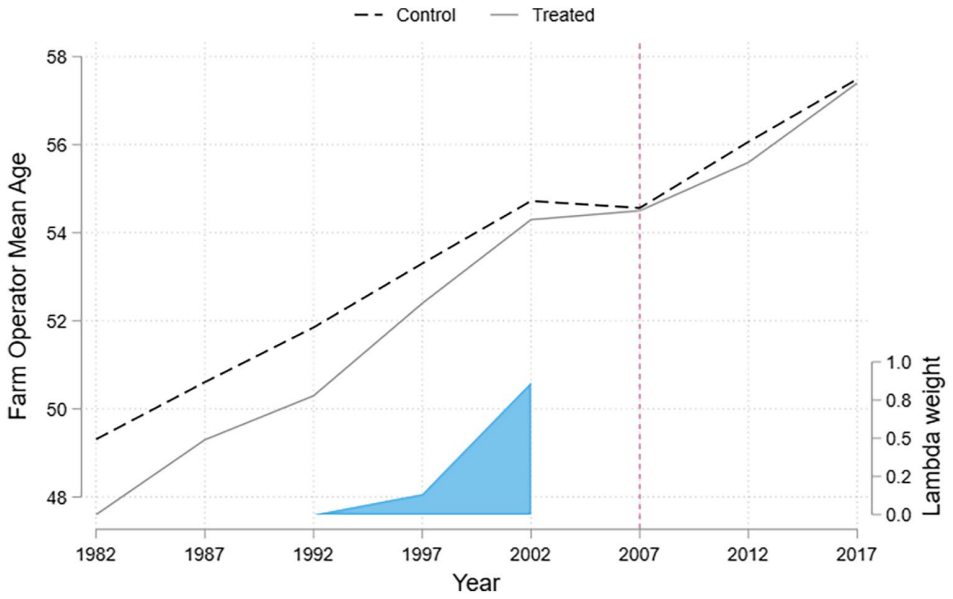


**FIGURE A2** | Actual versus synthetic projections for Table 4 (Farm Operator Median Age). "Treated" is actual Iowa data, "Control" is synthetic Iowa.

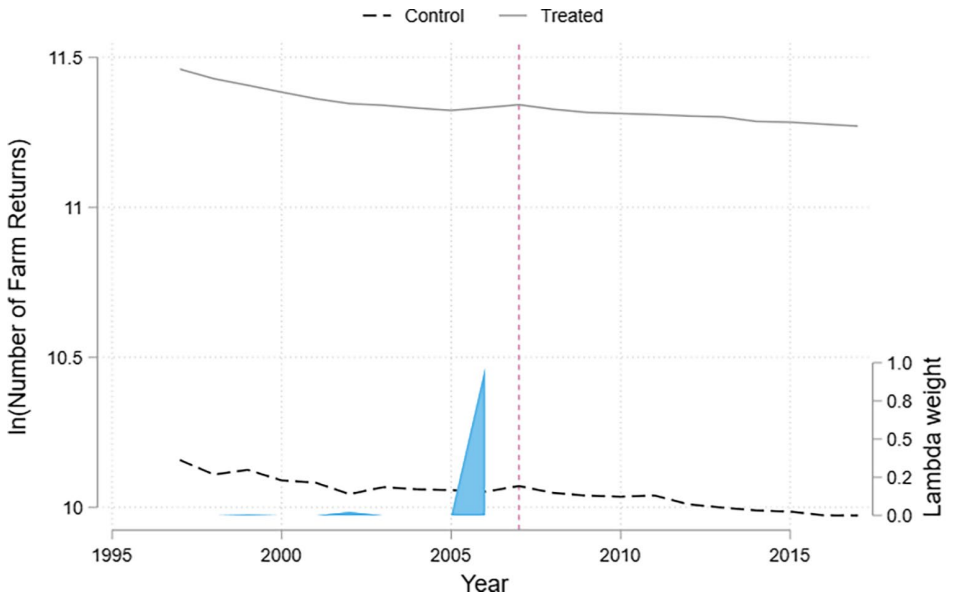


**FIGURE A3** | Actual versus synthetic projections for Table 4 (ln(Schedule F Filers)). "Treated" is actual Iowa data, "Control" is synthetic Iowa.

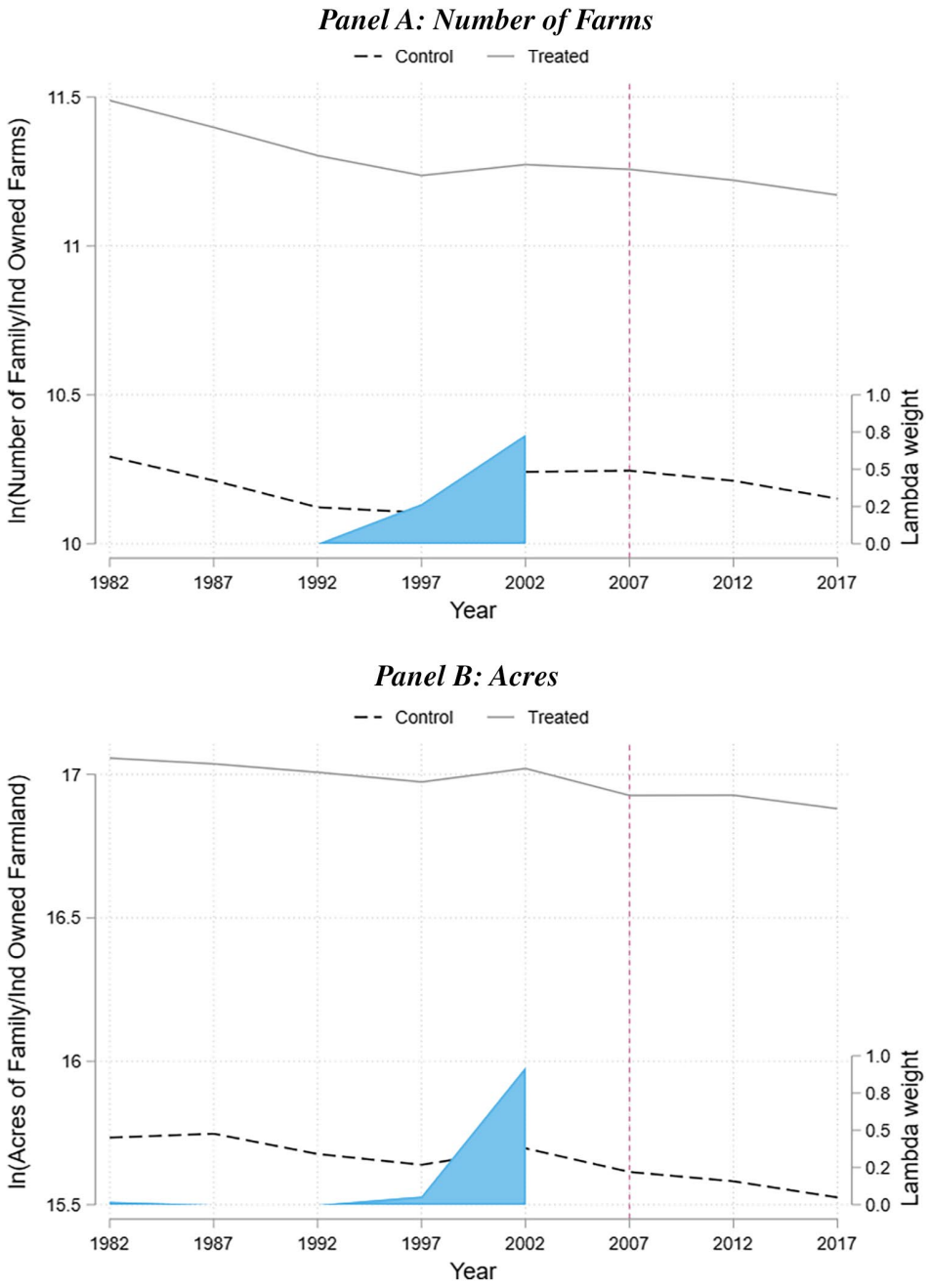


**FIGURE A4** | Actual versus Synthetic Projections for Table 4 (ln(Family Farms)). Panel A: Number of Farms. Panel B: Acres. "Treated" is actual Iowa data, "Control" is synthetic Iowa.

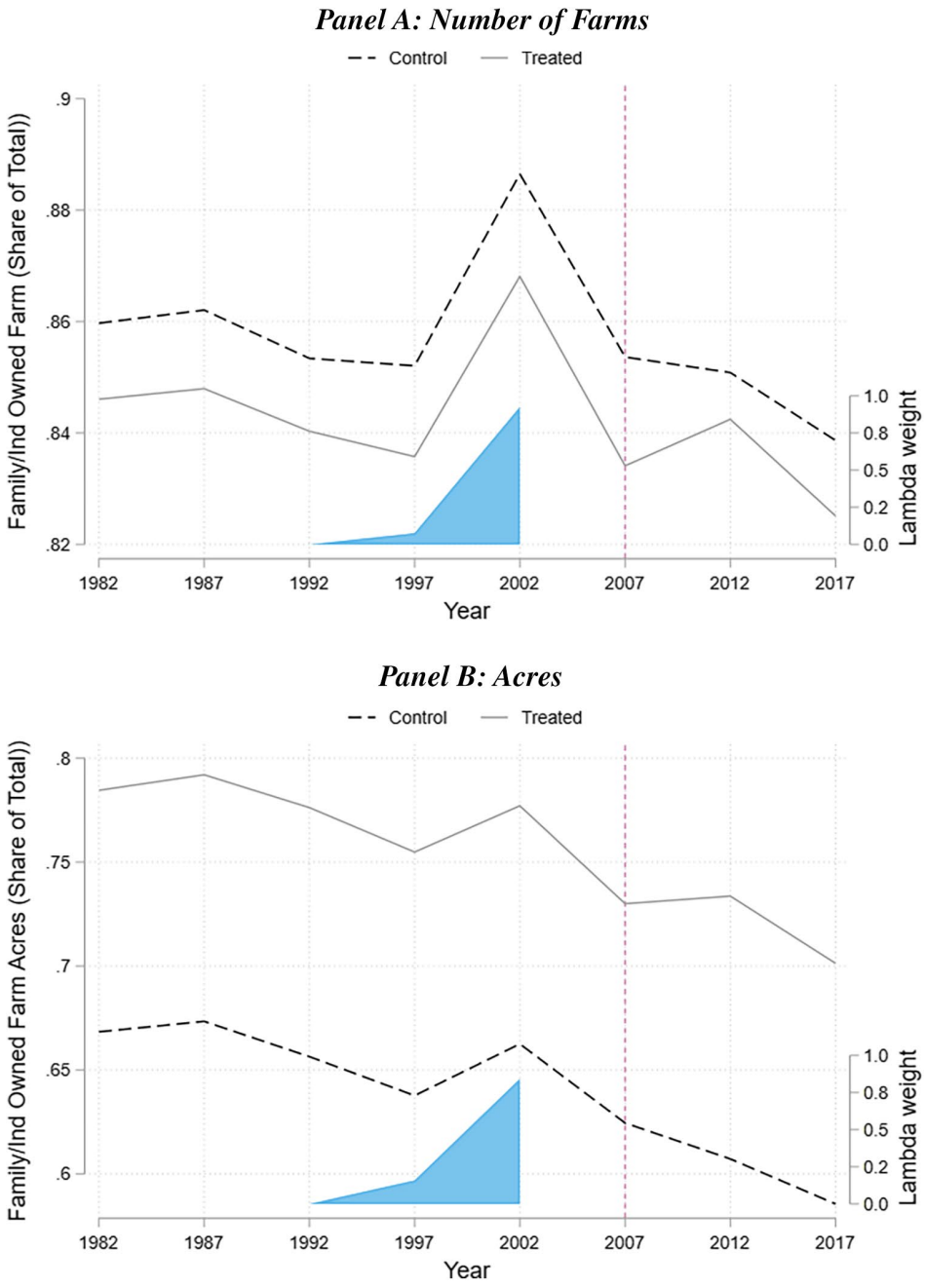


**FIGURE A5** | Actual versus Synthetic Projections for Table 5 (Family Farm Share of Total). Number of Farms. Acres. "Treated" is actual Iowa data, "Control" is synthetic Iowa.