Property Taxes for Agriculture

Use-Value Assessment and Urbanization across the United States

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Abstract

We analyze the spread of use-value assessment (UVA) programs applied to agricultural and rural land for property tax purposes across the 50 states. Taxing such land on the basis of its current use in agriculture rather than its full market value can confer significant property tax reductions on owners of the land. Effects are often substantial for land near large urban areas. Using a time-to-event model, we find, as others have posited, that a driving force behind the spread of UVA has been the secular trend toward urbanization across all 50 states. We also find that models of collective action do a good job of explaining the spread of UVA. Urbanization and divergence of the values of agricultural and nonagricultural land are critical to the spread of UVA. However, other important factors include changes in average farm size and changes in agriculture's share of state income. We find that in states where average farm sizes increased more rapidly, legislatures were quicker to adopt UVA. That finding is consistent with an increased concentration of agricultural interests. We also find that states where agriculture's share of state income declined more rapidly also were quicker to adopt UVA. That finding, too, is consistent with models of collective action. As groups become smaller, the burden of subsidizing them also falls. Note that although the findings are consistent with models of interest group behavior, they are at odds with traditional voting models.

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1. Introduction and Background

From 1960 to 1995, all 50 US states adopted some form of use-value assessment (UVA) for agricultural land. UVA programs treat agricultural land preferentially for property tax purposes, basing valuations only on prospective returns from agricultural activity, even when development opportunities are lucrative or are expected to be so in the future. Although UVA programs receive little attention, the programs are vast, encompassing more than 100 million acres of land in California alone and more than 61 percent of all land in Ohio (Anderson and England 2014).[1] Furthermore, the benefits that the programs confer can be substantial. Anderson and England note that for a number of counties in Ohio, UVA results in assessed values that are more than 80 percent below market values. In a stark example, agricultural land in Bedford, Massachusetts, is assessed at an average of $155 an acre, whereas some nonagricultural land in Bedford is assessed at more than $10,000 per acre.[2]

Although the degree of the distortion is not known, such incentives certainly distort the use of land toward less efficient uses. Even when the use of the land is not distorted, UVA encourages rent-seeking: property owners lobby to maintain and expand benefits and undertake socially wasteful measures to qualify land for UVA, when the land is only nominally used for agriculture. At the federal level, agricultural interests have a strong track record in obtaining

[1] The numbers in this paragraph are from Anderson and England (2014).
[2] The agricultural and nonagricultural land being compared would not have identical market values absent UVA; however, Anderson and England show that UVA has a tremendous impact in Bedford, a city 15 miles outside Boston.

subsidies for their industry; thus, their success at the state level should not be surprising. However, when compared with experiences at the federal level, the experiences of 50 different states provide a better natural experiment for assessing the importance of factors that have contributed to the success of agricultural interests.

In this paper, we model the spread of UVA statutes across the 50 states to understand what factors were most important in determining the rate of UVA adoption. We estimate time-to-event models for UVA policy adoption, relating our findings to the literature on policy diffusion. Although we find evidence supporting some of the traditional mechanisms for policy diffusion (see Shipan and Volden 2008), we also find a pattern consistent with models of interest group behavior built on Mancur Olson's (1965) *Logic of Collective Action*. The central theme in that interest group literature is the idea of concentrated benefits and diffused costs. Other things being equal, interests that are smaller and more concentrated (a) place a smaller burden on the rest of society for providing a given level of subsidy to each beneficiary, (b) enjoy lower costs of coordinating political activity, and (c) are less affected by the free-rider problem because the support of large individual players could be critical to the interest group's success. By contrast, for taxpayers who finance such transfers, costs are diffused. The costs to each taxpayer may be trivial, so the benefits to the taxpayer of becoming aware of such programs and working to prevent them outweigh the costs. This observation is doubly true because the transaction or coordination costs associated with organizing a large and disparate populace are likely immense.

We find, as others have posited, that a driving force behind the spread of UVA has been the secular trend toward urbanization across all 50 states. However, urbanization and divergence between the value of agricultural and nonagricultural land do not tell the full story. Other important factors include changes in average farm size and changes to agriculture's share of state income. We find that in states where average farm sizes increased more rapidly, legislatures were quicker to adopt UVA. That finding is consistent with an increased concentration of agricultural interests. We also find that states where agriculture's share of state income declined more rapidly were quicker to adopt UVA. This pattern too is consistent with models of collective action. As groups become smaller, the burden of subsidizing them also lessens. Note that although those findings are consistent with models of interest group behavior, they are at odds with traditional voting models.

A number of researchers have focused on UVA programs; however, little systematic analysis has examined the underlying factors that led those programs to spread to all 50 states. Early research on UVA and its effects includes Carman (1977), which examines the adoption of UVA in California; Conklin and Lesher (1977), which considers whether UVA can reduce development at the urban fringe; and Coughlin, Berry, and Plaut (1978), which analyzes UVA as a means of preserving open space. Ladd (1980) provides an early review of the efficiency and equity aspects of preferential tax treatment of agricultural and rural land, including UVA and other programs that tax such land uses at lower rates. England (2002) and England and Mohr (2003) examine UVA programs specifically analyzing their withdrawal penalties if landowners decide to develop their land. Morris (1998) and Liu and Lynch (2008) analyze whether preferential tax treatment delays land development. Kashian and Skidmore (2002) estimate the willingness to pay for land preservation with UVA or other approaches. Kashian (2004) provides a comparative study of the characteristics of state UVA programs. He concludes that in the absence of other complementary policies (such as income supplements) to preserve agricultural land, UVA is "simply a strategy to time the market" (p. 10). Youngman (2005) gives advice to policymakers on nonuniform property taxation. She argues that taxing farmland at a preferential rate is not sufficient to prevent its ultimate development. However, Youngman notes that UVA policies address a perceived unfairness that results from taxing land on the basis of its most profitable use, a criticism that is leveled at all market-based assessments.

The next section provides an overview of UVA programs, including the underlying theory of market value and current agricultural use value, the effect of reduced assessment ratios on the effective rate of property taxation, the potential effects of that preferential taxation, and the literature on UVA programs and their effects. Section 3 reviews the literature on policy diffusion with an eye toward testing whether diffusion theories from the political science literature help explain UVA policy diffusion. Section 4 presents our data and estimation techniques. Section 5 presents our results, and section 6 provides concluding remarks.

2. Use-Value Assessment Programs

UVA for property taxation is the practice of valuing property in accordance with its current use rather than at its market value. A property owner pays property tax to local units of government on the basis of the assessed value of the property and the tax rates that are applied by each local unit to that valuation. Market value that exceeds use value may reflect prospective development opportunities that may yield greater returns than if the land were restricted to its current use. Disparities between market and use value are common for agricultural land located near large and growing cities. The gold standard in valuation for tax purposes is market value—or property value taking into consideration the highest and best use of the property, independent of current use (Wildasin 1982). By using such a value, the property tax system ensures the most efficient and equitable outcomes possible (Wildasin 1982, Tideman 1982). Despite the negative efficiency implications, policymakers may wish to reduce the tax liability for a certain class of property (whose current use value may be less than market value) by adopting a state statute that permits or directs local assessors to value that class of property using UVA techniques rather than assessing at market value. Their motivation may be founded in political pressure brought to bear by a powerful voting group—farmers—whose self-interest drives them to pursue favorable tax treatment.

In the United States, the practice began in 1960, and the policy of applying UVA to agricultural and rural land spread rapidly through the 1990s to the point at which all 50 states adopted some form of UVA. Although UVA applies primarily to agricultural land use, it also may apply to rural land of various types (e.g., open space, timberland, and wetlands), depending on state law. Anderson and England (2014) review the historical context of UVA programs and identify two primary reasons stated for early adoptions.[3] First, policymakers expressed concern over the demise of the small family farm as economic pressures forced farm sizes to increase. Second, policymakers expressed concern that rapid urbanization was forcing farmland surrounding cities to be developed for other uses. From 1950 to 1990, urban land in the United States increased at 2.7 times the rate of urban population growth (O'Sullivan 2011, 181). In an effort to save the family farm and slow farmland conversion at the urban fringe, policymakers turned to UVA. Whether UVA was effective at combating either trend is debatable. Nevertheless, the adoption of UVA statutes rapidly spread from state to state following the lead of Maryland in 1960. Table 1 (page 37) lists UVA adoptions by state and year of adoption. Maryland was the first adopter, and Hawaii quickly followed. During the 1960s, the first decade of adoptions, 14 states enacted UVA statutes. In the 1970s, the use of UVA exploded with adoptions by 26 additional states. In the 1980s, another nine states adopted UVA laws. By 1995, all 50 states had adopted some form of UVA policy.

[3] Anderson and England note that before codified law, informal practices by assessors often afforded preferential assessments for agricultural land. UVA legislation emerged partly in response to restrictions on those informal practices.

This section proceeds with a theoretical background on how use value is determined and how it relates to market value. Next is a brief description of how UVA works in practice, including variations in program details across states. A discussion of tax expenditures and effective tax rates resulting from UVA then illustrates both the potential economic distortions from such programs and the benefits accruing to owners of agricultural land.

Market Value and Use Value

Fundamental to the examination of UVA programs is an understanding of the difference between the market value and the use value of land. Very generally, use value ignores amenities and represents the shadow price of farmland, which would equal the market price if the land's most efficient use would, in perpetuity, remain in agriculture. To understand why market and use values may differ, consider the model presented by Capozza and Helsley (1989). They identify four fundamental drivers of land value: (1) agricultural land value (assuming no prospective alternative uses), (2) the cost of land conversion to developed use, (3) the value of accessibility, and (4) the present value of the difference between expected future rents and expected future rents from agriculture.

Capturing these four components, Capozza and Helsley (1989) write the price of developed land at time t and location z in an urban area, $P^d(t,z)$, as

$$P^d(t,z) = \frac{A}{i} + C + \left(\frac{1}{i}\right)\left(\frac{x}{\bar{L}}\right)[\bar{z}(t) - z] + \left(\frac{1}{i}\right)\int_t^{\infty} R_u(u,z)e^{-i(u-t)}du. \quad (1)$$

The first term in equation 1, $\frac{A}{i}$, is the capitalized value of the annual agricultural net rental stream, which is assumed to continue in perpetuity. That component captures the pure agricultural value of the land that is based solely on the capitalized net income stream A that can be generated with agricultural production, where the capitalization rate is i. The second term, C, represents capital improvements or the cost of conversion of raw land to developed land use. The term can be considered the capital investment made in converting raw land to developed land. Capozza and Helsley assume that those first two components of land value are invariant to location z; hence, they are drawn as horizontal lines in figure 1 (page 38). The third component of property value reflects accessibility to the city center, given by the next term, $\left(\frac{1}{i}\right)\left(\frac{x}{\bar{L}}\right)[\bar{z}(t) - z]$. That term depends on transportation cost x and the mean lot size $\bar{L}$. Increases in transportation cost or reductions in lot sizes result in an increase in this term. Both of those parameters are exogenous in this model. Together, they determine the slope of the land bid-rent curve, which is the rate at which land prices change with distance to the city center, where distance from the city center is represented by $[z - \bar{z}(t)]$.[4] The symbol $\bar{z}(t)$ represents the radius of the monocentric city; thus, $[\bar{z}(t) - z]$ equals zero at the edge of the developed city. The final term in equation 1, $(\frac{1}{i})\int_t^\infty R_u(u,z)e^{-i(u-t)}du$, captures the value of expected future rent increases caused by population growth in the urban area. That component of value can be viewed as an expected growth premium. Land rents and land values may rise in the future because of growth in the urbanized area, reflected in a positive derivative $R_t(t,z)$. The final term in equation 1 can be substantial in size within the urbanized area, but it declines in size beyond the developed area of the city, as indicated in figure 1.

Figure 1 illustrates the value of land at any given distance z from the center of the city as the sum of the four components of value, shown as the bold upper contour line. As distance z increases, the value of accessibility declines. Land users who value proximity to the central business district (CBD) are willing to pay a high price for land, but farther from the CBD, the

[4] For example, all else being equal, willingness to pay for land does not increase in response to higher transportation costs, but higher transportation costs increase the premium for land close to the city center.

value of accessibility diminishes. Urban land within the ring circumscribed with radius $\bar{z}$ also has been developed with improvements such as water and sewer lines, streetlights, and other features that distinguish it from undeveloped land.

The fourth component of land value is the present value of expected future returns to land (e.g., increases to land rent in future years) arising from alternative uses, because expected rents for use in agriculture (the perpetuity in the first term) are already incorporated in the first component (i.e., agricultural land value). That portion of value exists because landowners expect future urban growth to increase the value of their land within the urbanized zone of the city. The stronger the expectation of future growth, the larger that component of value is. The first component of urban land value is the pure agricultural land value. Even undeveloped urban land has value based on its capacity to produce agricultural crops or pasture for animals. Beyond the edge of the developed city, $\bar{z}$, both the value of accessibility and the cost of conversion are zero, and the value of future expected land rent declines spatially with additional distance. Farther from the city edge, the market value of land declines and approaches its pure agricultural use value. At sufficient distances from the edge of the city, virtually no difference between market value and agricultural use value remains. Hence, taxing land on the basis of UVA rather than market value in such locations should have virtually no effect on tax liability.

Near the urban fringe, however, market value may be well above use value. Capozza and Helsley (1989, 295) state, "In rapidly growing cities, the growth premium may easily account for half of the average price of land and may create a large gap between the price of land at the boundary (minus conversion cost) and the value of agricultural land rent." That spatial pattern of property values has been confirmed with empirical data for properties around both Omaha and Lincoln, Nebraska, in Anderson and Griffing (2000a, 2000b).

UVA in Practice

Just two components of land value are relevant for undeveloped agricultural land: its agricultural use value and prospective increases in rental income from development. Thus, agricultural land value is the combination of the pure agricultural value of land and the rent increases that may be expected in the future, depending on spatial location. However, UVA statutes ignore expected future rent increases that are due to growth and designate the agricultural land value as only the capitalized net agricultural rent. Hence, in the simplest exposition of UVA, we can use the familiar perpetuity formula where the agricultural land price at time t is the annual net income from current agricultural use A divided by the discount rate of interest i:

$$P^a(t) = \frac{A}{i}. \tag{2}$$

In the presence of a property tax system, the familiar perpetuity formula must also include the effective property tax rate τ^e to account for the capitalization of the tax into the land price:

$$P^a(t) = \frac{A}{(i+\tau^e)}. \tag{3}$$

As a perpetuity formula, that estimate of use value assumes a constant annual net rent earned on the land and constant discount rate and effective property tax rate. In reality, all three of those properties may change over time. Recognizing that situation, many states mandate that UVA be applied by using moving averages of at least some of those properties. In that case, the present value of land at time t is based on a moving average of its previous agricultural land rents earned over a period of time—say five years—discounted accordingly. Implicitly, that average net rent is assumed to continue in perpetuity for the purpose of computed use value today. But next year, the average net rent is updated on the basis of previous realizations of net rent, and the average is again assumed to pertain in perpetuity.

States apply UVA statutes in varying ways as they provide specifics regarding assessment procedures. In general, UVA statutes direct assessors to use an income capitalization approach in estimating use value. That process is consistent with the early UVA recommendations of Gloudemans (1974) and the guidelines of the International Association of Assessing Officers. Anderson (2012) provides an overview of how states currently implement UVA methods, estimating both the numerator and the denominator of equation 2, with case studies drawn from several prominent states.

Details on UVA programs vary widely from state to state. First, UVA programs vary in defining *agricultural land*. Some states apply narrow definitions that require active production agricultural use with minimum acreage or income requirements. Other states have no particular statutory definition of agricultural land and thereby apply UVA very broadly to undeveloped land, perhaps including fallow land, wetlands, forests, and so on. Second, UVA programs may be applied in a widespread manner, applying to all agricultural land in the entire state, for example, or they may be more targeted and apply only to agricultural land surrounding major cities in a state. Third, UVA programs may not require any particular commitment on the part of landowners, or they may require specific enrollment for a fixed period of time and a withdrawal penalty for premature sale for development. For specific state UVA program descriptions, see Aiken (1989), Malme (1993), and Rodgers and Williams (1983), which provide the earliest comprehensive reviews of UVA programs on a state-by-state basis. For the latest state-by-state catalog of UVA programs, see Anderson and England (2014).

Whether UVA can theoretically alter the timing of land development depends on how the land is taxed. Anderson (1986) and Skouras (1978) have developed theoretical models of land development timing and show that property taxes can have a timing effect. Tideman (1982) objects to that view and argues that a tax on land is neutral in its effect. The key difference underlying the apparent contradictory results of those models is that Tideman (1982) models a land tax that is unrelated to the current use of the land, whereas Anderson (1986) and Skouras (1978) model the property tax as related to market value, which is presumed to reflect current use. Anderson (1993) specifically models the tax based on UVA and demonstrates the potential timing effects of a switch from market valuation to UVA.

Implications of UVA for Tax Expenditures and Effective Tax Rates

Use-value assessment reduces tax liability and thereby creates a tax expenditure—an expenditure made by the local government in the form of forgone tax revenue that in many respects is equivalent to a direct outlay. In adopting UVA, state and local governments are spending money in an attempt to preserve open space or agricultural land, to give general assistance to owners of farmland, or to accomplish whatever the stated objective of the UVA program may be. In practice, UVA may be an example of the "Bootleggers and Baptists" principle (Yandle 1983), which argues that regulations are often the result of alliances between groups with very different motivations. In this case, environmental groups may make the moral case for UVA, whereas the agriculture lobby works behind the scenes to influence the political process to gain a tax preference.[5] The outcome is a state policy on property assessment that has direct effect on local government revenue. Local property owners wishing to have lower property taxes effectively circumvent the usual property tax laws by successfully convincing the state to adopt an alternative tax regime on their behalf. Local government agencies reliant on property tax revenues—public schools in particular—feel the impact in the form of lower revenues.

[5] In Yandle's classic example, Baptists provide the moral case for prohibiting the sale of "demon rum" on the Sabbath, whereas bootleggers lobby for the same goal because it eliminates much of their competition, at least for one day a week.

The size of the UVA tax expenditure can be substantial in urbanized areas where the difference between market value and use value is large. For example, Anderson and Griffing (2000a, 2000b) estimate spatial patterns of market value and use value around both Omaha and Lincoln, Nebraska, and find that the tax expenditure involved with UVA is quite substantial. Their estimates indicate that the tax expenditure is approximately 36 percent of total revenue in Lancaster County, Nebraska, home of the City of Lincoln, and 75 percent of total revenue in Sarpy County, Nebraska, on the west side of the City of Omaha.

Whether that type of substantially reduced tax is sufficient to prevent farmland from being developed or to alter the timing of development (slowing development) is questionable. The tax reduction resulting from UVA is capitalized into land values, undoubtedly, although the extent of that capitalization has not been studied. Whether the tax reduction is sufficient to retain rural land in undeveloped use is an important question. If the UVA tax savings are swamped by the potential gain from selling the land to a developer, then ultimately the policy will have no appreciable effect on eventual development. However, there are examples of landowners who blatantly work to have their land classified as agriculture solely for tax purposes but whose land is, for all intents and purposes, used for nonagricultural activities.[6]

Assessment practices can result in differences between statutory (or nominal) and effective property tax rates. The property tax liability T for a given property is given by the relationship

$$T = \tau \text{AV}, \tag{4}$$

[6] For example, Tax Analysts (2013) reports on an Indiana Tax Court case related to the Allisonville Development Company's challenge to Hamilton County's reassessment of its land based on the land use change from agriculture to undeveloped, usable commercial land. After the landowner succeeded in the assessment challenge, the county reassessed the land as agricultural rather than commercial, and the assessment was reduced from $2,237,300 to $15,684.

where τ is the nominal tax rate and AV is the assessed value of the property. Assessed value is related to market value (MV) by the assessment ratio r:

$$\text{AV} = r\text{MV}. \tag{5}$$

The effective tax rate denoted τ^e is given by the ratio of the tax liability to the market value of the property:

$$\tau^e = \frac{T}{\text{MV}} = \frac{\tau AV}{\text{MV}} = \frac{\tau r\text{MV}}{\text{MV}} = r\tau. \tag{6}$$

Hence, the effective tax rate is the product of the assessment ratio and the nominal tax rate. For a given nominal tax rate, the lower the assessment ratio is, the lower the effective tax rate will be. UVA programs are designed to reduce the assessment ratio, thereby reducing the effective property tax rate.

3. Policy Diffusion Mechanisms and the Logic of Collective Action

In a federalist system, many political decisions are left to the states or localities. However, across jurisdictions, those policy decisions are often not independent from one another. One explanation for those patterns is *policy diffusion*, which is defined by Shipan and Volden (2012, 788) as "one government's policy choices being influenced by the choices of other governments." Beginning with Walker (1969), researchers have sought to understand the factors, processes, and interrelationships involved in policy adoption across states (or localities).

Our focus is on the spread of UVA policies across the 50 states. We consider policy diffusion mechanisms that fit Shipan and Volden's definition but also observe the role of secular economic (rather than political) trends that traverse state boundaries. When examining those secular trends, we apply ideas from interest group models used to explain the logic of collective action. For example, what do the trends we observe suggest about the costs and benefits arising from collective action?

The broad secular trend we examine is urbanization (including underlying trends that we believe are driven by urbanization). Trends in urbanization do not fit within the policy diffusion mold because urbanization within a state is, for the most part, not an explicit policy choice and does not result from "the choices of other governments." Nevertheless, the wave of urbanization across states, when confronted by existing state political institutions, may lead states to independently enact similar policies. The situation is analogous to a drought that affects multiple jurisdictions and that results in the enactment of similar water conservation policies across the affected jurisdictions. The reaction would not necessarily be an example of policy diffusion, because the decisions of some governments may not have increased the likelihood that others would act in a similar fashion. Often the effect of secular trends is a complementary explanation for the spread of policies across states rather than a competing one.

As in the drought example, factors associated with urbanization may influence policy changes independently of the actions of other states. However, it is also possible that the formation or expansion of special-interest groups in one state could have spillover effects for other states. To the extent that urbanization results in such spillover effects, it is no longer solely independent of activities in other states and thus could also feed into a mechanism for policy diffusion.

Policy Diffusion Mechanisms

Shipan and Volden (2008) discuss four key mechanisms that drive policy diffusion: learning, economic competition, imitation, and coercion.[7] Learning and economic competition are both

[7] Shipan and Volden (2012, 791) define *coercion* as "the use of force, threats, or incentives by one government to affect the policy decisions of another." It is not germane to UVA adoption, so it is not discussed further here.

consistent with Tiebout (1956) models of local government formation and voters "voting with their feet." States can be viewed as laboratories; policies that are less successful may be abandoned or avoided in favor of those in other states that are more effective. Moreover, at its best, the act of individuals and businesses voting with their feet pressures states (and localities) to adopt more desirable policies.

Imitation may be difficult to distinguish from learning. Shipan and Volden (2012) state that learning focuses on the "action" and its consequence, whereas imitation focuses on the "actors" and is independent of consequences. Imitation may be an example of herding behavior, a popular concept in modern behavioral economics that dates at least to Veblen's *Theory of the Leisure Class* (1899). Recent state bans on capital punishment and acceptance of same-sex marriage have likely emanated in part from imitation, for example. A number of other underlying factors are surely at play, but the fact that other states have taken the lead may make the policy seem less risky or radical, even if too little time has passed to "learn"—that is, to assess the effect of the policies in other states.[8]

The Role of Interest Groups and Collective Action

The fountainhead that spawned extensive literature focusing on interest groups was Mancur Olson's (1965) *Logic of Collective Action*. Olson argues that the impediment to influencing government policy is the collective action problem. In most cases, parties have an incentive to free-ride because they can reap the rewards from policies whether or not they expend resources to achieve the outcome. Interests that are more successful in achieving policy outcomes are those that figure out ways to overcome the collective action problem.

[8] In some cases, policy changes are made through state courts, in which case imitation may reflect the decisions of a handful of unelected judges. For example, that situation may have been the case with same-sex marriage in a centrist state such as Iowa, prior to the eventual Supreme Court decision on that issue.

Two key determinants of success for interest groups, again posited by Olson, are situations in which the benefits of a policy are concentrated and in which the costs are dispersed. Interests that are more concentrated have lower costs of coordination, and each party has a larger stake in the outcome, thereby reducing the incentive to try to get a free ride. When the costs of those who stand to lose are dispersed, costs of organizing will be great, whereas the per capita loss to each individual is small. A classic example is US tariffs or import quotas on sugar. As a result of such policies, consumers in the United States often pay two times the world price for sugar. Perry (2013) estimates that for 2012 the policies resulted in a transfer of $3 billion to a small number of large US sugar beet farmers while they cost more than 300 million to consumers—most of whom are surely unaware of the policy—just by adding $0.17 per pound of sugar. Subsidies for sugar also receive support from other agricultural interests, such as corn growers, who benefit from the increased demand for corn syrup as producers substitute away from sugar because of its artificially inflated price.

Much evidence suggests that agriculture fits Olson's theory of collective action quite well. Several studies show that in poorer countries, where agriculture represents a large share of the economy, agriculture is treated less favorably than are other industries. By contrast, in developed countries, agriculture is heavily subsidized. Van Bastelaer (1998, 43) finds that across 31 countries, "the level of political pressure wielded by interest groups in food markets, and hence the level of protection they receive, is an inverse function of the relative size of their constituencies."

Many other mechanisms are used to overcome the collective action problem. In general, it is argued that with time and stable institutions, parties often develop sophisticated techniques for overcoming the collective action problem. That argument could help explain the political strength of groups as large and seemingly diffuse as homeowners and senior citizens.

Mixon, Caudill, Ford, and Peng (1997) provide some evidence suggesting that organized interest groups may play an important role in policy diffusion. Lobbying groups, having undertaken substantial fixed costs to organize in one state, may be primed to use their influence at a lower incremental cost in other states. Examples abound and include labor unions as well as the agriculture and manufacturing lobbies, to name just a few.

The Spread of Inefficient Policies

Tiebout competition and the learning mechanism suggest greater diffusion of policies that produce better economic outcomes or at least that are more desirable to a state's citizens. However, that outcome is not always the case with learning or with the other mechanisms. By definition, the gains to society from efficiency-enhancing policies will be greater than the losses. Thus, interests benefiting from efficient policies should have more resources available to push for such policies. That conclusion is related to the common-law hypothesis developed by Richard Posner (e.g., see Posner 1980) and others, which argues that the common law is biased toward efficient policies even if judges themselves have no such inclination. Research on interest groups and on the logic of collective action, however, suggests that other factors often tip the balance in favor of policies that may be economically harmful.

Even in cases of learning and economic competition, economic competition can lead to a "race to the bottom" with respect to welfare policy. Inferior policy decisions result if US citizens favor welfare or income distribution but feel that they can get a free ride by providing only minimal support in their own state in the expectation that individuals who would be eligible for such benefits will locate to other states where benefits are more generous. For this reason, research into fiscal federalism generally finds that redistributive policies are better left to the federal government (Giertz and Tosun 2012).

Furthermore, voters and politicians may be systematically biased in evaluating lessons from other states. The learning may take place among lobbying groups or the concentrated interest benefiting from a policy rather than among the general populace. For example, cities compete for professional sports teams by spending hundreds of millions of dollars on sports stadiums. Casual empiricism suggests that such tax dollars are often well spent, but economic research suggests that, in most cases, the costs of government-financed stadiums far exceed the benefits. For example, Coates and Humphreys (2008, 311) note that "economists reach the nearly unanimous conclusion that 'tangible' economic benefits generated by professional sports facilities and franchises are very small; clearly far smaller than stadium advocates suggest and smaller than the size of the subsidies." Economists reach different conclusions from the general public because the benefits from stadiums are concentrated and easy to see, whereas the costs are disbursed and not easily seen.[9]

Examples from the Policy Diffusion Literature

A major focus in the policy diffusion literature is the spread of state lotteries (and casino gambling) across states (e.g., see Berry and Berry 1990; Alm, McKee, and Skidmore 1993; Erekson et al. 1999; Mixon et al. 1997). Other prominent work has focused on the spread of antismoking laws (e.g., see Shipan and Volden 2008; Givel and Glantz 2001). Lobbying seems to play an important role in the proliferation of antitobacco legislation both from the tobacco and health lobbies. More recently, Geddes and Wagner (2013) examine the proliferation of laws allowing for public-private partnerships.

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[9] The hidden costs are apparent if we consider that the federal government also plays an important role here. Because stadiums are often financed with tax-exempt bonds, a significant share of the construction costs are shifted to taxpayers in other parts of the country through the federal tax expenditure involved.

A few papers have examined the diffusion of tax policies, as we do in this paper. For example, Berry and Berry (1992) examine factors that lead states to adopt new tax programs, focusing particularly on state income and gas taxes during the 20th century. Those factors include state economic development (Wagner's Law, reflecting the pattern that as output and income per capita rises, the demand for public services also rises); fiscal conditions; political party dominance; and regional diffusion. Berry and Berry conclude that the likelihood that states will enact a new tax falls the closer the state gets to its next election year. Fiscal stress is a good predictor of new or increased taxes. Berry and Berry also conclude that regional diffusion plays a role if the policy choices of neighboring states positively influence own-state policy. Omer and Shelley (2004) also examine tax policy diffusion, focusing on tax competition and apportionment formulas for state business income. Researchers have produced a large body of literature on tax competition; although much of that literature is not focused directly on policy diffusion, it is closely related.

4. Data and Estimation Techniques

In analyzing the adoption of UVA across states, we collected data on state UVA adoptions and other economic, demographic, and political variables to test the urbanization and collective action hypotheses. Using those data, we employ two modeling techniques to explain state UVA program adoptions.

Data

Data used in this analysis are from several sources. Data on the year in which states enacted UVA are from state revenue departments, annual reports, legislative documents, and personal contacts with various state employees.[10] The year of each state adoption is listed in table 1. As discussed earlier, the first state to adopt UVA was Maryland in 1960; Wisconsin was the last state to adopt it in 1995. After Maryland's adoption, a number of other states followed suit in rapid order so that by the end of the decade 14 states had enacted UVA legislation. Adoption rates were by far the highest in the early to mid-1970s. By the end of the 1970s, an additional 26 states had adopted UVA, bringing the total to 40 states. Six more states adopted UVA between 1980 and 1982. The final four states adopted UVA between 1984 and 1995.

Figure 2 (page 39) shows Kaplan-Meier survival rates for UVA policy adoption for the 50 states overall and by four census regions. Kaplan-Meier is a nonparametric approach that shows the relationship between time and the share of states that have yet to adopt the policy. Survival (or duration) analysis examines the time to an event. In our case, the event is the adoption of the UVA policy for property taxation of agricultural land. For a given period, states that have not enacted the policy are deemed to have "survived," whereas those that have enacted the policy are categorized as having "failed."[11] Kaplan-Meier estimates are presented to show the overall pattern of policy diffusion. In later sections, models are developed to estimate the relationship between various factors and survival rates. A common issue in the policy diffusion literature and with survival analysis more generally is censoring. That is, some observations may have failed before the beginning of the sample, or some observations may survive through the end of the sample. Our data is not censored, however. Because our dataset is not censored, we

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[10] We conducted a comprehensive study to collect UVA adoption dates and relied primarily on printed state documents for reported years of adoption. In some cases, we used personal contacts with state officials to verify adoption dates.

[11] This language is not connotative but rather is borrowed from the biostatistics and epidemiological literature, where *survival* may have meant continuing to live and *failure* may have meant death or recurrence of disease.

are able to use statistical techniques that likely would not be sound were censoring prevalent. That circumstance is discussed in a subsequent section.

Note, however, that the simple adoption–nonadoption dichotomy hides a number of variations in UVA programs across the states. The extent of geographic coverage in UVA application, methods of estimation of use value, withdrawal penalties or lack thereof, additional forms of property tax preferences such as assessment caps, and a host of other factors vary in state UVA programs.

Figure 2 shows that, initially, the West adopted UVA at a faster rate than did the other three census regions. By 1970, for example, less than 30 percent of states had adopted UVA compared with nearly 54 percent of western states. By 1970, the share of northeastern states that had adopted UVA mirrored that of the nation as a whole. However, the rate of diffusion in the Northeast rapidly increased in the early 1970s, and by 1980, the Northeast became the first region to have 100 percent adoption of UVA. By that time, Wyoming was the one holdout in the West, waiting until 1989 to adopt UVA.

In addition to data on UVA adoption, we have collected data from the US Census Bureau that includes, for each state, the level of urbanization, metropolitan statistical area populations, and census divisions.[12] Those data are summarized in table 2 (page 40). In some cases, in which variables are available only for select years (such as the decennial census), we interpolate by assuming a linear trend over the intervening years. Data on agriculture's share of state income, land values for agriculture, average farm size, and property taxes on agricultural land are from the US Department of Agriculture. Our political variables are from William Berry's website[13]

[12] The yearly metropolitan statistical area population is from the Real Estate Center, Texas A&M University, http://recenter.tamu.edu/data/pop/.
[13] https://dataverse.harvard.edu/dataverse/wberry.

and are described by Berry, Fording, Ringquist, Hanson, and Klarner (2010). In terms of political measures, we rely mainly on data about the balance between Democrats and Republicans in the legislature.[14]

The Empirical Model

To analyze UVA adoption, we use the following empirical specification:

$$y_{it} = \alpha + X_{it}\beta_1 + \beta_2 Z_{it} + \varepsilon_{it}. \quad (7)$$

We use two models that use the same data but differ in that they the dependent variable is structured differently. In the first case, we use ordinary least squares (OLS) estimation, where y is the log of time to UVA adoption (in years). In the other model, we employ logit estimation, where y is a dichotomous variable that equals 1 in the year a state adopts UVA and 0 otherwise. In the case of the logit, we are estimating the likelihood of adoption, which is a latent variable expressed as a log-odds ratio: $\ln\left(\frac{\Pr(adoption)}{1-\Pr(adoption)}\right)$. In all instances, observations are not included for states in the years after UVA adoption. In equation 7, α is the intercept term; β_1 is a vector of coefficients for the explanatory variables represented by the vector X_{it} (i.e., economic and political variables associated with various diffusion mechanism variables); and β_2 is a vector of coefficients for other controls represented by the vector Z_{it}. Also, ε_{it} is an error term for state i at time t.

Time until UVA adoption equals the number of years since 1959, the year before the first adoption of UVA by Maryland. That is, our dataset begins the year before the first state's adoption of UVA. One could extend the dataset back earlier, however, at the expense of lower data quality (and variable availability). We take the logarithm of time until UVA adoption and

[14] Specifications that include information on the composition of state legislatures exclude Nebraska. Nebraska has a unicameral legislature and is officially nonpartisan, meaning individuals run for office without an official party designation.

most of our explanatory variables to produce estimated elasticities (in the OLS estimations) because a constant rate of change is consistent with a linear path in log form. As emphasized by Meyer, Viscusi, and Durbin (1995), and applicable to our analysis, the absence of censored observations implies that OLS-based duration models have clear advantages over more complex models because OLS does not require restrictive assumptions regarding the distribution of the residual term.

The logit models represent a robustness check. Shipan and Volden (2008) also use logits in examining the adoption of antismoking policies. Econometric models have been specifically designed to handle issues such as censoring, which could bias the methods that we use. However, those approaches are generally more restrictive in their distributional assumptions. In our case, logit and OLS are both sound approaches because we are not faced with censoring.

5. Empirical Results

We present results from both logit and OLS-based duration models. The results from both models suggest that a combination of factors helps explain the diffusion of use-value assessment policies across the 50 states. Urbanization, a trend occurring at different rates across the 50 states, is a key factor. In most cases, urbanization is the driving force causing land values to deviate from value in agricultural use. That deviation provides the economic incentive for interest groups to pursue policies such as UVA.

Other factors, consistent with Olson's model of collective action, also appear to be prominent. In particular, agriculture's decreasing share of state economies (in terms of state income and employment) suggests diminished political power from median voter models but increased influence from models of collective action. For example, as agriculture becomes smaller (relative to the overall economy), the burden of transfers to that group declines. Thus, the collective action costs for a diffuse public to stop such policies are likely greater than the burden of going along with the implicit transfers. Another phenomenon, increasing average farm sizes, works in the other direction, thereby making the problem of overcoming obstacles to collective action more manageable for agriculture. An interesting aside is the question of what has caused the increase in farm sizes over time. Clearly, technology with greater economies of scale has played an important role. However, the increase might also be driven partly by political advantages resulting from the lower costs of collective action.

OLS Estimates: Time to Adoption

Table 3 (page 41) reports estimates from OLS-based duration models. Estimates from six specifications are reported, each employing alternative sets of explanatory variables. Because the dependent variable is the log of the number of years until state adoption of UVA, a positive estimated coefficient implies a delay in adoption, whereas a negative coefficient denotes earlier adoption. Each specification includes a set of census division dummies. Those variables control for unobserved time-invariant factors that are associated with the rate of UVA adoption and vary by region. In some cases, estimated coefficients on these dummies vary greatly, suggesting that some of the explanatory variables are correlated with those controls.

In column 1, we include only the log of the urban share of state population along with census division dummies. As expected, urbanization shows a strong and large negative correlation with adoption. A 1 percent increase in the level of urbanization is associated with a 2.1 percent reduction in the time until the adoption of UVA. That association suggests that, rather than diffusion, a secular trend toward urbanization is occurring across all states but at different rates. The trend toward urbanization is the key force that causes agriculture land values to diverge from their value in use. Without urbanization, UVA would, for the most part, be immaterial. Thus, urbanization may explain agriculture's desire for UVA, but it does not explain why agricultural property owners were successful in influencing the passage of UVA legislation in every state.

By definition, urbanization signifies increased population density and increased demand for land. However, the degree to which the increase in demand for land causes divergence between value in use and market value also depends on the supply elasticity of land for urban real estate uses. Thus, in markets with more inelastic supply of land for real estate, increasing urbanization should be less of a driving force behind UVA adoption. In column 2, we examine this assumption by adding to the model the log of agricultural land value per acre and the log of the effective tax rate on farm real estate. Here, the coefficient on land value per acre has a *t*-statistic of −5.8 and a coefficient estimate of −0.68. Meanwhile, the urbanization effect vanishes, falling to just about zero (and not statistically different from zero). Somewhat surprisingly, the estimated coefficient on the tax rate variable is positive (0.34) but not statistically different from zero.

Endogeneity may help explain the lack of statistical significance for the tax rate variable. As the date of UVA adoption approaches, expectations of such policies may become capitalized into real estate values. Thus, although a high tax rate on farmland provides impetus for UVA, capitalization from the imminence of UVA causes effective tax rates to fall before UVA is implemented. This phenomenon could explain the lack of statistical significance and the positive sign and would seem to be an issue with the land-value variable as well. However, with land values, the direct effect appears to dominate other effects.

A second factor that could affect interpretations of coefficient estimates on the tax rate variable is the tendency for effective property tax rates to rise as property values decline and to fall as property values rise. That tendency is caused by a combination of factors, including statutory changes and lags in reassessing property values, both of which act to lessen deficits and surpluses by keeping tax revenues in line with projected spending (Follain and Giertz 2014).

In column 3, we drop urbanization and add the log of average farm size to the model. The estimated coefficient on farm size is −0.43, implying that a 1 percent increase in farm size is associated with a 0.43 percent reduction in time until UVA adoption. Again, although rising land values suggest a motivation for UVA adoption, they do not explain the success of political efforts to enact UVA. Average farm size may be a proxy for the cost of collective action. As farm size increases, the costs of organizing become smaller. Moreover, an increase in farm sizes implies that the benefits from preferential tax treatment per landowner rise at a faster rate than do land values. Put another way, the direct return (to the landowner) from expending resources to influence UVA policy increases with farm size, whereas the spillover benefits to third parties fall. Thus, increasing farm size implies more concentrated benefits, a key component to overcoming the collective action problem (Mueller 2003; Olson 1965, 1982). With respect to the other explanatory variables, the addition of average farm size increases the estimated importance of land value per acre, and the sign on the average tax rate for farm real estate turns negative but is still statistically insignificant.

Next, we explore the addition of political variables constructed from data described by Berry, Fording, Ringquist, Hanson, and Klarner (2010). In general, variables on state ideology and the division of political power in the state have almost no effect on the model. An exception is the inclusion of the Republican share of the legislature. In column 4, a 1 percent increase in this variable is associated with a 1.5 percent reduction in the time-to-UVA adoption. Although that variable appears to be important, its inclusion has almost no effect on the estimated coefficient of the other explanatory variables. The exception is the geographic census division dummies, whose estimated coefficients sometimes change substantially. The change suggests that there is collinearity between party dominance and geographic region and that the measure of party dominance is reflecting within-census-division variation in party dominance.

The relevance of party affiliation is difficult to assess over this time period. Over the span of our data, the South transitioned from Democratic to Republican dominance. To a lesser extent, the Northeast and West shifted toward the Democrats. Across regions, great differences existed within the parties. For a period, Dixiecrats (or States' Rights Democrats) were an important political force among southern Democrats. That group differed greatly with Democrats in other parts of the country and has little in common with either major party today.

In column 5, we drop state legislature party affiliation and add the share of state income (in log form) attributed to agriculture. That change yields an estimated coefficient of 0.16 with a *t*-statistic of 7.4. As with farm size, the result also supports Olson's model of collective action. As agriculture becomes a smaller share of the economy, the cost to taxpayers from subsidizing the industry diminishes, making it more likely that the costs associated with preventing effective subsidies such as UVA will outweigh the benefits. Costs could include lobbying and organizational costs and even the cost of attention. Most owners of agricultural land likely are well aware of UVA, but inattention prevails among most voters, who are unaware of UVA.

In column 6, a variable measuring the share of adjacent states that have adopted UVA is added to the model (in levels, rather than logs). Policies from neighboring states are intended to capture the imitation mechanism. The estimated coefficient on this variable is −0.32. Thus, a state with four neighbors reduces its time to UVA adoption by 8 percent after one of its neighbors adopts UVA (one-quarter of 0.32). That finding suggests that more is at play than just issues related to collective action. Imitation may include herding effects, in which the policies of neighboring states alter the way in which individuals in a state perceive the policy.

Of course, it is also possible that the concentrated interests in a state who would benefit from UVA will be inspired by its passage in a neighboring state. Alternatively, learning could be at play. Here it would not be a case of learning from the positive economic effects of the policy, because UVA policies are at least moderately harmful to state economies. However, special interests may learn from approaches used in the neighboring states to overcome the costs of collective action. To the extent that the interests take advantage of their neighbors' experiences, that form of learning would further support Olson's model of collective action.

Logit Estimates: UVA Time to Adoption

Table 4 (page 42) reports the results of estimates from a logit model using the same sets of explanatory factors from our OLS analysis. For the logit, the dependent variable is dichotomous, taking on the value 1 when at the year of state UVA adoption and 0 otherwise. Estimated coefficients are expressed as odds ratios instead of log odds ratios. The coefficients can be interpreted as the predicted change in the odds ratio, $\Pr(adoption)/(1 - \Pr\ (adoption)$, associated with a one-unit increase in the covariate (or 1 percent increase for variables in log form). More generally, a change in the covariate of size δ implies a change of $\widehat{odds\ ratio}^{\delta}$. An odds ratio of less than one is directionally equivalent to a positive OLS coefficient because both imply a delay in policy adoption. The logit estimation can be regarded as a robustness check of our earlier results.

Results from the logit are qualitatively very similar to those from the OLS estimation, both in the implications of the estimates on the rate of UVA adoption and in terms of statistical significance. As with the OLS results, urbanization is a driving force, as seen in column 1 of table 3, but its effect disappears when more proximate factors are added, such as when land value per acre and effective tax rates are added in column 2. For example, a 1 percent increase in the value of agricultural land per acre is associated with an odds ratio of 3.81. When adding average farm size in column 3, that estimate jumps to 7.41. With respect to farm size, a 1 percent increase in average farm size is associated with an odds ratio of 2.97.

In column 5, a 1 percent increase in agriculture's share of GDP is associated with an odds ratio of 0.61, or a diminished probability of UVA adoption. In column 6, a neighboring state's adopting UVA increases the probability of a state's adoption, with an estimated odds ratio of 1.34, but that estimate is not statistically different from 1.

The logit estimation supports our findings from OLS that economic and geographic variables are important in determining policy adoption. More generally, the results suggest that interest group politics is a major factor behind the spread and timing of UVA enactment. The role of interest groups and collective action does not refute the importance of mechanisms for political diffusion overviewed by Shipan and Volden (2008). In fact, imitation appears to be important. The learning mechanisms may well be an important component underlying the effectiveness of interest groups.

6. Summary and Conclusions

Although much work has examined the role of interest groups in promoting policies favorable to agriculture, most of that work has focused on national programs or on international comparisons. For example, see Van Bastelaer (1998) and Krueger, Schiff, and Valdés (1991). Relatively little work has explored factors driving state agricultural policy, where common institutions and standards of living may help isolate factors that lead to the enactment of such policies. To further understanding in this area, we explore the spread of UVA policies, which by 1995 had been enacted in all 50 US states.

UVA policies apply to hundreds of millions of acres of mainly farmland in the United States, providing incentives that may prevent land from achieving its most productive use, as well as deteriorating the primary tax base for local governments. Our analysis suggests that the initial impetus for UVA legislation was rapid urbanization in the second half of the 20th century. However, after controlling for urbanization or rising land values, our analysis supports the role of interest groups in the spread of UVA policies, suggesting that interest group behavior dominates other explanations that use voting models to understand policy outcomes.

UVA policies appear to be an under-researched area in economics and political science. With respect to the spread of UVA, future research could explore the degree that trends in agriculture, such as toward larger farms, are owing to efficiency advantages from scale economies versus advantages that such changes may have for influencing policy outcomes. In terms of the effects of UVA, more research should be undertaken on the degree to which distortions alter land use decisions and into the fiscal adjustments made by state and local governments to those policies. For example, further research could examine the fiscal burdens that UVA imposes on some local governments, the interaction of state aid formulas for education with UVA policies, and the effect of UVA on statutory property tax rates and other forms of fiscal adjustment, such as changes in government spending and in other types of taxes.

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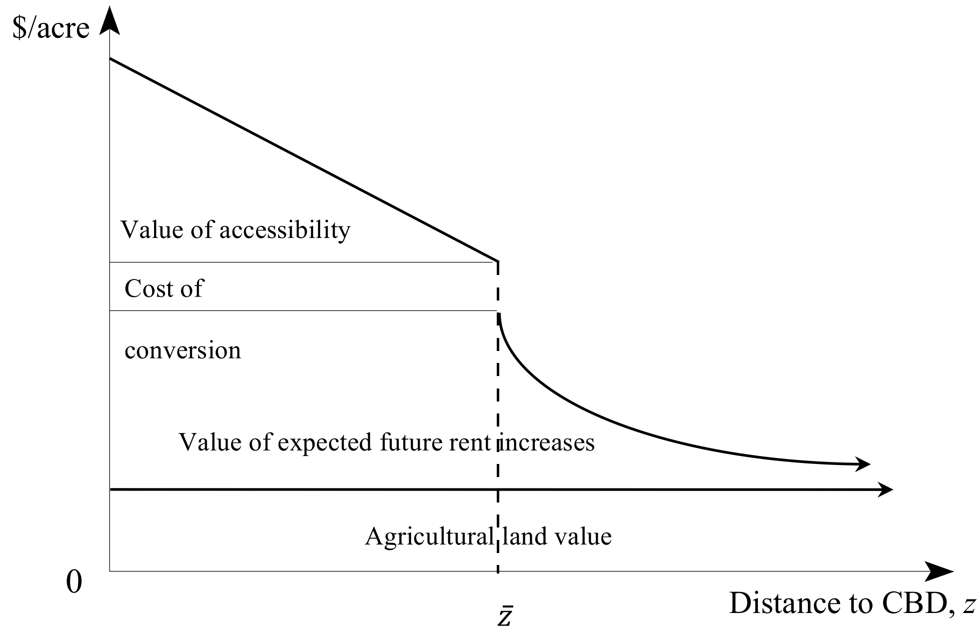
Table 1. Use-Value Assessment (UVA) Adoptions by State

State	Year of UVA adoption	Order of adoption	State	Year of UVA adoption	Order of adoption
Maryland	1960	1	North Carolina	1974	26
Hawaii	1961	2	Ohio	1974	27
Connecticut	1963	3	Oklahoma	1974	28
Florida	1963	4	Pennsylvania	1974	29
Oregon	1963	5	Tennessee	1974	30
Arizona	1964	6	Washington	1974	31
New Jersey	1964	7	Indiana	1975	32
California	1965	8	Maine	1975	33
Texas	1966	9	Missouri	1975	34
Alaska	1967	10	Nevada	1975	35
Minnesota	1967	11	South Carolina	1976	36
Delaware	1968	12	South Dakota	1977	37
Kentucky	1969	13	Iowa	1978	38
Utah	1969	14	New Mexico	1978	39
Colorado	1970	15	Vermont	1978	40
Idaho	1971	16	Mississippi	1980	41
New York	1971	17	Rhode Island	1980	42
Virginia	1971	18	Arkansas	1981	43
West Virginia	1971	19	Illinois	1981	44
Nebraska	1972	20	North Dakota	1981	45
Massachusetts	1973	21	Alabama	1982	46
Montana	1973	22	Georgia	1984	47
New Hampshire	1973	23	Kansas	1989	48
Louisiana	1974	24	Wyoming	1989	49
Michigan	1974	25	Wisconsin	1995	50

Source: Compiled by the authors using state records.

Figure 1. Land Value Fundamentals



Note: CBD = central business district; *z* = location of the land; $\bar{z}$ = radius of the urban area.

Figure 2. Kaplan-Meier Survival Curves

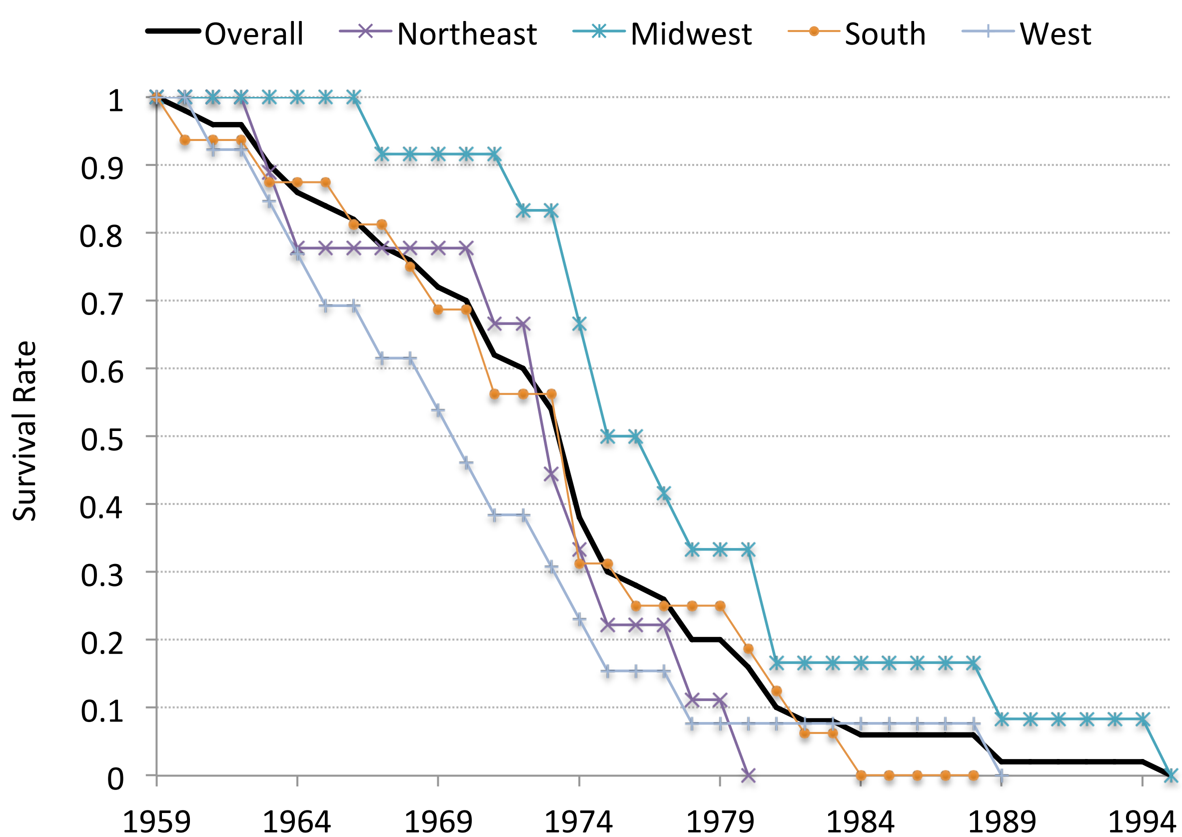


Table 2. Descriptive Statistics

Variable		Mean	Standard deviation	Minimum	Maximum	Observations
Urbanization share (in terms of population)	overall	0.6214938	0.1372366	0.3212924	0.8887431	*N* = 725
	between		0.1411265	0.3421796	0.8765899	*n* = 50
	within		0.0199927	0.5400979	0.6874915	*T*-bar = 14.5
Land value per acre	overall	1,091.769	798.1976	144	5,507.01	*N* = 699
	between		719.1051	241.4845	3,362.811	*n* = 47
	within		431.7166	−198.326	3,598.47	*T*-bar = 14.9
Farm real estate tax over $100 value	overall	0.9678336	0.5491451	0.1	2.42	*N* = 697
	between		0.517651	0.22	2.119286	*n* = 47
	within		0.182743	0.0940836	1.430691	*T*-bar = 14.8
Average farm size	overall	823.7652	1,358.073	94	6,262	*N* = 132
	between		1,508.255	98	6,262	*n* = 45
	within		79.4022	318.2652	1,134.265	*T*-bar = 2.9
Republican share in government	overall	0.3837878	0.2308857	0.0	0.8630137	*N* = 712
	between		0.2080335	0.0133345	0.6764468	*n* = 49
	within		0.079539	0.0662971	0.6772906	*T*-bar = 14.5
Share of agriculture in state GDP	overall	0.0533537	0.0513789	0.0052327	0.3719346	*N* = 578
	between		0.0455542	0.0065469	0.2123519	*n* = 48
	within		0.0168443	−0.0709947	0.2314828	*T*-bar = 12.04
Share of neighboring states that adopted UVA	overall	0.2900723	0.3464418	0.0	1.0	*N* = 725
	between		0.2025153	0.0	0.6190476	*n* = 50
	within		0.27977	−0.3289754	1.102572	*T*-bar = 14.5

Table 3. Diffusion Mechanisms: OLS with Log of *t* until UVA Adopted as Dependent Variable

	(1)	(2)	(3)	(4)	(5)	(6)
Log of urbanization share	−2.108***	−0.0170				
	(0.718)	(1.039)				
Log of agricultural land value per acre		−0.676***	−0.882***	−0.889***	−0.730***	−0.662***
		(0.117)	(0.127)	(0.0982)	(0.122)	(0.132)
Log of farm tax per $100 of value		0.337	−0.287		−0.339	−0.610
		(0.438)	(0.476)		(0.452)	(0.473)
Log of average farm size			−0.431***	−0.380**	−0.325**	−0.242
			(0.154)	(0.154)	(0.158)	(0.176)
Log of Republican share (total)				−1.483**		
				(0.559)		
Log of agriculture share in state GDP					0.155***	0.138***
					(0.0210)	(0.0230)
Share of neighboring states adopting UVA						−0.319*
						(0.183)
Census group						
Middle Atlantic	−0.062	−0.151	−0.236	−0.169	−0.261	−0.200
	(0.227)	(0.387)	(0.298)	(0.265)	(0.297)	(0.302)
East North Central	0.414*	0.678*	0.699**	0.712**	0.578*	0.555
	(0.242)	(0.348)	(0.341)	(0.269)	(0.336)	(0.359)
West North Central	0.091	0.107	0.372	0.561	0.034	−0.053
	(0.211)	(0.385)	(0.374)	(0.352)	(0.376)	(0.383)
South Atlantic	−0.186	0.182	−0.177	−0.373	−0.279	−0.408
	(0.224)	(0.411)	(0.443)	(0.309)	(0.448)	(0.472)
East South Central	−0.028	0.317	−0.125	−0.331	−0.276	−0.437
	(0.198)	(0.435)	(0.469)	(0.267)	(0.456)	(0.462)
West South Central	−0.028	0.230	0.102	−0.230	−0.163	−0.324
	(0.172)	(0.464)	(0.425)	(0.300)	(0.424)	(0.443)
Mountain	0.073	−0.615	0.004	−0.002	−0.269	−0.421
	(0.228)	(0.431)	(0.437)	(0.377)	(0.443)	(0.457)
Pacific	−0.456	−0.302	−0.046	−0.069	−0.314	−0.454
	(0.307)	(0.437)	(0.389)	(0.361)	(0.384)	(0.397)
Constant	2.94***	6.28***	10.54***	10.61***	9.52***	8.89***
	(0.318)	(1.119)	(1.744)	(1.322)	(1.669)	(1.825)
Observations	725	697	695	684	694	694
R^2	0.078	0.239	0.287	0.306	0.344	0.355

* $p < .10$, ** $p < .05$, *** $p < .01$.

Note: Standard errors are in parentheses. New England Division is the base category for division.

Table 4. Odds Ratios from Logit Estimation

Dependent Variable: 1 at year of UVA adoption; 0 otherwise

	(1)	(2)	(3)	(4)	(5)	(6)
Log of urbanization share	100.8***	2.936				
	(122.4)	(6.279)				
Log of agricultural land value per acre		3.809***	7.411***	8.389***	6.630***	6.239***
		(0.860)	(2.300)	(2.876)	(2.204)	(2.357)
Log of farm tax per $100 of value		0.124*	0.872		1.158	1.683
		(0.132)	(1.018)		(1.433)	(2.268)
Log average farm size			2.966***	3.012***	2.686***	2.501**
			(0.923)	(0.990)	(1.004)	(1.145)
Log of Republican share (total)				48.99***		
				(63.86)		
Log of agriculture share in state GDP					0.610***	0.626***
					(0.0831)	(0.0922)
Share of neighboring states adopting UVA						1.340
						(0.776)
Census group						
Middle Atlantic	1.013	1.130	1.377	1.029	1.925	2.037
	(0.380)	(0.769)	(0.767)	(0.440)	(1.217)	(1.318)
East North Central	0.609	0.224*	0.160**	0.164**	0.292	0.338
	(0.210)	(0.186)	(0.147)	(0.135)	(0.285)	(0.353)
West North Central	1.050	0.712	0.367	0.204**	1.283	1.496
	(0.384)	(0.616)	(0.299)	(0.151)	(1.397)	(1.735)
South Atlantic	1.776	0.501	1.096	2.260*	1.806	2.304
	(0.722)	(0.498)	(1.046)	(1.102)	(2.029)	(2.800)
East South Central	1.286	0.330	0.947	2.393**	2.136	2.885
	(0.481)	(0.360)	(1.042)	(0.997)	(2.736)	(3.901)
West South Central	1.159	0.374	0.598	1.818	1.594	2.119
	(0.366)	(0.396)	(0.585)	(0.851)	(1.929)	(2.731)
Mountain	1.003	2.723	0.763	0.693	1.897	2.444
	(0.344)	(2.496)	(0.789)	(0.488)	(2.818)	(3.921)
Pacific	2.161	1.208	0.608	0.593	1.749	2.011
	(1.048)	(1.016)	(0.521)	(0.439)	(1.770)	(2.097)
Observations	725	697	695	684	694	694
Pseudo R^2	0.025	0.094	0.119	0.125	0.143	0.144

* $p < .10$, ** $p < .05$, *** $p < .01$.

Note: Standard errors are in parentheses. New England Division is the base category for division.