THE EFFECT OF STATE RIGHT-TO-FARM LAWS ON LAND USE

by

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ABSTRACT

Since the 1960's, all states in the United States have enacted Right-to-Farm ("RTF") statutes. Under these statutes, qualified agricultural activities cannot be deemed as nuisances when certain conditions are met. RTF laws replaced the reasonableness test under nuisance law and reinvigorated the "coming to the nuisance" doctrine. I examine how RTF laws affect a farmer's incentive to sell land for development and determine land-use allocation. My model shows that more externalities are internalized under nuisance law because it can serve as a gap-filler of private contracts. The manner of farming practices under RTF laws tends to be less friendly to urban use. Therefore, RTF laws will decrease the land value for urban use and encourage agricultural activities. My model predicts that the adoption of RTF laws will lead to more farmland and less urban land.

I empirically test the predictions with the state-level panel data, examining how RTF laws affect the percentages of cropland and urban land in a state. Contrary to my prediction, however, results indicate that RTF laws discourage cropland use over the time, suggesting that RTF laws may reduce transaction costs and encourage farmland conversion for development. But the negative effect of RTF laws on cropland is not robust and no significant effect is found on urban land. In other words, the empirical study may also suggest that RTF laws do not have a significant effect on land use and do not necessarily help preserve farmland.

CHAPTER ONE – INTRODUCTION

1.1 Overview

Many agricultural operations are unable to benignly coexist with non-farming neighbors: feedlots exude offensive odors, feed mills generate noise and dust, herbicides and pesticides pose health hazards to the neighboring lands (Juergensmeyer and Wadley 1982, p.4). The incompatibility between agricultural land uses and urban land uses often give rise to disputes. Historically, the common law of nuisance law ("nuisance law") was employed to resolve such disputes. Nuisance law makes it possible to sue farmers if their activities adversely affect the property use of the adjacent land. However, by the early 1990s, all 50 states have passed Right-to-Farm ("RTF") statutes, which give farmers who meet the legal requirements a defense against nuisance actions. In this thesis, I examine the effect of these statutes on land use, especially the effect on farmland conversion and urbanization.

The term "nuisance" is broadly and loosely defined under common law. In Blackstone's Commentaries, one of the earliest definitions of nuisances was portrayed as "anything that worketh hurt, inconvenience or damage" (Blackstone 1890 [1765], p.738). Cases that held agricultural operations to be nuisances can be traced back to the early 17th century England. The earliest recorded agricultural nuisance case is *William Aldred's Case* (1610)[1], in which the court found a hog sty as a nuisance on the grounds that the offensive odor generated from the hog sty substantially affected the neighbor's use of his property. Such cases perhaps were very typical in history, as Blackstone used hog facilities to illustrate the legal theory of nuisances in the 18th century. He stated:

[1] 77 Eng. Rep. 816 (1610)

> *[I]f a person keeps his hogs, or other noisome animals, so near the house of another, that the stench of them incommodes him and makes the air unwholesome, this is an injurious nuisance, as it tends to deprive him of the use and benefit of his house. A like injury is, if one's neighbor sets up and exercises an offensive trade; as tanner's a tallow-chandler's, or the like; for though these are lawful and necessary trades, yet they should be exercised in remote places;* (Blackstone 1890 [1765], p.739)

In the United States today, agricultural activities continue to be a major source of nuisance actions in the United States Especially since the 1950s, as more people continue to move out of urban areas, the landscape of the rural America is being transformed. Massive urban expansion and population boom has increased tension between farmers and their new neighbors:

> *With the movement of people to suburbs and the countryside in the 1960s and 1970s, farmers were confronted with nuisance lawsuits and America was losing between two and three million acres of farmland a year. Especially troublesome to many of the new rural and suburban residents were the odors and annoying activities that accompanied the production of animals and use of chemicals. Neighbors resorted to nuisance law to end the disagreeable activities and caused some producers to cease farming* (Centner 2002).

As in the past, raising animals may often create a nuisance. Livestock operations are almost always viewed as undesirable by non-farming rural residents. A study in the 1960s estimates that "10,000 head of cattle produce as much waste as half a million people" (Juergensmeyer and Wadley 1982, p.20). American Law Reports have specialized articles on nuisance cases caused by poultry keeping[2] and hog breeding[3], two major types of agricultural nuisance cases. Common grounds in those nuisance cases include bad odors, pests, noise, polluting water supplies, trespass by animals and anticipatory trespass of wastes. Prior to the passage of RTF laws, nuisance law required courts to use the totality of the circumstances standard to determine whether the farming operation is reasonable. Non-negligence, priority use, conformity with the

[2] 2 A.L.R 3d 965 (Originally published in 1965)
[3] 93 A.L.R. 5th 621

accepted industry standards or applying state-of-the-art technology is not sufficient to shield farmers from liability.

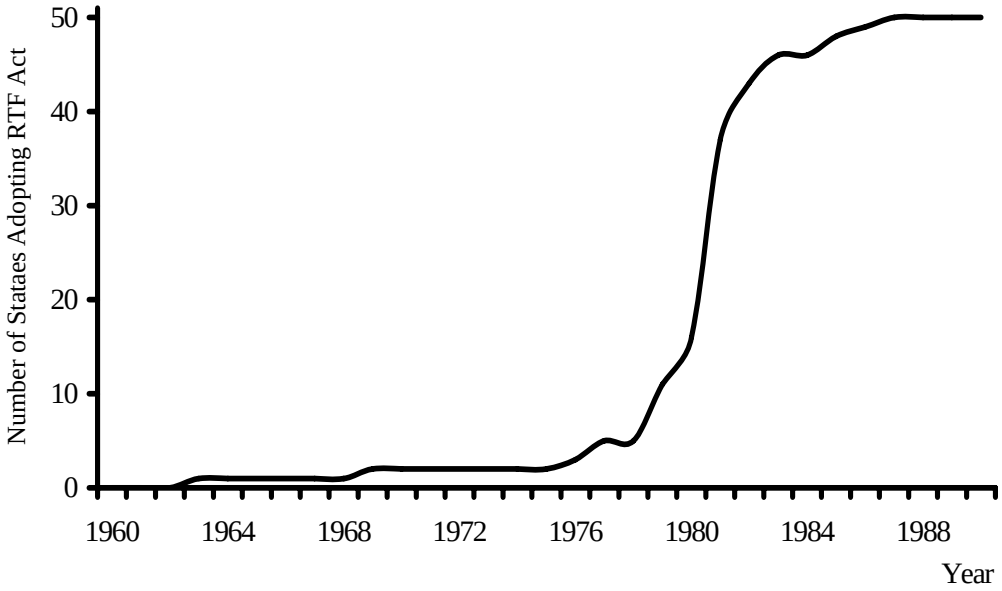

Figure 1–1: Cumulative Adoption of all RTF Laws[4]

Kansas enacted the first RTF law in 1963 to protect feedlots from nuisance liability, followed by a handful of other states in the 1960s and 1970s. Beginning in 1979, many states passed RTF laws that protect a broad spectrum of agricultural activities beyond those of the feedlot. By the early 1990s, all states had adopted comprehensive RTF laws. Figure 1-1 shows the number of states having a RTF statute (including both feedlot type RTF laws and comprehensive RTF laws) over time. Pursuant to RTF laws, qualified agricultural activities and facilities will not be deemed as nuisances. A typical comprehensive RTF statute provides:

> *No agricultural facility, agricultural operation, any agricultural operation at an agricultural facility, agricultural support facility, or any operation at an agricultural support facility shall be or shall become a nuisance, either public or private, as a result of changed conditions in or around the locality of such facility or operation if the facility or operation has been in operation for one year or*

[4] See Johnston and Lueck's working paper, *The Emergence of Right-to-Farm Laws*, Unpublished manuscript. July 2007.

> *more. The provisions of this subsection shall not apply when a nuisance results from the negligent, improper, or illegal operation of any such facility or operation.*[5]

It is not the purpose of this thesis to explain the emergence of RTF laws, but it is an interesting phenomenon that all states passed RTF statutes within such a short period of time. Just before and around this period, great changes were occurring in both the landscape of rural America and the governmental policy on land use.

Farmland was being converted to nonfarm uses at a growing rate. Studies show that "[t]he annual rate of conversion of rural land to urban use accelerated from 1.4 million acres per year in the 1958-67 period to 2.08 million acres per year in the 1967-1975 period" (CAST 1981, p.6). Out of all land converted to urban use, about one-third is cropland, about 606,000 acres per year in the 1967-75 period (CAST 1981, p.6).

In the 1960s, agricultural interest groups launched the farmland preservation movement, causing many states to adopt various programs such as the purchase of development rights (PDR), agricultural conservation easements, agricultural zoning, and property tax relief and so forth. "Almost every state and numerous counties or other local governments have some type of policy at least partly designed to protect agricultural land" (CAST 1981, p.19). For example, by the 1970s, at least 46 states assess farmland for taxation at its agricultural value rather than at the market value (CAST 1981, p.19). The passage of RTF laws followed the adoption of these agricultural preservation programs and was virtually a national legislative movement pushed forward by state Farm Bureaus, who represented the interests of farmers and agricultural operators.

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[5] Ga. Code. Ann. § 41-1-7 5 (c)

The benefit of RTF laws to the farmer seems obvious. Many agricultural activities that might be found as nuisances because of the development of the surrounding land under nuisance law will not be deemed as nuisances under RTF laws. Urban residents cannot easily drive out farming operations through nuisance actions. Nevertheless, it is unclear whether RTF laws will help preserve farmland or not because land-use allocation is largely shaped by the numerous economic decisions made by individual farmers and developers. High urban land prices will bring more land into urban use through the land market regardless of whether agricultural activities are a nuisance or not. Since RTF laws increase the certainty of law, they may actually encourage private bargaining and facilitate land transactions.

Moreover, despite all types of farmland preservation programs and policies, urbanization and farmland loss continued. Between 1949 and 1997, total farmland in the U.S. decreased by 20%, the number of farms declined by 65% and the conversion of farmland into alternative use was even faster in metropolitan areas. (Johnston and Swallow 2006, p.119). Therefore, the purpose of this thesis is to examine how nuisance law and RTF laws create different incentives for farmers to sell land for development, and discover the actual effects of RTF laws on land use.

1.2 Organization of Thesis

In Chapter 2, a historical and legal overview of nuisance law and RTF statutes, I examine the evolution of nuisance law, as well as several important legal doctrines and concepts. I also discuss the major features of RTF statutes, and make a comparison between RTF laws and nuisance law from a legal perspective.

In Chapter 3, which is devoted to an economic analysis of RTF laws, I review the literature on the economics of property regimes, controlling externalities and

transaction costs. Based on the previous literature, I develop a new model to approach the issue. I first assume that an urban developer will purchase land from the farmer when urban land prices are rising. The farmer decides the quantity of land to be sold based on the marginal benefit of agricultural production and the land price, both of which are in turn determined by the manner of the farming practice on the land reserved for agricultural use after the land sale. Second, I examine how nuisance law and RTF laws affect private negotiation and determine the expected manner of the agricultural operation after the land sale by affecting the private contracting on externalities. My model demonstrates that RTF laws create an incentive for farmers to sell less farmland for development when land prices are rising. In other word, my model predicts that the adoption of RTF laws encourages farming and leads to more farmland.

In Chapter 4, I empirically test the theoretical predictions discussed in Chapter 3. I compile state-level panel data that consist of 48 states for the nine agricultural census years between 1959 and 1997. The dataset includes land-use variables, RTF variables (which are created based on the time of adoption), governmental policy variables, median home value, and agricultural price indices. I apply a fixed-effects method to test the effects of RTF laws on the percentages of cropland and urban land in a state. The regressions results show that the percentage of cropland in a state tends to decrease over the time after a RTF law is passed, which is contrary to my prediction. Nevertheless, I also find that the effect of RTF laws on cropland is not robust and no significant effect of RTF laws is found on urbanization. Therefore, the empirical analysis suggests that RTF laws do not help preserve farmland and may not have a significant effect on land use at all. Chapter 5 summarizes the thesis and

discusses the limitations of the study and future work.

CHAPTER TWO – RIGHT-TO-FARM LAWS AND NUISANCE LAW

Before the passage of right-to-farm laws, disputes in connection with agricultural nuisances were largely resolved under the common law of nuisance in the United States. In this chapter, I first examine the evolution of nuisance law prior to the passage of RTF laws, and then discuss the emergence of RTF laws and their major features. I then summarize the major differences between nuisance law and RTF laws.

To illustrate the issues, I use the following hypothetical example to compare nuisance law and RTF laws. Consider Farmer A who has operated a feedlot for many years in a rural area, which previously was outside the city limit. Farmer A's feedlot operation does not cause any complaints from his neighbors, as the surrounding lands are also used for agricultural production, and therefore, the neighbors do not care about the odors from Farmer A's feedlot. A few years later, as a result of urbanization, a real estate entrepreneur, Developer B, purchases the farmland adjacent to Farmer A's feedlot and develops it into a residential neighborhood. Before long the residents in the new neighborhood begin to complain about the odors emitting from Farmer A's feedlot. No doubt that the presence of Farmer A's feedlot interferes with the new residents' enjoyment of their properties, but it also affects the sale prices the developer can attain. In the rest of this chapter, I illustrate how nuisance law doctrines of different periods and RTF laws address such a situation; that is, whether the law gives Developer B and the residents the right to enjoin A's feedlot operation or receive compensatory damages from Farmer A.

2.1 Evolution of Nuisance Law

The major source of nuisance law is common law, a set of precedential decisions, the origin of which can be traced back to English common law. There is much

uncertainty and confusion regarding the concept of “nuisance” under common law. Prosser and Keeton open the discussion of nuisance by noting that “[t]here is perhaps no more impenetrable jungle in the entire law than that which surrounds the word ‘nuisance’” (Keeton et al. 1984 p. 616). Speiser states that “‘[n]uisance’ is a pervasive force in the area of tort law, and it is also a protean one – often obfuscated by broad and confusing language and court dicta” (Speiser, Krause and Gans 1990, p.73). The meaning of the term “nuisance” was first fixed in the 13th century as a criminal writ affording incidental civil relief – the assize of nuisance, which covers “invasion of the plaintiff’s land due to conduct wholly on the land of the defendant” (Keeton et al. 1984, p.617). There was another separate development of a class of criminal cases known as purprestures, loosely defined as “an infringement of the rights of the crown, or of the general public.” Purprestures were later extended to things like “smoke from a lime-pit, and diversion of water from a mill” (Keeton et al. 1984 p. 617). Because of the substantial overlap with the assize of nuisance, purprestures cases were also labeled as “nuisances” (Powell 2007, §64.01[1]). Nuisances did not become fully recognized as a civil action in tort until the 16th century (Keeton et al. 1984 p. 617). One can see that the concept of nuisance was very broad in English common law from Blackstone’s Commentaries: A private nuisance[6] is defined as “anything done to the hurt or annoyance of the lands, tenements, or hereditaments of another” (Blackstone 1890, p.738).

The modern definition of “nuisance” in American common law also lacks precision. Powell defines private nuisance as “a nontrespassory, substantial and

[6] Generally speaking, nuisances can be classified as either public or private, on the basis of how many people are affected by the nuisance (Juergensmeyer and Wadley 1982, p.11). Public nuisances are consider an offence to the general public, and therefore only the government can sue to enjoin a public nuisance (Kurtz and Hovenkamp 2003, p. 743). This thesis mainly focuses on agricultural nuisances that are thought to be private, which involve injury to private individuals only.

unreasonable interference with another's use and enjoyment of real property" (Powell, 2007 §64.02[1]). Black's Law Dictionary defines it as "a condition, activity, or situation (such as a loud noise or foul odor) that interferes with the use or enjoyment of property."[7]

Despite the broadness and ambiguity in those definitions, a few things are clear. Nuisances are generally considered to be a separate category of torts as opposed to trespass. Trespass law is usually applied to "disputes involving physical invasions of another's property" (Powell 2007 §64.02[1]). An actual physical invasion of the plaintiff's property is required in trespass cases. Moreover, trespass cases generally involve "an interest in the exclusive possession of land" whereas nuisance cases involve "an interest in the use and enjoyment of the land" (Juergensmeyer and Wadley 1982, p.9). Sometimes a strict literal interpretation of the definition may cause some difficulty in distinguishing nuisance from trespass. For example, "overgrown trees, structural extensions, flying bullets, arms or any other object that penetrates the air space over another's land could give rise to an action in trespass" because intrusions of air space are deemed as invasions of one's possessory rights (Powell 2007 §64A.01[5]). Nevertheless, smoke, dust and insects resulting from agricultural activities are usually deemed as nontrespassory invasions and give rise to nuisance actions, even though an interference with the physical condition of the land is involved. The trend is that in cases where the distinction between a trespass and a nuisance is not clear, the plaintiff is allowed to proceed on both theories (Singer 1997, p. 324). For the purpose of this thesis the difficulty in distinguishing nuisance from trespass should not be overstated because courts have been consistently employing

[7] Black's Law Dictionary (8th ed. 2004)

nuisance law to solve land-use conflicts in connection with agricultural production activities.

Another major point in Power's definition is that the interference must be substantial and unreasonable so as to constitute a nuisance. Prosser and Keeton note that "it has been held that there is no nuisance arising from the mere unsightliness of the defendant's premises, from the temporary muddying of a well, or from an occasional unpleasant odor or whiff of smoke" (Keeton et al. 1984, p.626). It might be easy for courts to deny relief for slight inconveniences or annoyance, but the criterion for "reasonableness" has always been a disputable issue in the legal history. The evolution of nuisance law largely lies in the changing understanding of the term "reasonableness", which is discussed below.

2.1.1 The *sic utere tuo* Maxim

The position of early English law concerning agricultural nuisances was demonstrated in a widely cited early case, Aldred's Case (1610).[8] The dispute took place in Harleston, in the county of Norfolk, a largely rural county in the east of southern England. The plaintiff, a homeowner, had a house next to a hog sty[9], and brought an action against the defendant's offending operation. The court adopted a straightforward rule favoring nuisance complainants without considering the harm to adjacent lands and the social utility of the defendant's activity. In that case,

> *the defendant explicitly invited the court to consider the social value of his operations as a defense to the nuisance action, stating that because his activities were "necessary for the sustenance of man . . . one ought not to have so delicate a nose." But the court rejected the argument and instead articulated the doctrine of sic utere tuo ut alienum non laedas ("one should use his own property in such a manner as not to injure that of another.")* (Green 1997, p.547)

[8] 77 Eng. Rep. 816 (1611)
[9] It is not clear in the opinion whether the plaintiff built the house before the establishment of the hog sty or not.

According to *Blackstone's Commentaries on the Laws of England*, "*sic utere tuo, ut alienum non laedas*" was the rule for nuisance actions at the time. Literally, it means one should use his own property in such a manner as not to injure that of another (Blackstone 1890 [1765], p.739). The *sic utere tuo* maxim can be viewed as strict liability (Keeton 1984 p.624); neither faultiness nor social value of the activity is considered in determining whether an activity constitutes a nuisance. It is no more than a rigid rule that favors nuisance complainants, which "affords absolute protection to the rights of private property holders against harmful interferences with their quiet enjoyment of land" (Green 1997, p.549).

With respect to my example, application of the *sic utere tuo* rule means that Farmer A will be held liable for his feedlot operation on the grounds that the bad smells emitted from his feedlot degrade the nearby property and thus injure Developer B's property rights. Under such a rule, courts assume that in a situation like this, harm is caused by a single side. If the *sic utere tuo* rule is perfectly enforced, Farmer A will treat the negative impact on Developer B's property as it is on his own land and there will be no externalities.[10] This is the traditional view that operating a harmful activity that will impose a cost on another party without first obtaining permission is a "theft" of that party's property rights of an immovable asset (Lueck and Miceli 2007, p.229). From an economic perspective, it is based on the assumption that private bargaining is impossible, and nuisances are regarded as "a source of market failure requiring government intervention to force the responsible party to curtail the harmful activity" (Lueck and Miceli 2007, p.187).

[10] One fact in my example is not considered yet that whether or not Developer B purchases the land with the knowledge of the presence of Farmer A's feedlot. That fact may completely change the verdict of the case, as common law has a well-known doctrine called "coming to the nuisance," which could possibly shield Farmer A from liability. This doctrine is discussed in Section 2.2.

Nevertheless, the assumption of single-sided harm is not necessarily correct. Coase (1960), in his influential paper, points out that nuisance is a result of two or more competing land uses. For example, if Developer B does not choose to develop the land adjacent to Farmer A's feedlot, there will be no nuisance in the first place. In a strict sense, it is inappropriate to say that one party injures the other, for nuisances are not caused by the nature of any single land use, but the incompatibility of two or more competing property uses.

2.1.2 Transition from *sic utere tuo* to the Reasonableness Test

The *sic utere tuo* maxim dominated several centuries in England and was later inherited by American courts, which generally assumed that "the defendant was strictly liable, and to have made no inquiry as to the nature of his conduct"[11] (Keeton 1984 p.624).

The United States did not experience substantial industrial development until a few years before the Civil War, and it was not until then that American courts began to face acute land-use conflicts and attempted to "resolve the tension between the property rights without abandoning the natural law foundation of property rights" (Lewin 1990, p.198). Most courts and commentators found that an absolute *sic utere* duty would be unacceptable as this "would have imposed too great a burden on expanding capital intensive, highly productive uses, which often caused unavoidable injury to neighboring landowners" (Bone 1986, p.1139). Most courts and commentators then attempted to modify the maxim by narrowly interpreting the word *Laedas* in the maxim to mean "legal injury", instead of "injury," and incorporated the concept of negligence into nuisance law (Bone 1986, p.1139).

[11] With very few exceptions, the maxim was enforced by American courts in eighteenth and early nineteenth century (Lewin 1990, p.196, Bone 1986, p.1138).

In *Loose v. Buchanan*[12], the New York court took one step further and discarded strict liability in nuisance actions. In the case, the defendant company's boiler exploded, causing damages on the plaintiff's property. The court had to decide whether the defendant could be held liable for the damage without proof of some fault or negligence. A strict interpretation of the *sic utere tuo* maxim does not consider the faultiness on defendant's part, but the court instead explained the general rules:

> *I may have the exclusive and undisturbed use and possession of my real estate, and that I must so use my real estate as not to injure my neighbor, are much modified by the exigencies of the social state. We must have factories, machinery, dams, canals and railroads. They are demanded by the manifold wants of mankind, and lay at the basis of all our civilization. If I have any of these upon my lands, and they are not a nuisance and are not so managed as to become such, I am not responsible for any damage they accidentally and unavoidably do my neighbor.*[13]

Some scholars believe that this modification of the *sic utere tuo* rule "favored active land uses typical of the industrial revolution over the interests of small residential property holders. The opinion stressed the relative strength of interests in developmental uses of land" (Green 1997, p.550).

Beginning in the late 19th century, many other jurisdictions followed New York in loosening the strict interpretation of *sic utere tuo* maxim. For instance, in *Pennsylvania Coal Company v. Sanderson*[14], the plaintiffs purchased a tract of land, which held a stream of water. By the time of purchase, the stream was pristine and dams were built by the plaintiffs for the purpose of cultivating fish. The water became polluted after the defendant opened a coal mine on the side of a hill above the plaintiff's land. The plaintiffs then sued the defendant to recover damages for the corruption of the stream. The trial court and appellate court disagreed on whether or

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[12] 51 N.Y. 476 (1873)
[13] *Id.* at 484
[14] 113 Pa. 126 (1886)

not faultiness should be a basis for liability. After four times back and forth between the courts, the Supreme Court of Pennsylvania finally held that the mining company had no liability for damage as there was no fault found. The rationale of the holding is well explained below:

> *It may be stated, as a general proposition, that every man has the right to the natural use and enjoyment of his own property, and if whilst lawfully in such use and enjoyment, without negligence or malice on his part, an unavoidable loss occurs to his neighbor, it is damnum absque injuria, for the rightful use of one's own land may cause damage to another, without any legal wrong.*[15]

Before long courts and commentators found that even the negligence-based doctrine was insufficient to accommodate all property use conflicts, and the concept of reasonable use arose, which allowed courts to take into account more factors (Bone 1986, p.1149). Initially, courts only focused on the acts of the defendant and held the defendant liable "if the manner of use was negligent or imposed unnecessary harm on adjacent landowners," but later on, some courts began to expand "the concept of wrongfulness to impose liability for conduct that was 'unreasonable' under the totality of the circumstances" (Lewin 1990, p. 203). By the early 20th century, many courts had already recognized negligence as an important basis for liability, and the social utility of the defendant's activity became a consideration in determining the case. Judge Burnett noted about the development of nuisance law in the United States during this period:

> *American tort law in the nineteenth and early twentieth centuries was founded upon the rock of "fault." As the notion of fault burrowed into the concept of nuisance, the strict liability which had attended nuisance in property law began to deteriorate. American courts stressed that liability for nuisance would arise only from "unreasonable" uses of property.*[16]

The reasonableness test seems to afford courts much discretion as the interpretation of

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[15] Id. at 146

[16] *Carpenter v. Double R Cattle Company, Inc* (1983). 669 P.2d 643

“reasonableness” can be flexible and infinite factors can potentially be considered. Nevertheless, in applying the reasonableness test, American courts usually give more weight to some particular factors, thus making the reasonableness test more concrete and easier to implement. The nature of the locality is frequently considered to be a factor in nuisance determination.

Professor Bone states that “[c]ourts used the locality doctrine, in effect, to set aside areas where industrial, manufacturing and other interfering uses could be conducted at a distance from residential neighborhoods. In those areas, a landowner had wide latitude to conduct any interfering use” (Bone 1984, p.1150). Professor Keeton also states that “[i]f a locality is given over predominantly to manufacturing, the plaintiff will have less right to complain of factory noise or smoke than if it is of a residential character. What is nuisance in Palm Springs is not necessarily one in Pittsburgh” (Keeton et al. 1984. p.633). If the locality rule is applied to my example, then whether Farmer A’s feedlot is a nuisance does not only depend on the practice and degree of interference, but also the nature of the locality. If the surrounding lands are also in agricultural use, the criterion of “reasonableness” will be much easier to satisfy for the farmer than that in the case where the surrounding lands are all developed for urban uses.

The advantages of the locality rule are obvious from an economic perspective. By enforcing such a rule, courts encourage compatible land uses to move together and relocate the activity that does not fit the area at a lower cost, thus largely mitigating externalities. In addition, the locality rule is a relatively concrete standard. It helps clarify the meaning of reasonableness and reduces the uncertainty of nuisance law.

2.1.3 The Balancing Test

As discussed in the above section, by the early 20th century, American courts had already replaced the *sic utere tuo* rule with the reasonableness test in nuisance determination. Nevertheless, the concepts of "nuisance" and "reasonable use" were still plagued by vagueness. The *Restatement (First) of Torts* in 1939 made an attempt to clarify the confusion in this area:

> *Under the first Restatement, a nuisance was defined as "a non-trespassory invasion of another's interest in the private use and enjoyment of land"*[17] *that is either "(i) intentional and unreasonable; or (ii) unintentional and otherwise actionable under the rules governing liability for negligent, reckless or ultrahazardous conduct."*[18] *The Restatement expressly incorporated a test for balancing utilities into the question of the invasion's reasonableness. "An intentional invasion of another's interest in the use and enjoyment of land is unreasonable under the rule [previously stated], unless the utility of the actor's conduct outweighs the gravity of the harm."*(Green 1997, p. 553)

According to the *Restatement*, "reasonable use" will be determined by comparing the utility of the defendant's activity and the gravity of the harm to the plaintiff. Commentators argue that this definition is an "application of economic principles to the understanding and analysis of law" (Powell 2007, §64.01[1]). The balance of utility test "requires the decision maker to engage in cost-benefit analysis by comparing the social utility of the harmful conduct with the harm it causes" (Singer 1997, p. 330). Between 1939 and 1969 only a handful of jurisdictions such as in New Jersey, California, Iowa, and Wyoming used the quantitative balancing test in a few cases. Even in those states, the rule was not fully established, as many cases during the same period and after still ignored the balance of utility test (Lewin 1990, p.213 note. 121). Most jurisdictions only considered the utility of the property use "simply one of the many factors in the analysis of surrounding facts and circumstances"

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[17] Restatement (first) of Torts 822 (1934-1939)
[18] *Id.* 822(d).

(Green 1997, p.554). The majority of courts continued to adopt the reasonableness test without explicitly weighing the utility and harm.

The *Second Restatement of Torts* (1979) also clings to the balance of utility test by providing that "the social value that the law attaches to the type of use or enjoyment invaded"[19] is one of the factors in determining the gravity of harm. It also provides that "the social value that the law attaches to the primary purpose of the conduct"[20] is a factor in determining the utility of conduct. It then clarifies the meaning of "unreasonable":

> *An intentional invasion ... is unreasonable if (a) the gravity of the harm outweighs the utility of the actor's conduct, or (b) the harm caused by the conduct is serious and the financial burden of compensating for this and similar harm to others would not make the continuation of the conduct not feasible.*[21]

In addition to the balancing test that can be found in the *First Restatement*, by including the criterion (b), the *Second Restatement* also makes "severe harm" a basis for liability, thus leaving courts more discretion. Nonetheless, despite the great popularity of the *Restatement*'s definition in the academia, as of 1990, no more than fifteen states have explicitly adopted the *Restatement*'s quantitative definition of unreasonableness set forth in the *Second Restatement* (Lewin 1990, p. 234).

It can be said that the *Restatement* had made a radical modification of nuisance law. The term "reasonableness" changed from a vague qualitative concept to a more accurate quantitative one. Although according to Lewin, the number of states that explicitly follow the *Restatement*'s balancing test is small, the real difference between the reasonableness test and the balance of utility test should not be overstated. Coase (1960), having examined many nuisance cases, pointed out that American courts had

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[19] Restatement (second) of Torts (1979) 827
[20] *Id.* at 828
[21] *Id.* at 826

been employing cost-benefit analysis all the time, even though it may not always be stated in an explicit manner:

> *In a world in which there are costs of rearranging the rights established by the legal system, the courts, in cases relating to nuisance, are, in effect, making a decision on the economic problem and determining how resources are to be employed. It was argued that the courts are conscious of this and that they often make, although not always in a very explicit fashion, a comparison between what would be gained and what lost by preventing actions which have harmful effects.* (Coase 1960, p.27)

2.2 The "Coming to the Nuisance" Doctrine

2.2.1 "Coming to the Nuisance" as a Factor in the United States

As noted above, the "coming to the nuisance" doctrine can be a defense in nuisance actions. The doctrine states that the plaintiff may not have relief if he knowingly comes after the establishment of the nuisance-causing operation and the would-be damages are foreseeable. This doctrine has old roots in the ancient Roman maxim *volenti non fit injuria,* which literally means "he who consents is not wronged" (Calnan 2005, p.185). Medieval jurists endorsed this Roman tort maxim; Bracton noted in his treatise on English law in the 13th century that "long continued acquiescence amounts to consent and [consent]…nullifies an *injuria*" (Calnan 2005, p.186). The maxim was favored in the dictum of *Rex v. Cross* (1826)[22], a 19th century English nuisance case, which was widely viewed as the case establishing the "coming to the nuisance" doctrine in nuisance actions. In *Rex v. Cross*, although the defendant's slaughtering house was found as a nuisance because of the strong offensive smells from its operation, in the dictum the court explicitly expressed its acceptance into the "coming to the nuisance" doctrine:

> *If a certain noxious trade is already established in a place remote from habitations and public roads, and persons afterwards come and build houses within the reach*

[22] *Rex v. Cross*, 172 Eng. Rep. 219 (1826)

> *of its noxious effects… in those cases the party would be entitled to continue his trade, because his trade was legal before the erection of the houses…*[23]

However, the dictum in *Rex v. Cross* was soon "followed by judicial skepticism" (Powell 2007 §64.05[2]). In *Bliss v. Hall* (1838)[24], the defendant was sued in a nuisance action for the making manufacturing of candles, which delivered large quantity of grease and tallow on the plaintiff's property. The defendant claimed that he had carried the business in the same manner for a long time before the plaintiff occupied the property, but the court held that it was no defense that the business was carried on before the plaintiff became possessed of the adjoining property. Hence, this ruling basically rejects the idea that "coming to the nuisance" can be a defense. By the mid-1800s the English common law had basically repudiated the doctrine that gives the rights to the person who was there first (Wittman 1981 p. 557-558).

The American experience of the "coming to the nuisance" doctrine has been uneven in different jurisdictions (Powell 2007, §64.05[2]), but as a whole, the doctrine was never a strong defense. The prevailing rule is that "the defendant cannot condemn the surrounding premises to endure his operation, and that the purchaser is entitled to a reasonable use and enjoyment of his land" (Keeton et al. 1984, p.635).

Since early in United States history, cases explicitly rejecting "coming to the nuisance" as a defense have been plentiful (Speiser 1990, §20:23 p.135).[25] For example, in *Crommelin v. Coxe & Co.* (1857)[26], the landowner maintained two excavations connected to the building. The excavations were filled with water after rains and flooded the tenant's cellars. The tenants sued against the landowner and the court held that the fact the nuisance was there at the time of purchase is no defense to

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[23] *Id.*
[24] *Bliss v. Hall*, 132 Eng. Rep. 758 (1838)
[25] For a list of such cases, see 42 A.L.R. 3d 344
[26] *Crommelin v. Coxe & Co.* 30 Ala 318 (1857)

the action. In *United States v. Luce* (1905)[27], a factory was prosecuted by the government as a nuisance. The court, applying Delaware law, stated that "the mere fact that one voluntarily 'comes to a nuisance' will not preclude him from complaining of and obtaining relief against it," and called it "a contrary doctrine would be so unreasonable and oppressive as to work [toward] its own condemnation."[28]

The same position can be found in more recent cases such as *Carter v. Lake City Baseball Club, Inc.* (1950)[29]. In that case, the residents sought an injunction to prevent the school trustees from permitting the use of the athletic field of the school for the playing of professional baseball at night. The court found that the glaring flood lights, loudspeakers, drinking, and blocking of driveways were conditions sufficient to render the playing of professional baseball at night a private nuisance. The court also rejected the "coming to the nuisance" doctrine as a defense:

> *The fact that a person voluntarily comes to a nuisance by moving into the sphere of its injurious effects, or by purchasing adjoining property or erecting a residence or building in the vicinity after the nuisance is created, does not prevent him from recovering damages for injuries sustained therefrom, or deprive him of the right to enjoin its maintenance, especially where, by reason of changes in the structure or business complained of, the annoyance has been since increased.*[30]

Despite the numerous cases completely rejecting the "coming to the nuisance" doctrine, there are also many cases showing that the doctrine still has an influence in nuisance actions. Though the doctrine does not constitute an absolute defense, many courts consider it a factor in determining the grant or denial of the relief. [31] In *Tuttle v.*

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[27] *United States v. Luce* 141 F 385 (1905)
[28] *Id.* at 68
[29] *Carter v. Lake City Baseball Club, Inc.,* 218 S.C. 255 (1950)
[30] *Id.* at 272
[31] For a list of the reported cases regarding this rule, see 42 A.L.R. 3d 344

Brightman (1892)[32], the defendant engaged in the business of manufacturing oil and fertilizer was sued for emitting strong offensive odors and smoke. In applying the reasonableness test to determine whether a nuisance exists, the court emphasized on the nature of the locality, but in the reasoning the court also considered "coming to the nuisance":

> *In determining this question, everything must be looked at from a reasonable point of view. An injury which affects a person's comfort and happiness may or may not be a nuisance, according to the locality in which it occurs. If one voluntarily moves into a town or neighborhood where smoke or noxious gases abound, it may be presumed that he does so for sufficient reasons, and he should not be permitted to come into a court of equity and restrain the prosecution of industries already established, and upon which the business interests and welfare of the community may depend.*[33]

In this opinion, the court seemed to favor the "coming to the nuisance" doctrine, but what the court essentially stated is that the nuisance determined depends on the locality. In other words, it is still possible that the defendant's activities be deemed as a nuisance when the nature of locality changes.

In *McIntosh v. Brimmer* (1924) [34], a California Court of Appeal enjoined the defendant chicken ranchers from continuing to conduct their chicken corrals in such a manner that they injure their neighbor's property. The court endorsed the principle established in earlier cases that priority use may be a factor but not conclusive in nuisance determination. The court stated that "[l]ocation, priority of occupation, and the fact that the injury is only occasional, though matters to be considered, are not conclusive but are to be considered in connection with all the circumstances of the particular case; and whether the use is unreasonable or not is an inference to be drawn from all the facts."

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[32] 53 F. 422
[33] *Id.* at 10
[34] *McIntosh v. Brimmer* 68 Cal App 770 (1924)

In Kentucky, the dictum of *Hall v. Budde*[35](1943) showed a very similar attitude toward "coming to the nuisance." The neighbor sought to enjoin the operation of a hog farm. The injunction was denied by the court on the grounds that the neighbor failed to show that the farmer operated the hog farm in an unsanitary manner, but the dictum also noted that "coming to the nuisance" could be factor.

> *The law is well settled that a person acquiring property has the right to expect and require that his neighbor will utilize his property, notwithstanding its previous use, so as not to interfere with the reasonable enjoyment of his own, and that there is no such thing as a prescriptive right to operate a nuisance. At most, the fact that the complainants "moved to the nuisance" is but a factor, though an important one, to be considered in connection with all the circumstances in determining the equities of a given case*[36]*.[citation omitted.]*

While jurisdictions may have slightly different positions on the "coming to the nuisance" doctrine, the generally accepted rule in modern American law is to consider the doctrine "one factor in the defendant's favor, not an absolute bar" (Powell 2007, §64.05[2]). The majority view is also reflected in the *Second Restatement of Torts*:

> *The fact that the plaintiff has acquired or improved his land after a nuisance interfering with it as come into existence is not in itself sufficient to bar his action, but it is a factor to be considered in determining whether the nuisance is actionable.*[37]

2.2.2 Locality Rule and the "Coming to the Nuisance" Doctrine

Although the majority of the jurisdictions in the United States claim that they recognize "coming to the nuisance" as a factor, it is nonetheless not clear how important this doctrine is in nuisance determination. When courts apply the doctrine, it seems that they are actually considering other factors such as the nature of locality, the knowledge of the nuisance, and the purchasing price plaintiff's property. In this subsection, one might find that even in the cases citing the "coming to the nuisance"

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[35] *Hall v. Budde* 293 Ky 436 (1943)
[36] Id. at 437
[37] Restatement (second) of Torts §840D (1979)

doctrine, what really matters is the nature of the locality, rather than the "coming to the nuisance" doctrine. Shipley notes that "the nature of the area where the nuisance is carried on—whether, for example, the area is primarily residential, industrial, or commercial—may affect the weight to be given to the defense that the complainant moved into the area after the defendant had done so"(Shipley 1965, p.344).

In *Michelsen v. Leskowicz*[38](1945), the plaintiff complained about a duck farm, which was located in an area that had been zoned by the township authority so that the operation might be lawfully conducted therein. The court denied injunction "for the reason that he came 'to the nuisance,' and thereafter suffered this business not only to be conducted for a number of years," and the court explained that "[w]hen the plaintiff selected her home or her property…she might well expect the incidents of country life…When, as in this case, she came to this quarter of the Town of Brookhaven, where duck business had long been maintained, she was bound to recognize the conditions and the incidents thereof."[39] The opinion indicates that the defendant's duck business was located in an agricultural area, which had not changed much since the time the plaintiff moved in. The verdict would probable be very different, if the nature of locality had changed. As shown in many cases[40], if the

[38] *Michelsen v. Leskowicz* (1945, Sup), 55 N.Y.S.2d 831

[39] *Id.* at 838

[40] In *Ashbrook v. Commonwealth* (1867), the defendant's pens for keeping animals were located in such an area that was entirely outside of the city limits at the time of establishment, but they became surrounded by latter-built houses upon urban growth. The court enjoined the operation, saying that "we do not regard the prior occupancy of the property for such purpose, before the increasing population of the city and public necessity required the extension of the city limits and streets beyond this property, as a legal defense, we cannot reverse the judgment for this cause."

In *Boehm v. Philadelphia* (1915), it had been made clear that once priority use clashes with economic development, priority use has to give way to the more valuable land use. The city passed an ordinance providing that it was a nuisance to keep hogs or swine in the city. This ordinance seems to be the opposite of RTF laws. The plaintiff claimed that such an ordinance was unlawful and sought to enjoin the city from enforcing the ordinance. The court dismissed the action, stating that "[i]t is no defense to an action or prosecution for a private or public nuisance, that the work or business giving rise thereto was first established in a secluded locality, or was not a nuisance in its origin, but that the injury or offense complained of is the result of the subsequent voluntary location in the neighborhood by the person or persons injured, though with a knowledge of the existence of the alleged nuisance."

defendant's operation is located in an area that was initially remote from a city and later became populated because of subsequent settlement or urban growth, "coming to the nuisance" may not make a defense.

It has been noted in Section 2.2 that the locality rule is important in nuisance determination, but the validity of the "coming to the nuisance" is also based on it. "Coming to the nuisance" makes no defense where the location concerned is an area isolated upon establishment of nuisance but later populated, though exceptions may be found.[41] It may not be exaggerating to say that in most situations the ruling will be the same no matter whether the "coming to the nuisance" is cited[42].

The doctrine may be valid against the first homeowner who moves to an agricultural area (actually not because of priority use, but the nature of locality), but it is not likely to be valid against a developer whose development plan that has transformed the area. Consider the hypothetical example at the beginning of this chapter. It is uncertain whether Farmer A may use the "coming to the nuisance" doctrine as a defense. If the surrounding lands remains in agricultural uses after the purchase of the land, then the doctrine may still be valid; but if the surrounding lands are also converted into urban uses, or the developer has a very big development plan, then the doctrine will not constitute a defense in the farmer's favor.

2.3 Summary of Nuisance Law

Figure 2-1 summarizes the evolution nuisance law. The *sic utere tuo* maxim

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The same rule was upheld in *Yaffe v. Ft. Smith* (1928), where a junkyard was found to be a nuisance by the court after it had been conducted for a long period of years and before other property owners put up buildings. The court made it clear that when the nature of locality is changed, prior use is no defense. The court held that"[a]ppellant's business has been established for a number of years, and at the time it was established it was probably not an interference with the rights of any one. But it has become so because of the growth of the city, and, having become so, the private rights of appellant must yield to the public good."

[41] In *Youngstown Tp. v. Youngstown* (1903), 6 Ohio CC NS 498, the court held that, although the alleged nuisance was established in an isolated area that later became populated, the complaint could not have it abated.

[42] However, the doctrine may affect the remedies as in the *Spur* case discussed in Section 2.4.

inherited from the English common law gives most protection to the urban residents from any interference with the enjoyment of their property, while “the coming to the nuisance” doctrine gives the greatest rights to the farmer to use his land for agricultural production, free of liability for generating offensive orders. In the United States, both doctrines only have very limited influence on nuisance law. Since the Civil War, American courts began to loosen the *sic utere tuo* maxim, giving more consideration to the social utility of the defendant’s activity. By the early years of the 20th century, the reasonableness test had already become the most popular rule, which allows courts to consider a broad spectrum of factors. Among other things, the nature of locality was often an important factor to consider in nuisance determination. In 1939, the *Restatement of Torts* defines “reasonable use” by comparing the utility of the defendant’s activity and the gravity of the harm to the plaintiff. This is often referred to as the balancing test. Although the *Restatement of Torts* does not necessarily has a binding force in most jurisdictions, the balancing test has a great influence on nuisance law, and is widely accepted as a standard definition of “reasonable use” in most legal treatises and textbooks.

The “coming to the nuisance” doctrine is not a dominating rule in the United States. In applying this doctrine, courts have to consider the overall conditions of the circumstance, especially the location of the defendant’s activity. The doctrine is merely a factor and not conclusive in nuisance determination.

Table 2–1: Evolution of Nuisance Law

Time Periods	Doctrines and Rules
English law	
12th Century	The Assize of Nuisance allowed individuals to obtain relief for non-direct injuries in criminal actions.
16th Century – 19th Century	The *sic utere tuo* maxim: the defendant is held as strict liable. The "coming to the nuisance" doctrine was established (*Rex v. Cross*), but was soon followed by judicial skepticism.
American law	
Prior to the Civil War	The *sic utere tuo* maxim was inherited from English law. The "coming to the nuisance" doctrine is not an absolute defense but merely a factor.
The Civil War – early 20th century	Negligence based liability was introduced. "Reasonable use" became the criteria in nuisance determination, which allowed courts to take into account all the factors of the circumstance The nature of locality was often a key factor in nuisance determination.
1960s - present	RTF statutes are passed to gives farmers who met the legal requirements a defense against nuisance actions.

2.4 Remedies under Nuisance Law

The previous sections basically focused on the determination of liability in nuisance actions, whereas this section discusses the consequences after a nuisance is established. There are three normal remedies once the existence of a nuisance is established: damages, injunction and self-help abatement (Keeton et al. 1984, p.637). Since the remedy of self-help abatement has little relevance today (Powell, 2007 §64.07[2]), the following discussion only focus on damages and injunction.

The following rule has been widely accepted:

> *An injunction is the more appropriate remedy in those situations in which the nuisance is abatable, that is, can be corrected…Some courts are willing to grant an injunction even if it results in closing the operation…In other cases, the more appropriate remedy is money damages to compensate the injured party for the*

> *loss of property value due to the permanent nature of the nuisance.* (Looney and Uchtmann, 1994)

An injunction is often the appropriate remedy in agricultural nuisance cases as "the usual basis for equitable intervention is normally present in a nuisance action" (Powell 2007, §64.07[2]). First, the harm of agricultural activities is usually recurrent, and therefore only injunctions can give complete relief in a single action. Second, "private nuisance involves harm to land for which money damages are traditionally said to be inadequate" (Powell 2007, §64.07[2]).

An Injunction does not necessarily mean the whole agricultural facility will be shut down; the court can only enjoin a certain farming practice or order the farmer to take measures to abate the nuisance. Damages are almost always compensatory in nuisance cases[43]: If the harm is permanent, the measure of damages is usually "the depreciation in the market value of the realty by reason of the nuisance," whereas if the harm is temporary, the measure of damage is "the depreciation in the rental or use value of his property during the period in which the nuisance exists, plus any special damages" (Keeton et al. 1984, p.638).

Traditionally (especially before *Boomer v. Atlantic Cement Co.* (1970)[44]), once a nuisance is established, an injunction is almost always awarded plus the appropriate damages (Dobris 1990, p. 179). However, in the 1970s, two landmark cases were decided by American courts, which added two new forms into the catalog of remedies.

In *Boomer v. Atlantic Cement Co.*, the plaintiffs were homeowners, farmers and small business people who sought an injunction against a cement factory for the

[43] Punitive damages are rare in agricultural nuisance cases and may only be granted when the defendant acts with malice (Powell 2007, §64.07[2]).
[44] *Boomer v. Atlantic Cement Co.* 257 N.E.2d 870 (1970)

vibration, smoke and dirt it had generated. On the one hand, the New York Court of Appeals acknowledged that such a nuisance would be enjoined: the "plaintiffs have been damaged substantially" and the legal doctrine "has been consistently reaffirmed in several leading cases in this court and which has never been disavowed here, namely that where a nuisance has been found and where there has been any substantial damage shown by the party complaining an injunction will be granted."[45] But on the other hand, the court also saw "the large disparity in economic consequences of the nuisance and of the injunction."[46] A permanent injunction would destroy a multimillion-dollar investment and cause a great loss of jobs. In the end, the court granted an innovative remedy – vacatable injunction, which is conditioned upon the defendant's payment of permanent damages:

> *One alternative is to grant the injunction but postpone its effect to a specified future date to give opportunity for technical advances to permit defendant to eliminate the nuisance; another is to grant the injunction conditioned on the payment of permanent damages to plaintiffs which would compensate them for the total economic loss to their property present and future caused by defendant's operations … [T]he court chooses the latter alternative.*[47]

Another equally famous nuisance case, which also spawned substantial discussion was *Spur Industries, Inc. v. Del E. Webb Development Co.*[48], decided by the Supreme Court of Arizona in 1972. Plaintiff Del Webb, a land developer, complained that the defendant Spur's "feeding operation was a public nuisance because of the flies and the odor which were drifting or being blown by the prevailing south to north wind over the southern portion of Sun City."[49] The court acknowledged that the feedlot operation was both a public and private nuisance and therefore should

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[45] 257 N.E.2d 872 (1970)
[46] *Id.* at 872
[47] *Id.* at 873
[48] *Spur Industries, Inc. v. Del E. Webb Development Co*,.494 P.2d 700 (1972)
[49] *Id.* at 705

be enjoined. Nevertheless, in view of the fact that the feedlot operation had preceded the growth of the city, the court held "that the doctrine of 'coming to the nuisance' would have been a bar to the relief asked by Webb,"[50] and that "Spur is required to move not because of any wrongdoing on the part of Spur, but because of a proper and legitimate regard of the courts for the rights and interests of the public."[51] Finally, injunction was granted, but the plaintiff was also required to indemnify the defendant for his costs of relocating or shutting down the feedlots.

Both *Boomer* and *Spur* provided with courts more options under the "circumstances when a court did not want to put the plaintiff in a position to close a plant, nor extract large gains from the defendant" (Dobris 1990, p.179). Today, most academics agree on the four theoretical outcomes for a nuisance action: no remedy, compensated injunction (the Spur case), damages only (the Boomer case) and permanent injunction (Dobris 1990, p.179). In choosing the appropriate remedy, the courts will balance the equities, considering the "the relative benefit and hardship to the parties and the effect on the public interest in considering whether to grant an injunction" (Powell 2007 §64.07[2]). The practice of balancing the equities only determines the suitable remedy in an action, and does not affect the nuisance domination. Originally this practice was not universally accepted: Some "courts viewed an injunction as mandatory when a nuisance exists and damages fail to provide an adequate remedy" (Farber 2005, p. 118), but today the great majority of courts already recognize the doctrine of balancing the equities (Powell, 2007 §64.07[2]).

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[50] *Id.* at 707
[51] *Id.* at 708

2.5 History of Right-to-Farm Laws

In the previous sections, the principles of nuisance law are discussed. Land-use conflicts in connection with agricultural production were resolved in the framework of nuisance law until the passage of RTF laws, which had modified nuisance law in many aspects. Section 2.5 examines the emergence of RTF laws and Section 2.6 discusses the major features of RTF laws.

Kansas enacted the first RTF statute in the United States in 1963, but that statute only protects feedlots and was not applicable to other agricultural activities. The statute provides that any feedlot operated in compliance with standards, and regulations shall be deemed to be *prima facie* evidence that a nuisance does not exist.[52] Soon after, a couple of other states such as Oklahoma and Iowa adopted the similar feedlot type RTF laws. Comprehensive RTF laws that protect a much broader scope of agricultural operations did not come into existence until the late 1970s. These statutes extend the protection to almost all types of agricultural activities. Table 2-2 reports the year in which that comprehensive RTF laws are passed. The table clearly shows that the enactment years of RTF laws are highly concentrated; more than half the states enacted comprehensive RTF laws between 1979 and 1982. By the middle of 1980s, all states except South Dakota and Wyoming had passed RTF laws.[53]

After the World War II, more people began to migrate to rural areas, and "[o]ver forty percent of the homes built during this decade were constructed on rural land and often were scattered throughout the countryside on relatively large lots" (Hand 1984

[52] K.S.A. § 47-1505

[53] For a thorough study of the emergence of RTF laws, see Johnston and Lueck working paper (unpublished manuscript, July 2007).

p.291). Farmland was heavily affected by these population shifts as "many American cities were founded along major land and water transportation routes which generally bisected fertile river or coastal flood plains" (Hand 1984 p.291). As a study in 1982 shows, thirty-three out of the United States' top one hundred counties in production of farm products value are located central to metropolitan areas (Hand 1984 p.291). Farmers' decision to sell off farmland can be attributed to many economic and personal reasons, and the threat of nuisance suits was one of the factors.

Some legal scholars tend to deem the adoption of various farmland preservation programs as reactions of state and local governments to a growing public concern on food security (Hand 1984) [54]. Nevertheless, most of the proponents of these programs are agricultural producers who have direct interest in these programs. Hamilton and Bolte state that "[r]ight-to-farm statutes represent a major legal achievement for the interests of agricultural producers to ensure that nuisance law does not work to the detriment of agriculture" (Hamilton and Bolte 1988 p. 101). The major sponsors of RTF statutes were the state Farm Bureaus, which are independent, non-governmental, voluntary organizations governed by representing farm and ranch families with the mission to implement policies that will improve the financial well-being and quality of life for farmers and ranchers. Many state Farm Bureaus put right-to-farm legislation at the top of the list of priorities early or later during the 1970s and 1980s. For example, "the first section of the New Jersey Farm Bureau's 1980 policy guidelines establishes the promotion of right-to-farm legislation as one of the bureau's most important goals."(Palma 1980 p. NJ1) Similarly, the Arizona Farm Bureau

[54] A study reviewed the description of objectives in farmland protection legislation. In the 48 pieces of legislation, the stated objectives include orderly development (18), food security (30), local economy (24), environmental services (29), and protection of rural amenities (36). (Johnston and Stephen 2006, p. 223)

passed a resolution calling for a right-to-farm law at the delegate policy development session of the annual meeting in December, 1980.[55]

Table 2–2: Years of Enactment of Comprehensive RTF Laws

Year	States	Number of States
1979	Alabama, Florida, North Dakota, Washington	4
1980	Delaware, Georgia, Kentucky, Mississippi, Oklahoma, South Carolina	6
1981	Arizona, Arkansas, California, Colorado, Connecticut, Idaho, Illinois, Indiana, Maine, Maryland, Michigan, Montana, New Mexico, New York, North Dakota, Oregon, Texas, Utah, Virginia, Vermont	20
1982	Hawaii, Iowa, Kansas, Missouri, Nebraska, Ohio, Pennsylvania, Rhode Island, Tennessee, West Virginia, Wisconsin	11
1983	Louisiana, Minnesota, New Jersey	3
1985	Nevada, New Hampshire	2
1986	Alaska	1
1987	Massachusetts	1
1991	South Dakota, Wyoming	2

2.6 Key Components of Right-to-Farm Laws

The requirements under the RTF laws of different states are not exactly the same, but RTF laws share many common components. This section discusses the key elements of a typical RTF law and also compares RTF laws with nuisance law.

First, RTF laws of many states embody a requirement similar to the "coming to the nuisance" doctrine under nuisance law, requiring that the established date of operation precedes the competing property use, though the language used in statutes could be different. For example, some statutes simply provide that the farming practices must be established prior to the nearby nonagricultural activities; others may require that the conflicts of land use to be "due to changed condition in or about the locality," or that the operation was not a nuisance when it began. The exact meaning of "changed condition" may depend on the interpretation of case law, but basically it

[55] See *"Right to Farm" Leads List of Farm Bureau Priorities*, Arizona Farm Bureau News, Dec 22, 1980, p.1

is also a priority requirement. Some cases indicate that this requirement implies that farmers cannot expand their agricultural production so as to qualify the protection. In *Payne v. Skaar* (1995)[56], the defendant's feedlot tripled in size and nearby landowners began to experience offensive odors and an increasing amount of dust and flies. The court found that the RTF law did not prevent a finding of nuisance where an expanding agricultural operation was surrounded by an area that had remained substantially unchanged.

Second, some states have the existence requirement, which provides for a certain length of time of the existence of the farming practice. The length of time varies from state to state, but it is most commonly one year. There are two different types of existence requirements. The first type, simply requiring a certain length of the existence of the operation, is more like a statute of limitation, and has nothing to do with the priority requirement. The other type requires a certain length of existence prior to the changed conditions, which actually is an extra condition on the priority requirement, making the rule more stringent for farmers. For example:

> *No agricultural, manufacturing or other industrial plant or establishment, or any farming operation facility, any of its appurtenances or the operation thereof shall be or become a nuisance, private or public, by any changed conditions in and about the locality thereof after the same has been in operation for more than one year…*[57]

Third, a large number of states require the agricultural activities to be generally accepted agricultural practices (GAAP), or good agricultural practices, or normal agricultural practices. Not many RTF statutes have clearly defined GAAP, but basically, farms complying with applicable laws and using practices commonly found in the state will satisfy this requirement (Hamilton 1992, p.35). The following is a

[56] 127 Idaho 341
[57] Code of Ala. § 6-5-127

definition of GAAP in the Arizona RTF statute:

> *Agricultural operations undertaken in conformity with federal, state and local laws and regulations are presumed to be good agricultural practice and not adversely affecting the public health and safety.*[58]

Local governments have established many regulations for each particular activity. Restrictions on agricultural operations may also be found in zoning laws and environmental regulations. For examples, state rules may require new livestock facilities to be located at least ½ mile from the nearest house (Hamilton 1992, p.89-95). The Environmental Protection Agency has also promulgated a rule regulating concentrated animal feeding operations ("CAFO") as required by the Clean Water Act. All CAFOs must implement nutrient management plans to obtain the National Pollutant Discharge Elimination System (NPDES) permits.[59] Although the GAAP requirement may encourage state and local governments to establish extensive rules for all types of agricultural activities, it is still more favorable to farmers than the reasonableness test under nuisance law, because it does not require courts to consider the nature of the locality, or balance the utility of the activity. The GAAP requirement is also a relatively concrete standard because the restrictions in regulations and zoning laws are usually rigid, which do not afford courts much discretion.

Additionally, negligence or impropriety may deprive farmers from the protection of RTF laws. This exception may give courts a little more discretion as the meanings of negligence and impropriety depend on case by case. Pollution, public health and safety are also grounds that can outlaw agricultural practices. A couple of special RTF laws embody an agricultural zoning requirement.

Powell states that RTF laws "reinvigorate the 'coming to the nuisance' defense

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[58] Ariz. Rev. Stat. Ann. §3-112

[59] See the EPA website. http://cfpub.epa.gov/npdes/afo/cafofinalrule.cfm

for preexisting agricultural user" (Powell 2007, §64.05[4]). It is probably true that RTF laws may be deemed as a statutory version of the "coming to the nuisance" doctrine as most RTF laws have a priority requirement, which can be analogous to that doctrine. Nevertheless, RTF laws also have some unique features that the "coming to the nuisance" doctrine does not have, such as conformity to local laws and regulations. Priority alone will not be sufficient to exempt the farmer from liability. As modern technologies advance and cities grow, the concept of GAAP will also evolve, and the government can modify pollution laws and regulations. Under RTF laws, the reliance on industry standards and administrative regulations increases. Although courts no longer decide nuisance cases based on the social utility of the activity, farmers are required to upgrade production technologies and methods to comply with industry standards and regulations, which reflect the changes of social utility of the agricultural production activity. It is possible that local laws and regulations outlaw a farming practice that has been in operation for a long time. RTF laws shift part of the judicial responsibility of determining whether an activity is a nuisance to the legislative and the administrative branches, which probably are at a better position to weigh the harm and benefits of agricultural activity. There is a trend of nuisance law over the past half-century that public law and administrative regulations are replacing the dominating position of common law in nuisance cases.

As summarized in Table 2-3, RTF laws have brought three major changes to the law of agricultural nuisances. First, most RTF laws codify the "coming to the nuisance" defense into statute, whereas under nuisance law "coming to the nuisance" is merely a factor. Nevertheless, RTF laws are not completely equivalent to the "coming to the nuisance" doctrine because the qualified agricultural activities must

satisfy all the other conditions under the RTF statutes as well as other laws and regulations. Second, under either the reasonableness test or the balancing test of the common law, the courts make *ex post* judgments to determine whether an agricultural activity is a nuisance. Agricultural activities are often ordered by courts to give way to the more valuable land use after the change of the locality, especially urban development. In contrast, under RTF laws, once an agricultural activity satisfies all the requirements, the only option to convert farmland for other uses is through private transactions. Third, most requirements under RTF laws, such as the priority requirement, the existence requirement, conformity to local regulations and industry standards, are very rigid and usually can be determined on objective facts that are known to both parties *ex ante* before they make investment decisions. There will also be more certainty with respect to the outcome of a lawsuit and will be more predictable to both parties. Accordingly, many actions will be avoidable under RTF laws.

Table 2–3: Major Differences between Nuisance Law and RTF Laws

Nuisance Law	**RTF Laws**
Prior use is only a factor	Prior use is a defense
Ex post entitlement	*Ex ante* entitlement
Case by case, vague	Mechanical rules

It is worth noting that under RTF laws the legislative bodies play a more important role in regulating farming operations though statutes, administrative regulations and other industry standards, which are constantly revised over the time so as to account for technology advancement, economic development and the demand for environmental protection. These regulations and standards serve a similar function

to the “reasonable use” criterion under nuisance law. In this regard, it is unclear how big the actual difference is between RTF laws and nuisance law.

CHAPTER THREE – ECONOMICS OF RIGHT-TO-FARM LAWS

In this chapter I use and develop economic models to examine the effects of RTF laws on land use. In Chapter 2, I note that RTF laws changed nuisance law in some aspects. This chapter mainly discusses how RTF laws affect the farmers and land developers' incentives in investment decisions, which ultimately determine land-use allocation. The land use problem may be modeled in many ways based on different assumptions. I describe the situation that I intend to model in Section 3.1. To simplify the problem, I assume that there are only two parties, a farmer and a land developer, who arrives later and purchases land from the farmer. My model attempts to show how nuisance law and RTF laws differently affect the farmer's decision in the quantity of land to be sold.

In Section 3.2, I examine the literature on property legal regimes, which may provide implications for the study RTF laws. The literature review starts with the Coase Theorem, covers the literature on transaction costs, economic analysis of the "coming to the nuisance" doctrine, and the economics of the accident law. Section 3.3 reviews a number of economics papers concerning RTF laws and derives predictions about the effect of RTF laws on land use. In Section 3.4, I construct theoretical models to examine the situation that I describe in Section 3.1. I first build a model for the first-best situation, assuming that the entire land is owned by one party. I then build a model that has two parties involved where transaction costs are not zero and examine how legal regimes affect private contracting on externalities and the farmer's incentive to sell farmland.

3.1 The Economic Problem

This section explains the situations my model examines in Section 3.4. Suppose that in Period I, as shown in Figure 3-1, Blackacre is a parcel of land located in a rural area near a city and solely owned by a farmer, who operates a feedlot on the land. It is assumed that all the surrounding land is also agricultural lands so that land-use conflicts do not arise between Blackacre and these surrounding areas. Therefore, the surrounding lands are not considered in the models. Production costs not being considered, the value of Blackacre in Period I is determined by the value of the output of the feedlot.

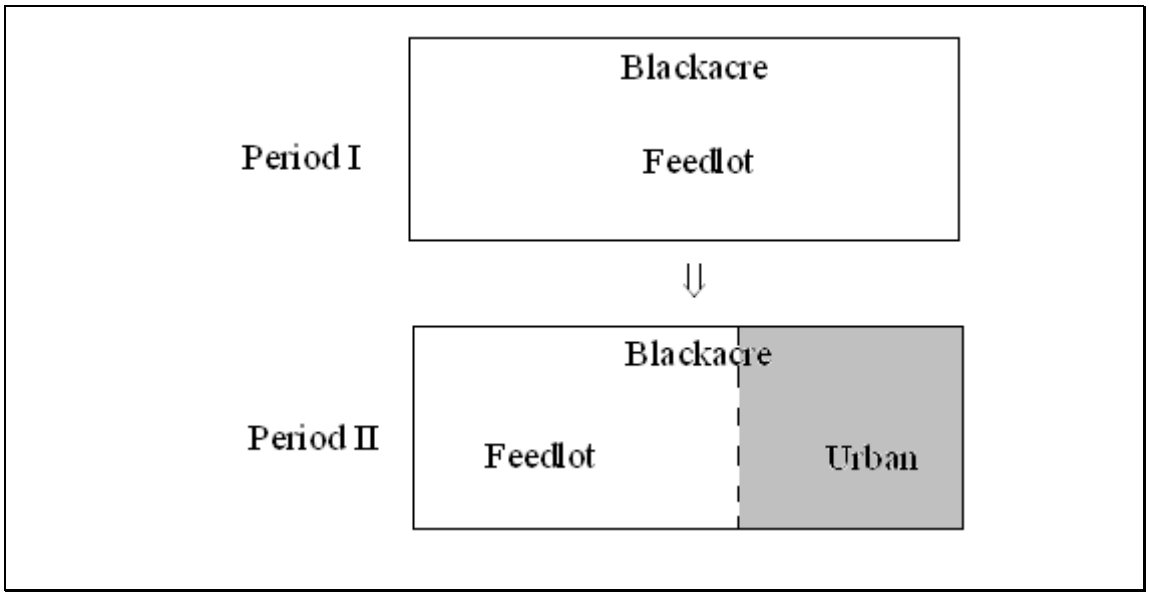

Figure 3–1: Modeling Situation

In Period II, as a result of many unspecified factors, the city near Blackacre begins to expand quickly, giving rise to an increasing demand for urban land. The land value for possible urban uses on Blackacre increases faster than the land value for agricultural uses. To further simplify the problem, I only consider the following two situations that will arise when the returns to urban use exceed the returns to agricultural use. In Situation A, the farmer in Period II builds residential houses for his own use on Blackacre, next to his feedlot. The smell emitting from the feedlot will

certainly interfere with the farmer's enjoyment of his newly built houses. In this situation, neither nuisance law nor RTF laws will affect the farmer's choices because the farmer will decide the allocation of land use solely based on his own economic incentives. Since the farmer owns the entire land, there are no transaction costs that needs to be considered. Situation A may be deemed as the first-best situation because the farmer is the sole owner of Blackacre and therefore, transaction costs can be ignored. As shown in Figure 3-1, in Period II, the boundary between the two land uses is solely determined by the farmer, depending on the magnitude of the disamenities (or the externalities) that the feedlot generates, and the land value for different land uses.

In Situation B, I assume that the farmer sells a portion of Blackacre to an urban developer who develops the land for residential purposes, and the farmer still keeps the rest of the land for agricultural production. Just as in Situation A, since there are two incompatible land uses, the feedlot operation becomes a nuisance to the urban developer. The presence of the feedlot will decrease the value of the newly developed residential neighborhood. If it is assumed that the magnitude of the nuisance is at least partially foreseeable to both the farmer and the developer before the land sale, then the price of the land will probably reflect this reduced value. Unlike in Situation A, the allocation of land use in Situation B is not solely determined by the farmer, but by a joint decision of the farmer and the developer. As described in Chapter 2, nuisance law and RTF laws give different property entitlement to the farmer and the developer. The nuisance law regimes impose constraints on the farming operations and affect the parties' private negotiation on controlling externalities. Therefore, the expected externalities in Period II will be different under nuisance law and RTF laws. Moreover,

the land prices decided in Period I is determined by the expected externalities in Period II and the farmer's choice in selling the land is affected by the land prices. Hence, in Situation B, the nuisance law regimes will ultimately affect the land market and the allocation of land use.

3.2 Economic Perspectives on Nuisances

3.2.1 Coase's Contribution

The legal concept of "nuisance" is known to economists as an activity that generates negative externalities, which has been extensively studied by economists. Coase laid down the foundation of the economic studies of property legal regimes through his modification of the traditional economic view on externalities. In his seminal paper "The Problem of Social Cost", Coase (1960) argues that the essence of a nuisance issue is land-use conflicts that involve two competing property rights. Since the problem is of a reciprocal nature, discussion that only focuses on harmful effects is inadequate. The real problem is how to choose the appropriate property institutions to address the harmful effects. Coase suggests that "when an economist is comparing alternative social arrangements, the proper procedure is to compare the total social product yielded by these different arrangements" (Coase 1960 p. 34) and he implies that legal intervention sometimes is not necessary or even desirable. He notes that a smoothly operating pricing system will lead to efficient allocation:

> *If we are to attain an optimum allocation of resources, it is therefore desirable that both parties should take the harmful effect (the nuisance) into account in deciding on their course of action. It is one of the beauties of a smoothly operating pricing system that, as has already been explained, the fall in the value of production due to the harmful effect would be a cost for both parties* (Coase 1960, p. 13).

Most significantly, Coase has points out that when transaction costs are zero,

regardless of the initial arrangement of property rights, the market will lead to an efficient solution resulting from private bargaining. This proposition has become widely known as the Coase Theorem. The Coase Theorem, thus provides a benchmark for the economic analysis of property rights, and has spawned much literature on the conflicts of property rights. One important implication drawn from the Coase Theorem for this thesis is that, the initial designation of property entitlement is not determinative in land-use allocation as the majority of land-use conflicts are not resolved through litigations, but private negotiation, or land sales. Therefore, the focus should be on how legal regimes affect the incentives of private parties in land transactions.

3.2.2 The "Coming to the Nuisance" Doctrine

A corollary of the Coase Theorem is that when transactions are not costless, as is the case in the real world, the legal assignment of property rights does matter and land-use allocation will deviate from the first-best. According to Coase, a nuisance issue is reciprocal in nature, and therefore the injurer-victim distinction will be insufficient to determine the optimal assignment of property rights. The question then becomes -- What kind of property legal regimes will encourage efficient use of resources?

Calabresi and Melamed (1972) argue that the cost should be put on the party or activity best located to make a cost-benefit analysis; if it is uncertain, the cost should then be put on the party or activity which can, with the lowest transaction costs, act in the market to correct an error in entitlements by inducing the party who can avoid social costs most cheaply to do so. More relevant to this thesis, following Calabresi and Melamed's argument, some economists have attempted to study the assignment of

property rights when there is a sequential order for the parties involved. Thus the question is narrowed down to whether the property rights should be assigned based on the sequential order of property uses. Such studies are actually an evaluation of the "coming to the nuisance" doctrine, and, to some extent, RTF laws.

Wittman (1981), in examining the "coming to the nuisance" doctrine, postulates that there are two locations (good and bad) and two time periods (1 and 2). He looks at the different scenarios in terms of the locations and the time periods that the polluters and pollutees are associated with. Wittman notes that the legal rules that encourage such efficient sequences can only be determined depending on the relative magnitudes of the costs and benefits of the activities. He studied cases assuming courts have unlimited information and claims that case law is consistent with his analysis that economic efficiency actually dictates whether the prior activity is in the right or not:

> *The courts have held that being first is not sufficient to grant rights even when the party should have been first. Thus pig farms, horse stables, and dog kennels must go as the city expands. While it is appropriate that these activities were there first, it is more costly for the city to leapfrog beyond these places of animal husbandry (or for residents to put up with the smell) than for these places to rebuild elsewhere. In such cases, the courts have consistently rejected coming to the nuisance as a defense* (Wittman, 1981 p.564).

Wittman's major concern is how legal rules affect the *ex ante* decisions of the party who invests in the prior activities. Basically, his approach is normative. Wittman simply gives his propositions that what legal rules will induce what kind of land-use allocation without theoretical models.

Following Wittman, Pitchford and Snyder (2003) build a rigorous bargaining model to examine the effect of various property rights regimes on the initial investment made by the party who determines the prior activities, the so-called "the

first mover" in their paper. They assume that there is a sequence between the inceptions of the two incompatible property uses. The first mover can foresee that a second mover will invest in a subsequent land use on the adjacent land in the future, and the presence of the subsequent land use will result in a land-use conflict between the two parties. It is assumed that the first mover cannot contract with the second mover prior to the second mover's identity being revealed, but the two parties can negotiate with one another after the second party's arrival. Property rights regimes determine the position of the two parties in the negotiation process and thus affect the first mover's decision on an *ex ante* investment. Granted, these assumptions simplify the reality and may ignore some important facts of the issue. For example, the first mover may not be able to contract with the second mover, but he may contract with the original owners of the surrounding lands to reserve the right to farm in the form of easement. Also, other situations are not considered by this model such as that the first mover may change land use by himself.

Let me use my example in Section 3.1 to illustrate Pitchford and Snyder's model. The farmer, when compared with the developer, can be regarded as the first mover, because he determines the location and the type of agricultural activity in the first place. Before the urban development plan is revealed, the farmer can neither identify the specific land developer nor can he accurately pre-estimate the potential harm of his agricultural activities and the land value of perspective urban use. Therefore, contracting between the farmer and developer will be impossible when the farmer chooses his initial investment in agricultural production.

In Pitchford and Snyder's model, A is the first mover, who makes an initial investment x and B is the second mover. After B's arrival, A and B engage in Nash

bargaining, equally splitting the gains from arriving at an efficient *ex post* agreement. That is, each party obtains its threat point surplus, the payoff to each party respectively if an agreement cannot be reached, – denoted $t_R(x)$ for A and $\tilde{t}_R(x)$ for B – plus half of the gains $s^*(x) - t_R(x) - \tilde{t}_R(x)$ from the agreement, where s^* is the maximum *ex post* social surplus.

Thus A's *ex post* surplus from Nash bargaining is $t_R(x) + \alpha[s^*(x) - t_R(x) - \tilde{t}_R(x)]$ (where α is A's bargaining power relative to B). A will adjust its initial investment x so as to maximize its *ex post* surplus. The basic idea is that the determination of the threat points $t_R(x)$ and $\tilde{t}_R(x)$ depends on property legal regimes, and therefore the initial investment level x is also determined by property legal regimes.

Pitchford and Snyder's predictions are that regimes favoring the first mover will induce the first mover to over-invest before the property use conflicts arise. Regimes favoring the second party, except second-party damage rights, will result in *ex ante* underinvestment of the first party, and "second party damage rights always produce the first best since it forces the first mover to internalize the effect on the second mover of all its decisions (investment, externality, and so forth)" (Pitchford and Snyder 2003, p.511). Equilibrium *ex ante* investment in the various property rights regimes can be ranked as follows: second-party injunction rights < second-party damage rights < first-party injunction rights < first-party damage rights. They conclude that when the court cannot implement a damage rights regime due to insufficient information, the court should favor the party whose contribution to social surplus dominates the other. Only when the first mover is such a party should the "coming to the nuisance" doctrine be applied.

It is worth noting that the property legal regimes discussed by Pitchford and Snyder (2003) are not exactly the same as the ones in the real world. As noted in Chapter 2, the property rights under nuisance law is based on *ex post* determination. In addition, both damages and injunction may be granted as remedy under nuisance. For example, the *sic utere tuo* maxim may be viewed as second-party injunction rights regime, which leads to the lowest *ex ante* investment in the first-party's activity. In contrast, the *Spur* case represents the first-party damage rights regime, which leads to the highest *ex ante* investment in the first-party's activity.

RTF laws, analogues to the "coming to the nuisance" doctrine, can be deemed as the first-party rights regime in Pitchford and Snyder's model. According to their model, allocating property rights to the first mover leads to overinvestment. With respect to my example in Section 3.1, their model suggests that in order to gain a windfall in the future, the farmer will over-invest in agricultural activities and preempt land use before the developer comes to purchase land because RTF laws only give the developer the option to buy out the farmer the farmland.

3.2.3 Legal Regimes and Transaction Costs

Since Coase's seminal paper, the focus of the study of property rights regimes has shifted from traditional Pigovian analysis to finding out how the transaction costs associated with various property legal regimes affect private behaviors. It has been argued[60] that "the best policy for the law is to lubricate bargaining by defining clear and simple rights when transaction costs are already low" (Cooter and Ulen 2000, p. 103).

[60] What kind of situations can be considered with low transaction costs is arguable. It is generally held that low transaction costs are associated with clear, simple rights, few and friendly parties, reasonable behaviors, instantaneous exchange, low costs of monitoring, cheap punishment, etc. Since I focus on private nuisances where only a few parties are involved, I assume that transaction costs are low, though this may not be necessarily true. See Cooter and Ulen 2000, p.87-91, for a general discussion of the factors affecting transaction costs.

Calabresi and Melamed (1972) make a distinction on the property rule and the liability rule. Under the property rule, “someone who wishes to remove the entitlement from its holder must buy it from him in a voluntary transaction in which the value of the entitlement is agreed upon by the seller” (Calabresi and Melamed 1972, p.1092). Under the liability rule, when someone destroys the initial entitlement, he is only required to pay an objectively determined value for it (Calabresi and Melamed 1972, p.1092). Obviously, RTF laws can be considered property rule, whereas typical nuisance law embodies both property rules and liability rules: Injunction is a property rule and damage is a liability rule. The standard argument in the law and economics literature is that where there are few obstacles to cooperation (i.e., low transaction costs), the property rule is more efficient (Cooter and Ulen 2000, p. 103). If compensatory damages were the dominating remedy under nuisance law, then it probably could be said that RTF laws are more efficient with low transaction costs. Nevertheless, injunction is quite common under nuisance law, and therefore the distinction between property rules and liability rules is insufficient to distinguish RTF laws from nuisance law.

Merrill (1985) makes a related point in examining the distinction between trespass law and nuisance law. Merrill argues that when transaction costs are low, a legal system would tend to adopt mechanical entitlement-determination rules that afford courts little discretion, such as trespass law. On the other hand, when transaction costs are so high that make market exchanges unlikely to take place, the legal system tends to adopt a judgmental entitlement-determination rule, which affords very broad discretion to courts in determining entitlements, such as nuisance law. Since courts are not at a good position to evaluating property entitlements,

private contracting is always a preferred option when it is possible from a social standpoint. Therefore, if transaction costs are low enough to make contracting a viable option, the rule should minimize entitlement determination costs so as not to frustrate Coasean bargains. For example, trespass law always stipulates in unambiguous terms which party has the right in dispute and little *ex post* judicial judgment is needed.

RTF laws probably can be better characterized as a mechanical rule by Merrill's standard because the requirements under RTF laws are clearly defined, requiring little *ex post* judgment from courts. According Merrill's argument, whenever transaction costs are low enough (e.g. few parties, reasonable behavior, low costs of monitoring) to make contracting a viable option, a mechanical rule like RTF laws will reduce the entitlement-determination costs and further maximize the joint wealth of the parties. With respect to my example, the only option for the developer under RTF laws is to buy out the farmer's farmland, whereas under nuisance law the parties' respective entitlements are less certain and predictable, which may discourage the developer to strike a deal with the farmer. Therefore, it is possible that RTF laws will promote private bargaining between the farmer and the developer. In other words, RTF laws may encourage farmland conversion when urban land prices are rising.

However, some economists have argued that the above suppositions, though widely accepted, are not necessarily true. Ayres and Talley (1995) argue that the liability rule (the less than complete rights) is superior than the property rule even when transaction costs is low because it can better induce the parties to bargain to a solution. More relevant to RTF laws, contrary to Merrill's argument, Johnston (1995) shows that a contingent, *ex post* entitlement (such as the balancing test) is more likely to induce efficient bargaining than a definite, *ex ante* entitlement (such as RTF laws).

Johnston's bargaining models find that a contingent entitlement will make credible a threat to enjoin the farming operation, while such a threat is not creditable under a definite entitlement. The credible threat may supplant strategic delay as a screening device and will induce immediate *ex post* efficient agreement. However, one of the basic assumptions in Johnston's model may not be realistic. He assumes that with *ex ante* entitlement, the nuisance victim[61] only accepts an offer p that is greater than the harm h to give up his entitlement, or $p<h$, whereas with *ex post* entitlement, the victim accepts any offer greater than the expected compensation determined by courts, or $p-h>-qh$, where q is the probability that the victim will be left without a remedy for the harm. Since q is less than 1, the nuisance victim is willing to accept low offer with *ex post* entitlement. This is not necessarily true because the court's estimation of harm could be greater than the actual harm and with *ex post* entitlement the expected compensation does not necessarily to be less than the actual harm. Nevertheless, Johnston's model demonstrates that under his assumptions nuisance law is superior to RTF laws in inducing private bargaining; therefore, it is more likely to encourage farmland conversion when urban land prices are rising.

3.2.4 Economics of Accident Law

The accident law model[62] is developed to show how tort liability rules create incentives for individuals to take precautions so as to maximize social welfare. As noted in Chapter 2, nuisances are classified as a subcategory of torts. This section is devoted to an introduction of the accident law model and discusses how the accident law model can be related to nuisance law and RTF laws.

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[61] The case of RTF laws is the opposite of the example given in Johnston (1995). In Johnston's example, the *ex ante* entitlement to be free from nuisances is given to the nuisance victim.

[62] For the accident law model, see Cooter and Ulen (2000), p.300-311.

According to the Coase Theorem, tort liability should only arise when contracting is not a viable option due to high transaction costs. It has been argued that "the economic purpose of tort liability is to induce injurers to internalize the [externalities]" (Cooter and Ulen 2000, p290). From a social standpoint, the expected social costs of accidents have two components: the costs of precaution and the expected harm. Let w be per-unit precaution costs, x be the quantity of precaution, $p(x)$ be the probability of accident, which decreases with increases in precaution, and A be the monetary value of the harm from an accident. Thus the expected social costs can be denoted as the following: $SC=wx + p(x)A$. By simple algebra, it can be easily shown that the socially optimal level of precaution x^* can be found by solving the following equation: $w= - p'(x^*)A$, where the marginal cost of precaution equals the expected marginal benefit of precaution.

Recall that the *sic utere tuo* doctrine of nuisance law will hold the farmer liable for any spillover effects on his neighbors. A rule like this is strict liability, which requires one party to perfectly compensate the other party. Under such a rule, the social optimum is also the private optimum to the injurer and therefore, he will set the precaution level which also maximizes social wealth. In contrast, the victim is indifferent between an accident with compensation and no accident and has an incentive not to take any precaution. The opposite of strict liability is no liability, under which the victim will be the sole bearer of the cost of harm. This rule gives the victim incentives for efficient precaution but provides the injurer no incentive to take precaution.

Nevertheless, strict liability or no liability only gives one party the incentive to take precaution, and therefore "is preferable when only the injurer can take precaution

against accidents"(Cooter and Ulen 2000, p.304). Again, Coase has pointed out the essence of a nuisance issue is land-use conflicts that involve two competing property rights. Farmers may take actions to abate externalities, whereas urban developers may select locations that minimize the interference. Hence, ideally, nuisance law should give both parties the incentive to take precautions and strict liability is not optimal in mitigating land-use conflicts.

In the accident law model, the negligence rule affords both parties the incentive to take precaution. The negligence rule imposes a legal standard of care with which the actor must comply in order to avoid liability. There are four forms of the negligence rule. Under a simple negligence rule, only the injurer's act is examined at a legal standard of care: the injurer is held liable only if taking less precaution than the socially optimal level. Under the rule of negligence with a defense of contributory negligence, the injurer is only liable when the injurer is at fault and the victim is faultless. If both parties are at fault, the injurer has no liability. The third form is called "comparative negligence" and is enacted when both parties are at fault: the cost of harm will be divided based on each party's contribution of negligence to the accident. The final form, strict liability with a defense of contributory negligence, is where the injurer is held liable as long as the victim is faultless. It can be proved that all four forms of the negligence rule "gives the injurer and victim incentives for efficient precaution" (Cooter and Ulen 2000, p310); only the harm bearer will be different.

As noted in Chapter 2, negligence, or faultiness was introduced as a basis for liability under 19th-century nuisance law. Initially, courts seemed to have applied the

simple negligence rule, only considering the manner of the defendant's operation[63]. Before long the simple negligence rule was found insufficient. The rise of the "reasonableness" concept allowed courts to take into account more factors, including the nature of the location, thus creating incentives for both the farmer and the developer to locate their activities in a way that minimizes land-use conflicts. American courts had developed various theories of the reasonableness test: a theory focusing on the defendant's right, a theory focusing on the plaintiff's right, and a theory considering the nature of the location and other surrounding circumstances[64]. These variations in the reasonableness test may be analogous to the different forms of the negligence rule respectively, but all of them will achieve similar results, inducing both parties to take optimal precaution to mitigate land-use conflicts.

RTF laws also contain a negligence requirement, which generally has nothing to do with the nature of location. In that respect, RTF laws adopt the rule of no liability for farmers with regards to the selection of the location of agricultural activities. Hence, farmers will have no incentive to relocate their facilities when the value of urban land is rising, only developers have incentives to select good locations to avoid or mitigate land-use conflicts. This suggests that without private bargaining, RTF laws will not lead to efficient land-use allocation because farmers lack the incentive to efficiently relocate land uses.

The accident law model completely excludes the possibility of private bargaining because it is assumed that it is impossible to strike a deal between the injurer and the

[63] Here the legal characterization of the liability rules does not necessarily correspond to the economic classification. In nuisance actions, the great majority of jurisdictions also recognize comparative negligence and contributory negligence in some circumstances (Powell 2007, §64.03[5]), but the legal concept of "negligence" only emphasizes the conducts of the parties, or the manner of property use. The location of the defendant's activity is usually not considered a basis for negligence, but from an economic perspective, the choices of good location is definitely an important precaution that the parties need to take so as to avoid land-use conflicts. The concept of "unreasonableness" may be more close to the economic idea of negligence.

[64] For the different theories of the reasonableness test, see Lewin (1990), p.200-208.

victim to avoid an accident before it takes place. Nonetheless, in the matter of land-use conflicts, private bargaining is often possible. For example, a developer can buy out the farmland from a farmer. My model in Section 3.4 partially modifies the accident law model so as to allow private bargaining.

3.3 Economic Perspectives on Right-to-Farm Laws

In the preceding sections, economic literature on property legal regimes and controlling externalities is reviewed. In this section, I discuss the papers focusing on RTF laws from an economic perspective.

Bergstrom and Centner (1989) regard nuisance law as a means to internalize the social cost of agricultural activities. On the contrary, under RTF laws, the social costs of agricultural activities are not incurred by the farmers. Therefore, Bergstrom and Centner predict the following:

> *Right-to-farm laws attempt to establish the zero liability rule in qualifying situations for reductions in aesthetic enjoyment caused by agricultural waste by-products. The expected economic effects of the zero liability rule are increased agricultural commodity production and decreased consumption of aesthetic enjoyment* (Bergstrom and Centner 1989, p.29).

The view of Bergstrom and Centner is the traditional economic approach towards externalities, solely focusing on the harmful effects.

Jackson (1986) analyzes RTF laws under the framework of the Coase Theorem. Burgess-Jackson shows that when transaction costs are insignificant, all property rights regimes will achieve the same efficient result, and when the transaction costs are prohibitive, RTF laws are less efficient than the compensational liability under nuisance law, assuming that courts have full information. However, because Burgess-Jackson provides no evidence of the actual magnitudes of the transaction costs under RTF laws and the information costs and legal costs under nuisance law,

his point is no more than a restatement of the Coase Theorem. To compare the effect of RTF laws and that of nuisance law, one might need to first examine the effect of the various regimes on transaction costs and legal costs.

Kwong and Baden (1986) call Burgess-Jackson's argument a "Nirvana" approach because Burgess-Jackson fails to consider the comparative efficiency of the different property rights regimes. They assert that the enforcement of RTF laws could reduce the uncertainty and give individuals a clear idea of what controls and exclusions should be exercised regarding resources. This is analogous to Merrill's (1985) argument. Because of the unambiguousness of the requirements embodied in RTF laws, the entitlement-judgment costs will be reduced. As a corollary of Merrill's argument, if the transaction costs are low enough to make private contracting feasible, RTF laws will then be a desirable option as they reduce the entitlement-judgment costs.

3.4 Theoretical Models

3.4.1 The First-best Situation

In this section, I model the economic situation that I describe in Section 3.1. The goal is to examine how RTF laws affect a farmer's incentive to sell land, which eventually determines land-use allocation. In this subsection, I first examine the first-best situation where the farmer is the sole owner of land and decides land-use allocation completely at his own will (Situation A as described in Section 3.1). The nuisance law regimes have no effect on the farmer's choices in this case. In subsection 3.4.2, I model the situation where two parties are involved (Situation B as describe in Section 3.2). Since transaction costs are not zero in this case, legal regimes affect private contracting on externalities and the farmer's incentive to sell farmland.

In Situation A described in Section 3.1, I assume that the farmer is the sole landowner of Blackacre, and he determines the land uses so as to maximize the value of land regardless of the constraints of the nuisance law regimes. Suppose that the total acreage of land is X and the landowner allocates x_A acres for agricultural use and the rest for urban use $x_U = X - x_A$. The total profits to the landowner come from two parts: the agricultural production and the urban use.

The agricultural output takes the following form: $Q = w(x_A) - c(e)$, where $w(x_A)$ is the observed output that is assumed to have a unit price; x_A is the acreage of the land allocated for agricultural production; $c(e)$ is the production costs; and e represents the manner of farming practices such as production technologies and waste management methods that the farmer adopts. I assume that $w_x > 0, w_{xx} < 0,\ c_e < 0$ and $c_{ee} > 0$, where the subscripts denote partial derivatives. It is further assumed that the manner of farming practices determines the magnitude of harm imposed on the urban land; that is $H=h(e)$, where H is the average harm per acre urban land. I assume that $h_e > 0$ and $h_{ee} < 0$. In other words, a greater e represents a technology or operation manner that causes more harm.

The above assumptions imply that a more urban-use friendly manner of farming practice, which causes less harm on the adjacent urban land, usually costs more to the farmer. For example, ammonia emissions to the atmosphere, which cause odor and contamination of water, are one of the environmental concerns in connection with livestock operations. A study shows that the ammonia emissions can be reduced 40-50 percent by using biofiltration at the animal housing area, but biofiltration also costs a farmer approximately $0.25/piglet, amortized over a 3-year life of the biofilter (Shih

et al. 2006, p.8). Generally speaking, a measure that a farmer takes to mitigate the harm on the adjacent land increases agricultural production costs. A similar assumption is found in literature on externalities. (Baumol and Oates 1988).

Furthermore, I assume that the urban land has a value *v* per acre, which will be diminished by the harm *h(e)*. The farmer jointly chooses x_A and *e* to maximize his profits from the whole parcel. Consequently, his objective is

$$\max_{x_A,e} \prod = w(x_A) - c(e) + (v - h(e))(X - x_A). \qquad (3\text{-}1)$$

The first-best solution e^* and x_A^* satisfies:

$$-c_e(e^*) \equiv h_e(e)(X - x_A), \qquad (3\text{-}2)$$

$$w_{x_A}(x_A^*) \equiv v - h(e). \qquad (3\text{-}3)$$

The first-order conditions indicate that externalities will be perfectly internalized when there is only one landowner. Equation (3-2) shows that the landowner has an incentive to take a measure to mitigate harm when the marginal cost of the measure in agricultural production is less than the marginal benefit on the urban land. Equation (3-3) shows that the landowner allocates land uses depending on the respective marginal benefits of agricultural and urban uses. For example, suppose that the farmer, who himself is also a developer, builds residential houses on his own land next to the feedlot. The spillover effects on the urban land then are completely internalized because the feedlot and the houses are owned by the same individual. He decides the quantity of land for residential development based on the value of the houses and the profits from the feedlot operation. In addition, as the feedlot operator, the farmer will take into account the impact of the feedlot operation on the value of his houses and adjust the manner of the feedlot operation so as to maximize his total profits.

3.4.2 The Nonzero Transaction Cost Model

In the preceding discussion, it is assumed that there is only one landowner so that transaction costs are zero and the nuisance law regimes do not matter. In this subsection, I model Situation B as described in Section 3.1 where a second party, the developer, is involved. As shown in Figure 3-2, in Situation A, since the farmer is the only landowner, he jointly chooses x_A and e to maximize his total profits in Period II. In Situation B, I assume that a developer purchases land from the farmer. Since there are two landowners in Period II, transaction costs cannot be assumed to be zero. Granted, it is always possible for the developer to buy the farmer's right to pollute through private contracts at the time of purchase and the farmer also has an incentive to adopt appropriate technologies to limit the harm on the urban land so as to increase land prices. However, not all aspects of the feedlot operation can be privately contracted due to prohibitive transaction costs because it is always costly to negotiate, draft and enforce a contract. Since private contracting cannot be perfect, strategic behaviors of the farmer in Period II are inevitable. The manner of the feedlot operation is not simply an economic choice of the farmer, but is more of a reaction to different legal regimes. Therefore, legal regimes determine the manner of the operation after the land sale; the operation manner determines the land prices; and the land prices in turn determine the farmer's decision to sell land for development.

In the model, I first examine how the farmer makes decisions on the quantities of land to sell to the developer (choosing the level of x_A) so as to maximize his profits from the entire parcel. I show that the farmer's choice of x_A depends on the expected

manner of the feedlot operation (the choice of *e*) in Period II. In the second step, I examine how the expected operation manner *e* is determined under different legal regimes. Based on the conclusions from the two steps, my model shows how legal regimes affect the farmer's choices of $x_{A.}$

The essential idea of my model is similar to that of Pitchford and Snyder (2003) that legal regimes determine the respective gains and losses of each party, and eventually affect the parties' incentive in investment, or resource allocation. The major difference between my model and Pitchford and Snyder's is that they use a bargaining model to examine the effect on the first mover's *ex ante* investment in his activity. Their model excludes private contracting between the parties before and at the time of purchase, whereas my model allows private bargaining on externalities at the land sale.

As described in Section 3.1, the farmer is the sole owner of Blackacre before the land sale. He maximizes the total profits from the entire parcel by choosing the quantity of land for sale. The farmer initially owns X . Let x_A be the quantity of land the farmer reserves for the feedlot and x_U *(*where $x_U = X - x_A$*)* be the land he chooses to sell. In the previous section I use *v* to denote the value of urban land, but in this model, the urban land value to the farmer becomes the market prices of land. I use *p* to denote the land prices of similar lands without nuisance harm. Since the presence of the feedlot decreases the land value for urban uses, the price of the land sold to the developer becomes $p - h(e)$ per acre where *h(e)* is the expected average harm on the urban land. The farmer's proceeds from the land sale are $(p - h(e))x_U$. The farmer's objective is:

$$\max_{x_A} \prod = w(x_A) - c(e) + (p - h(e))(X - x_A). \qquad (3\text{-}4)$$

The farmer's private solution satisfies:

$$w_x(x_A^*) \equiv p - h(e). \qquad (3\text{-}5)$$

In the farmer's objective function, I treat *e* as a parameter because the manner of the feedlot operation is determined by different legal regimes, which will be discussed later. This solution is almost identical to the first-best solution in the one landowner model. It suggests that the farmer decides the quantity of land to be sold based on the respective marginal benefit of agricultural production and the land price. Upon the assumption that $w_{xx} < 0$ and $h_e > 0$, it can be easily derived from equation (3-5) that:

$$\frac{\partial x_A}{\partial e} > 0. \qquad (3\text{-}6)$$

Equation (3-6) shows that the farmer tends to sell less farmland for development when the manner of operation is expected to be less friendly to urban uses (or causing more externalities). Unlike in the first-best situation, in this model, the manner of operation *e* is not solely determined by the farmer's choices, but constrained by legal regimes and private contracting. If the harm caused by the feedlot operation can be perfectly internalized, the farmer and the developer will agree on the first-best optimum *e**-- the ideal manner of feedlot operation after the land sale. Unfortunately, this cannot be the case in reality because of the farmer's strategic behaviors after the land sale. The following discussion focuses on how different legal regimes determine the expected *e* – the manner of the feedlot operation after the land sale. First, I separately examine the farmer's choice of *e* under nuisance law and RTF laws in Period II without account of private contracting. That is actually the starting point for private negotiation. Second, I consider how legal regimes affect private contracting,

which determines the expected manner of the feedlot operation *e*.

(1) The farmer's initial entitlement under nuisance law and RTF laws

In Period II, it is assumed that the acreage of the farmland x_A is fixed. The farmer can only adjust the manner of the farming operation (choosing *e*) within the limits set by law to maximize his profits from agricultural production. The manner of the operation determines the magnitude of the harm on the developer's land.

Under nuisance law, whether the farmer's operation is a nuisance depends on *ex post* judicial determination. As noted in Chapter 2, if an activity is found as a nuisance, the court will either enjoin the activity (in most cases) or grant compensatory damages (in a few occasions). Nonetheless, only a very small proportion of land-use conflicts are directly resolved by judicial intervention. Land-use conflicts are largely resolved through the market mechanism. Private parties only resort to legal intervention under the circumstances that private bargaining is not viable. In most situations, nuisance law only serves as a benchmark for private negation. If the expectations of the farmer and the developer with respect to the legal standard of nuisance law are close and transaction costs are low, it will be unnecessary for them to go for a trail. If the farmer clearly knows that his farming operation will be enjoined, he can choose to "bribe" the developer by paying him an amount greater than the nuisance harm but less than the cost of an injunction to the farmer.

For the above reasons, injunctive relief or monetary damages is not distinguished in my model. My model assumes that if the farming practice fails the legal test, there will be an extra cost for the farmer, which is a little greater than the cost of harm on the adjacent urban land. Again, x_A is the acreage of the farmland, x_U the acreage of the

adjacent urban land, and $h(e)x_U$ the total harm on the adjacent urban land. The farmer's objective under nuisance law can then be written as:

$$\max_e \prod^n = \begin{matrix} w(x_A)-c(e) & \text{if } e < e^L \\ w(x_A)-c(e)-(h(e)x_U+b) & \text{if } e > e^L \end{matrix}. \qquad (3\text{-}7)$$

The piecewise function (3-2) corresponds to the simple negligence rule in the accident law model in Section 3.2.4. Let e^L be the legal criterion for "reasonable use" under nuisance law and *b* an extra amount that the farmer needs to bribe the developer so as to avoid an injunction. If the farming practice passes the legal test ($e<e^L$), the farmer will have no liability and his total profit from agricultural production will be $w(x_A)-c(e)$; on the other hand, if the farmer fails the legal test, he will have to incur an extra cost $h(e)x_U+b$.

The farmer's solution under nuisance law e^N satisfies:

$$w_e(e^N) = \begin{matrix} e^L & \text{if } e^L \geq e^* \\ [e^L, e^*) & \text{if } e^L < e^* \end{matrix} \qquad (3\text{-}8)$$

The reasoning is self-evident: The farmer has an incentive to operate in a manner with the lowest production costs. If $e^L>e^*$, the manner of the operation will be the legal criterion for "reasonable use" e^L because of the assumptions that $c_e < 0$ and $h_e > 0$. Otherwise if the farmer violates the legal standard, the marginal cost will be greater than the marginal benefit of operating in such a manner that violates the legal standard because the farmer is required to compensate the developer an amount that is greater than the saved production costs by adopting a less urban-use friendly technology. In the other case, if the legal criterion for "reasonable use" is too strict ($e^L<e^*$), the farmer's choice of *e* will depend on the size of the total compensation $h(e)x_U+b$. If

the total compensation $h(e)x_U + b$ is sufficiently small, the farmer may choose to violate the legal standard, so long as the total compensation is less than the total. However, the farmer's choice of *e* will not be greater than the social optimal *e**, because in that case the total compensation cannot be less than the total saving in production cost.

Equation (3-8) shows that the manner of the operation *e* depends on the expected legal standard e^L which is set by courts. If the goal of courts is to maximize social wealth, then the ideal legal standard e^L will be equal to the first-best optimum *e**, but the actual law could deviate from the first-best because of information costs. Theoretically, the expected legal standard e^L to the farmer could be either higher or lower than the ideal standard *e**. Additionally, the size of the total compensation $h(e)x_U + b$ is also uncertain. Hence, with respect to the farmer's choice of e^N, all three cases that $e_1^N < e^*$, $e_2^N = e^*$, and $e_3^N > e^*$ are possible under nuisance law.

After the adoption of RTF laws, the legal criterion for agricultural nuisances is no longer "reasonable use." Instead, RTF laws give the farmer a right to pollute as it was at the time his neighbors purchased the land so long as the conditions under RTF laws are not violated. As noted in Chapter 2, under nuisance law, even when a farming operation satisfies all the regulations and industry standards, it may still be found as a nuisance. Therefore, it can be said that the legal standard e^L under RTF laws is more lenient than that under nuisance law because it is unlikely that a farming practice that passes the legal test under nuisance law will fail the requirements under RTF laws. Moreover, since courts are not required to balance the utilities under RTF laws, the legal standard on the operation manner under RTF laws is almost certain to be greater

than the first-best optimum e^*. Therefore, equation (3-8) suggests that without private contracting on the manner of the feedlot operation, the farmer's choice of e under RTF laws is greater than that under nuisance law ($e^R > e^N$).

(2) Private contracting under nuisance law and RTF laws

The above analysis only shows that the farmer's choice of e under the nuisance law regimes, regardless of private contracting, which is only the starting point for private negotiation. The farmer and the developer can certainly negotiate on the manner of the farming operation with respect to issues such as production technologies and waste management methods. However, because of transaction costs, many aspects of the agricultural practices may not be contracted and enforced. I assume that only α part of the manner of the farming practice (such as production technologies, methods and plans) (where $0 < \alpha < 1$) can be contracted at the time of purchase and be enforced in Period II and the rest $(1-\alpha)$ part of farming practices cannot be privately contracted. Although $(1-\alpha)$ part of the manner of the operation cannot be contracted, the potential harm is still foreseeable at the time of purchase and therefore, affect the land prices. The key issue is how different legal regimes affect α. Let α^N and α^R be the share of farming practices that can be contracted under nuisance law and RTF laws. Thus the expected manner of the operation becomes $e^{Nexpected} = (1-\alpha^N)e^N$ under nuisance law, and $e^{Rexpected} = (1-\alpha^R)e^R$ under RTF laws. As it is already known that $e^R > e^N$, I only need to compare α^N and α^R; that is how the nuisance legal regimes affect private contracting.

The aspects of the farming operation that cannot be successfully contracted

can be regarded as the "gaps" in contracts. One of the biggest distinctions between nuisance law and RTF laws lies in that nuisance law imputes an implicit term in the contract that the farming operation must be "reasonable use" of the property. This implicit term provides a mechanism which allows courts to adjust the rights of the two parties *ex post* so as to maximize their joint wealth. Gaps in private contracts can be filled by courts' interpretation of law after land use conflicts arise. Nonetheless, under RTF laws, judicial intervention is excluded after the land sale and everything must be fixed before the land sale. In other words, courts are unable to fill the gaps of private contracts. Since the costs to pin down every aspects of the farming practice in a private contract are prohibitive, the farmer may behave strategically under RTF laws and cause unreasonable harm on the urban land after the land sale. For example, under RTF laws, the farmer will probably adopt a nuisance-abating technology before the land sale in order to increase land prices, but he has no incentive to update the technology after the land sale. It is also difficult for the developer to contract with the farmer on a future technology. In contrast, under nuisance law the developer may rely on courts' *ex post* determination, which takes into account technology advancement and rising urban land value. In this regard, because nuisance law allows courts to fills the gaps of private contracts, more aspects about the operation manner can be contracted under nuisance law than under RTF laws; that is $\alpha^N > \alpha^R$.

The literature discussed in Section 3.2.3 and Section 3.3 also shed light on how RTF laws affect private bargaining. Merrill (1985), Cooter and Ulen (2000), and Kwong and Baden (1986) suggest that RTF laws may facilitate private

bargaining because the rules embodied are more mechanical, which implies $\alpha^N < \alpha^R$. Johnston (1995), on the other side, argues that nuisance law is doing better in inducing private bargaining, which implies $\alpha^N > \alpha^R$. It is still debatable whether α^N or α^R is greater.

If it is assumed that my argument that nuisance may serve a gap-filler of private contracts but RTF laws cannot is a dominating factor in comparing α^N and α^R, then it can be derived:

$$e^{Nexpected}=(1-\alpha^N)e^N \quad < \quad (1-\alpha^R)e^R=e^{Rexpected} \tag{3-9}$$

Equation (3-9) indicates that the expected manner of the feedlot operation is friendlier to urban uses (causing less harm) under nuisance law than under RTF laws.

(3) Land-use allocation under nuisance law and RTF laws

So far, I have shown how nuisance law and RTF laws differ in determining the expected manner of the farming operation *e*. In the next step, I show how legal regimes ultimately determine land-use allocation.

Equation (3-6) indicates that the farmer tends to reserve more farmland for agricultural use when the manner of the farming practice is expected to cause more harm on the adjacent urban land. It has also been shown in equation (3-9) that the farming practices are expected to cause more harm under RTF laws are greater than under nuisance law, or $e^{Rexpected} > e^{Nexpected}$. Therefore, the farmer will choose to reserve more land for agricultural use under RTF laws than under nuisance law, or $x_A^R > x_A^N$. Hence, my model predicts that the passage of RTF laws encourage farming and discourage urbanization.

In summary, my model assumes that the farmer and the developer make a

one-time land transaction in which the land price depends on the expected harm caused by the farming operation. My model shows that the farmer tends to sell less farmland for development when the manner of the agricultural operation after the land sale is expected to cause more harm. In the following step, I examine how the expected manner of operation differ under nuisance law and RTF laws. I show that without account of private contracting, the farmer under RTF laws tends to choose to operate in a manner that causes more harm on the urban land. I then discuss how nuisance law and RTF laws affect private bargaining. I argue that since RTF laws exclude *ex post* gap filling of private contracts on the manner of farming practices by courts, private contracting can internalize more externalities under nuisance law than under RTF laws. For these two reasons, RTF laws can create an incentive for the farmer to reserve more land for agricultural uses. Therefore, my model predicts that the passage of RTF laws will lead to more farmland.

CHAPTER FOUR – EMPIRICAL ANALYSIS

The purpose of this chapter is to empirically test these predictions and evaluate the effect of RTF laws on land use, along with other variables of interest. I already discuss the predictions that can be directly or indirectly derived from previous economic literature and present my own theoretical models and predictions in Chapter 3. In Section 4.1, I summarize all of these theories and predictions. In Section 4.2, I first discuss the ideal data for the empirical analysis and then describe the data I actually use in this chapter. The data I have compiled consist of the observations of 48 states for the nine agricultural census years between 1959 and 1997. In Section 4.3, I conduct means analysis, comparing the means of the independent variables of the states with and without a RTF statute. A simple comparison between the means suggests that states that adopted RTF laws earlier tend to have a more dominating agricultural industry. Nonetheless the t-test indicates the differences are not statistically significant. In Section 4.4, I apply a fixed-effects method to the state-level panel data to examine the effect of RTF laws on the percentage of a state's cropland and urban land. The independent variables include RTF law variables, land-use variables, governmental policy variables, home value variables and price indices for agricultural production inputs and outputs. The results show that RTF laws tend to decrease the percentage of cropland in a state over the time, but no effects of RTF laws are found on urban land. The elasticities of the percentage of cropland are also

calculated and discussed. I also test the robustness of the model in Section 4.5, finding that the effect of RTF laws on cropland is not robust.

4.1 Summary of Predictions

In this section, I recapitulate the predictions discussed in Chapter 3. Basically, three different predictions can be derived from the literature. Several theories, including my model lead to the same prediction (Prediction 1) that RTF laws will encourage farming and discourage urbanization. Prediction 2 and Prediction 3 are derived from theories that do not directly predict whether RTF laws encourage farming or not. These theories basically debate on whether nuisance law or RTF laws can better induce efficient private bargaining. If it is assumed that urban land prices are on the rise, then the legal regimes that better induce efficient private bargaining will encourage urbanization.

Prediction 1: *RTF laws will lead to more farmland and less urban land (Section 3.4, Bergstrom and Centner 1989, Pitchford and Snyder's 2003).*

In Section 3.4, my model provides a prediction that the adoption of RTF laws will encourage farming. My model focuses on how the nuisance law regimes affect a farmer's decision to sell farmland. It has been shown that the farmer tends to keep more farmland when the manner of operation is expected to cause more harm on the adjacent urban land ($\frac{\partial x_A}{\partial e} > 0$). I then examine how nuisance law and RTF laws determine the manner of farming practice after the land sale. Generally, RTF laws give farmers a right to impose more harm on their neighbors' property without liability than nuisance law. Furthermore, when private contracting on externalities is allowed, I argue that nuisance law has the advantage of serving as a gap-filler of the contract between the farmer and the developer, whereas RTF laws, which give

definite, *ex ante* entitlement, exclude judicial intervention after land-use conflicts arise. As private contracting cannot be perfect and RTF laws do not allow courts to fill the gap of private contracts, the manner of the farming practice is expected to be friendlier to urban uses under RTF laws than under nuisance law. Therefore, the farmer will choose to keep more land for agricultural production under RTF laws. My model predicts that RTF laws will lead to more farmland and less urban land.

In addition to my models, similar predictions can be drawn from previous literature. As noted in Section 3.3, Bergstrom and Centner (1989) argue that RTF laws exempt farmers from the liability for generating nuisances, thus lowering production costs and resulting in increased agricultural commodity production. This argument is Pigovian type analysis, which does not allow any private negotiation between the farmer and the developer.

In Section 3.2.2, I discuss Pitchford and Snyder's (2003) model, which demonstrates that the "coming to the nuisance" doctrine (in this thesis, the RTF laws) gives more advantages to the first mover (in this thesis, the farmer) in the bargaining after property use conflicts arise. Therefore, the first mover has an incentive to over-invest in his property use *ex ante* before a property use conflict arises. As RTF laws may be considered a statutory version of the "coming to the nuisance" doctrine, Their model suggests that, under RTF laws when a farmer foresees a potential land-use conflict and the price of urban land is still on the rise, he may choose to over-invest in farmland before a developer appears because RTF laws will bring him a windfall through the private bargaining after the conflict arises. Hence, Pitchford and Snyder's model also predicts that RTF laws encourage farming and discourage urbanization.

Prediction 2: *RTF laws are more likely to induce efficient private bargaining. This suggests with rising urban land prices, RTF laws tend to encourage farmland conversion (Merrill 1985, Cooter and Ulen 2000, Kwong and Baden 1986).*

Prediction 2 and Prediction 3 are derived from the theories that disagree on whether nuisance law or RTF laws are more likely to induce efficient private bargaining.

Merrill (1985) and Cooter and Ulen (2000), among other economists, claim that clearly defined property entitlement is associated with lower transaction costs. Kwong and Baden (1986) argue that RTF laws are more clearly defined legal regimes compared to nuisance law. These arguments combined imply that RTF laws may lower transaction costs and are more likely to induce efficient private bargaining. Therefore, their arguments predict that with rising urban land prices, RTF laws encourage urban developers to buy out farmland, and thus they accelerate the urbanization process.

Prediction 3: *Nuisance law is more likely to induce efficient private bargaining. This suggests with rising urban land prices, RTF laws tend to encourage farming* (*Johnston's 1995).*

Johnston's (1995) argues the opposite of Merrill. Johnston's model shows that a contingent *ex post* property entitlement (such as nuisance law) is more likely to induce private bargaining than a definite, *ex ante* entitlement (such as RTF laws) because contingent *ex post* property entitlement may make credible a threat to take. Thus, according to Johnston's theory, RTF laws may discourage developers to convert farmland and therefore preserve farmland.

4.2 Data

4.2.1 Ideal Data

The empirical analysis examines how the adoption of RTF laws affects land use.

In Section 3.4, my model shows RTF laws create incentives for the farmer to keep more land for agricultural use. The ideal observations that verify my prediction is that the conversion of the agricultural uses, especially those mostly likely to interfere with urban uses (such as feedlots, diary farms and chicken farms), will tend to slow down after a state passes a RTF statute, or on the other hand, there will be a slower pace of urbanization after the adoption of RTF statutes. Nevertheless, my model only focuses the impact of legal regimes on the farmland conversion in the suburban area, and it does not necessarily predict any change in the total acreage of land allocated for agricultural land uses because once a developer buys the land from the farmer in the suburb, the farmer may relocate the agricultural facilities in another place. Therefore, ideally, I should confine my study to metropolitan areas and their immediate surrounding areas where there might have a conspicuous change in urban land prices relative to the land value for agricultural use. Only in these areas, will developers have the incentive to convert farmland for urban uses, land-use conflicts will arise and my prediction may be observed.

Moreover, not all farming practices will substantially interfere with urban land uses; some may even increase the land value for urban uses such as orchards. The nuisance law regimes are irrelevant in these cases. Therefore, the ideal empirical analysis should focus on agricultural activities that have the potential to be deemed as nuisances such feedlots, chicken farms, and dairy farms.

For the above reasons, the ideal data will be on the land uses in the metropolitan areas and the surrounding areas. In addition, since I need to compare the land use before and after the passage of RTF laws, the data must cover the time period both before and after the promulgation of RTF laws.

Unfortunately, the best continuous historical land use data that go back to the 1960s are only available at the state level, and those data do not disaggregate into specific categories such as feedlot, dairy farm, and chicken farm that I am most interested in. The state-level data will have the limitations mentioned above. For example, if a hog farm is driven out of the urban fringe due to residential development and relocated in another place in the same state, such a change will not be observed in the state-level data. But this phenomenon cannot be reflected at the state level. Also, since the land use data I use do not break down to specific agricultural uses, the observed effects of the nuisance law regimes may be diluted by including agricultural uses that do not substantially interfere with urban uses.

4.2.2 Description of Data

The state-level panel data consist of observations of 48 states (excluding Alaska and Hawaii) for the nine agricultural census years between 1959 and 1997.[65] As my theoretical model demonstrates, in addition to RTF laws, the land value and the profits from agricultural production also affect private parties' decision on land sales. Therefore, I have organized the independent variables controlling for these aspects and classified them into the following categories: RTF law, land-use, governmental policy, home value and price index.

(1) RTF Law Variables

Two RTF variables are created based on the year in which a comprehensive RTF law is adopted. A few states adopted feedlot type RTF laws in the 1960s and 1970s, but my study only confines the analysis to comprehensive RTF laws that protect all types of agricultural production. The first RTF variable, denoted as *RTF LAW*, is a

[65] Owing to the lack of available historical data, I have excluded Alaska and Hawaii from the dataset; the 9 agricultural census year are 1959, 1964, 1969, 1974, 1978, 1982, 1987, 1992 and 1997.

binary variable, which takes a value of one if a state has a RTF statute in a given year and a value of zero if it does not. Table 2-2 (in Chapter 2) shows that 41 states enacted RTF statutes between 1979 and 1982, seven states enacted RTF statutes between 1983 and 1987, and the last two states passed RTF statutes in 1991. In addition, the effect of RTF laws may not be observed immediately after the adoption because it may take time for private parties to realize the impact. Also, as noted below, the dependent variables are the percentage of land uses in a state, which is a stock concept. The effect of RTF laws on individual decisions over the years can be viewed as cumulative. Therefore, I also create a continuous variable, denoted as *RTF YEARS*, representing the number of years since a comprehensive RTF law is passed.

The way that the RTF law variables are created may oversimplify the issue by treating all RTF statutes to be homogeneous. Although RTF statutes share many things in common, no two of them are exactly the same. There are variations with respect to the existence requirement, the GAAP requirement and so forth. Therefore the effect on land use cannot be the same. For example, RTF laws with more stringent requirements may have a stronger effect on land use. Hence it could be an oversight to treat all RTF laws as the same. Nonetheless, the variances among RTF laws sometimes are often subtle and vague, thus making it very difficult to quantify the characteristics of RTF laws. In addition, because of the limited number of states, the variable will be too granular, if all the variances are taken into consideration.

(2) Land-Use Variables

The land-use data were collected from the USDA Economic Research Service. The raw data are the total land area of each land use in a state, based on which I calculate the percentage of each land use in a state so as to account for the

heterogeneity in the size of states. I use *% CROPLAND* and *% URBAN* as the dependent variables, and the lagged percentages of other land uses as independent variables in the regression. The definition of cropland covers the land used for multiple agricultural uses such as cropland for pasture. About one-third of the land converted to urban use is from cropland (CAST 1981, p.6).

According to the econometric theory, in the classic linear regression models, in order to maintain all the desirable properties of the OLS estimator, the independent variables should be distributed independently of the error terms. Otherwise the OLS estimator is asymptotically biased (Kennedy 2003, p.157-158). I intend to use the percentages of other land uses as controls for the land supply, but these variables cannot be regarded as exogenous because these land uses may be simultaneously determined by the percentages of cropland and urban land. Land-use shifts among corp production, grazing, and forest are common. For example, a study shows that from 1982 to 1997, there was a net change of 60 million acres from cropland to other rural uses such as grazing and forest, while during the same time, 26 million acres shifted from other rural land uses to cropland (Lubowski 2006, p.8). Nevertheless, lagged values of endogenous variables can be treated as exogenous variables "because for determination of the current period's values of the endogenous variables they are given constants." Their use creates asymptotically unbiased estimates (Kennedy 2003, p.192). Hence, I create lagged values of the land-use variables, which are the percentages of land uses in the previous agricultural census year. Since the total land supply in a state is fixed and these land uses are generally mutually exclusive, my expectation is higher percentages of land allocated for other uses in the previous time period will lead to lower percentage of land allocated for agricultural use and urban

use.

I would also like to emphasize that the land uses of rural parks and defense land are not directly determined by the land uses of cropland and urban land. Rural parks and wildlife areas include federal and state parks, wilderness areas, and wildlife refuges. The management objectives of these lands are obviously non-profit and change of the land use must pass legislative or administrative procedures. Similarly, defense land is also public land and its use is fixed by law. Hence, these two land-use variables could be viewed as independent of the dependent variables.

Pastureland includes grassland pasture and ranges, but excludes cropland used for pasture or forestland grazed. Forest-used land includes both forest-use land grazed and forest-use land not grazed. It is undeniable that pasture land, forest-used land, cropland and urban land are interchangeable and the land-use allocation is shaped largely based on private parties' economic incentives. But at least a big portion of forest land and grass land are under the management of the government. The Bureau of Land Management alone administers 160 million acres of public rangeland[66], which amount to almost one-fourth of the total amount of pasture land; more than 40% of the forest land is under public ownership[67], though it is not evenly distributed between eastern states and western states. The management objectives of these public lands are based on their conservation value, rather than the pure profitability of the land use. Hence, despite some degree of endogeneity, I include the lagged percentages of these land uses in my models for control purposes.

Table 4-2 reports the means and standard deviations of each land-use variable by

[66] Information from the BLM website as of September, 2007. http://www.blm.gov
[67] Information from the Forest Service website.
http://fia.fs.fed.us/library/briefings-summaries-overviews/docs/2002_ForestStats_%20FS801.pdf

year. The data show that the average percentages of forest-used land and pasture land in the 48 states were relatively stable with a small decline between 1959 and 1997. The average percentage of cropland peaked in the early 1980s and declined slightly afterwards, but the variation over the years is not conspicuous either. The average percentage of urban land increased from 2.96% in 1959 to 6.56% in 1997 and that of rural parks and wildlife areas increased from 1.59% to 4.71%. Only the percentage of defense land had a marked decline over the same period. The standard deviations of the percentage of urban land also increased over the years, partially due to increasing values. This may also suggest that states became more heterogeneous in urban development.

Table 4–1: Means and Standard Deviations of Land-Use Variables[68]

Variable Name	% CROPLAND	% PASTURE	% URBAN	% FOREST	% PARK	% DEFENSE
1959	25.42	22.05	2.96	40.34	1.59	1.25
	(18.46)	(20.55)	(4.54)	(22.14)	(1.58)	(1.28)
1964	24.45	21.80	3.18	41.20	2.32	1.29
	(18.52)	(21.25)	(4.89)	(23.51)	(2.07)	(1.26)
1969	25.67	19.81	3.51	41.35	2.49	0.93
	(20.05)	(21.64)	(5.47)	(24.03)	(2.27)	(1.32)
1974	25.34	19.34	3.84	40.44	2.69	0.91
	(19.88)	(21.62)	(5.78)	(23.44)	(2.34)	(1.31)
1978	25.62	18.75	4.79	39.56	3.30	0.90
	(19.76)	(21.87)	(6.68)	(23.17)	(2.63)	(1.31)
1982	25.48	19.04	5.25	39.01	3.59	0.87
	(20.00)	(21.77)	(7.09)	(23.05)	(2.81)	(1.29)
1987	24.96	18.80	5.61	38.65	4.40	0.79
	(20.12)	(21.58)	(7.07)	(22.97)	(3.42)	(1.21)
1992	24.50	18.77	6.03	38.80	4.48	0.78
	(20.07)	(21.74)	(8.09)	(23.07)	(3.43)	(1.15)
1997	23.94	18.41	6.56	38.15	4.71	0.65
	(19.96)	(21.69)	(8.56)	(22.79)	(3.88)	(0.82)

Standard deviations are in parenthesis.

[68] Full summary statistics are reported in Appendix B.

(3) Governmental Policy Variables

As noted in Chapter 1, in addition to the adoption of RTF laws, many states have taken other measures to preserve farmland as a way of implementing their governmental policies. The variables in these categories are intended to account for these measures.

The data were taken from USDA Economic Research Service and the United States Agricultural Statistics. One problem is that the raw data only give state totals for farmland property tax revenues and the total gross assistance in Agricultural Conservation Programs. To get better controls for governmental policy, I transformed the variable by first deflating the variables by national CPI and then weighting these variables by each state's total land in farm (in thousand acres). Table 4-3 reports the means and standard deviations of the transformed variables by year.

Table 4–2: Means and Standard Deviations of Governmental Policy Variables[69]

Year	*AVERAGE PROPERTY TAX*[70]	*AVERAGE ACP ASSISTANCE*[71]
1964	74.79	0.009
	(72.93)	(0.005)
1969	96.11	0.008
	(99.77)	(0.005)
1974	99.44	0.003
	(107.13)	(0.002)
1978	93.88	0.005
	(95.38)	(0.004)
1982	73.25	0.003
	(74.24)	(0.003)
1987	80.10	0.002
	(80.29)	(0.002)
1992	85.47	0.003
	(86.46)	(0.003)
1997	83.70	0.002

[69] Full summary statistics are reported in Appendix B.
[70] The unit is real dollars per thousand acres.
[71] The unit is real dollars per thousand acres.

	(86.62)	(0.002)

Standard deviations are in parenthesis.

AVERAGE PROPERTY TAX gives the average property taxes per thousand acres of farmland. Property taxes can be viewed as a cost of agricultural production. Low agricultural production costs encourage farming and discourage urbanization. My expectation is that low property tax on farmland will lead to high percentage of cropland and low percentage of urban land.

The Agricultural Conservation Program provides cost-share funds for approved agricultural practices. *AVERAGE ACP ASSISTANCE* is the average ACP assistance per thousand acres of farmland. ACP assistance is a type of governmental subsidies, which increases the profit of agricultural production. Therefore, I expect that it has a positive effect on *% CROPLAND* and a negative effect on *% URBAN*. Granted, weighing the gross assistance by total farmland is rough, because the benefits from this assistance vary greatly across various types of agricultural production activities.

(4) Median Home Value

The data on median home values were taken from the United States Census Bureau. The Table 4-4 reports the means and standard deviations of these variables by year. The *MEDIAN HOME VALUE*, adjusted for inflation in real dollars, is intended to control for urban land value. The home value variable is used as a proxy for the price of urban land. High urban land prices will create an incentive for the farmer to sell more farmland for development. Therefore, my models predict that it will have a positive effect on *% CROPLAND* and a negative effect on *% URBAN*.

Table 4–3: Means and Standard Deviations of Median Home Value[72]

Year	*MEDIAN HOME VALUE*[73]
1959	52794.58 (11616.68)
1964	56567.5 (12501.16)
1969	59641.46 (13719.42)
1974	72652.92 (16300.99)
1978	85049.58 (19941.51)
1982	93393.75 (24967.72)
1987	98758.33 (37719.11)
1992	104425.8 (43499.83)
1997	110547.7 (36178.56)

Standard deviations are in parenthesis.

(5) Agricultural Price Indices

The theoretical models suggest that the profitability of agricultural production will affect the farmer's choice in selling farmland. Therefore, I use the price indices that are constructed by Ball et al. (2004) to control for the costs and benefits of agricultural production. There are two output price indices (crops, livestock) and three input price indices (capital input, materials, land input). All the price indices are deflated, setting the price of Alabama in 1996 to be the baseline, which is equal to 1.

[72] Full summary statistics are reported in Appendix B.
[73] In dollar, adjusted for inflation.

The spatial price indices are constructed based on prices of selected common commodities in each state, but are not weighted by type of the commodities in each state. For most states, this should not be a big concern, but a comparison of some states such as Wyoming and Florida might be problematic because the major crops and livestock are very different between the two. Table 4-6 reports the means and standard deviations of the indices by year.

Although the real items selected to construct these price indices are unknown to me, they are still good proxies for the costs and benefits for agricultural production. For simplicity, my theoretical models adopt the simplest form of production function without consideration of the input and output prices. There are three input price variables: *PRICE OF CAPITAL INPUT*, *PRICE OF MATERIALS* and *PRICE OF LAND INPUT*. The economic theory suggests if the price of land input goes down, then the quantity of the land input will go up. In addition, if these inputs are complementary, rather than substitutable, then a decrease in the price of one will also increase the quantity of the other input. Hence, I expect these input prices to have a negative effect on the *% Cropland* and a positive effect on *% URBAN*.

The price of livestock can be considered as an output price. Increasing output price will increase the input quantity. Therefore, I expect a positive effect on *% CROPLAND* and a negative effect on *% URBAN*. The effect of the price of crops is complicated by the fact that crops may be regarded as both outputs and intermediate inputs. I prefer to consider crops to be output as a whole and, therefore, expect a positive effect on *% CROPLAND* and a negative effect on *% URBAN*. However, the effect of these variables can be further complicated by the fact that different types of agricultural activities (e.g. growing crops, raising livestock) require different

quantities of land as an input. The price fluctuation may affect the farmer's choice between different types of agricultural activities, which may result in an unexpected effect in land use.

Table 4–4: Means and Standard Deviations of Price Index Variables[74]

Year	*PRICE OF CROP*	*PRICE OF LIVESTOCK*	*PRICE OF CAPITAL INPUT*	*PRICE OF MATERIALS*	*PRICE OF LAND INPUT*
1959	0.37	0.35	0.16	0.33	0.05
	(0.03)	(0.05)	(0.004)	(0.03)	(0.02)
1964	0.41	0.33	0.17	0.36	0.06
	(0.05)	(0.05)	(0.004)	(0.05)	(0.03)
1969	0.42	0.43	0.23	0.40	0.14
	(0.05)	(0.05)	(0.004)	(0.05)	(0.06)
1974	0.87	0.60	0.36	0.71	0.31
	(0.17)	(0.08)	(0.02)	(0.08)	(0.12)
1978	0.78	0.79	0.43	0.79	0.44
	(0.08)	(0.09)	(0.01)	(0.08)	(0.20)
1982	0.89	0.91	0.74	1.02	0.86
	(0.06)	(0.10)	(0.02)	(0.10)	(0.33)
1987	0.90	0.92	0.88	0.97	0.88
	(0.11)	(0.11)	(0.02)	(0.11)	(0.38)
1992	0.98	1.00	0.86	1.14	0.75
	(0.11)	(0.14)	(0.02)	(0.13)	(0.36)
1997	1.05	1.00	1.02	1.28	1.02
	(0.15)	(0.10)	(0.02)	(0.15)	(0.42)

Standard deviations are in parenthesis.

4.3 Means Analysis

In this section, I conduct means analysis to examine the differences between states with and without a RTF statute. I divided the states into two groups: those without a comprehensive RTF statute, and those with a comprehensive RTF statue. By the year 1982, 40 states out of the 48 states in my dataset had already adopted RTF laws. Therefore, there are 40 states in the first group and only 8 states in the second. I then compare the means of all the independent variables in 1982. This simple method

[74] Full summary statistics are reported in Appendix B.

is limited because the independent variables are not controlled at the same time and there are two few observations in the second group. Nonetheless, it may still provide some insight about the characteristics of the states with and without RTF statutes. Table 4-5 reports these means and the t-value of a test of difference of means, in which the null hypothesis is that there is no difference in means.

Table 4–5: Means by Statute Group and Significance of Difference of Means (in 1982)

Variable	Group	N	Mean	Standard Deviation	t-value
Land Use					
% CROPLAND	States without Statute	8	17.69	18.20	1.21
	States with Statute	40	27.04	20.19	
% URBAN	States without Statute	8	8.55	12.04	-0.91
	States with Statute	40	4.59	5.64	
% FOREST	States without Statute	8	35.42	27.74	0.48
	States with Statute	40	39.72	22.34	
% PASTURE	States without Statute	8	25.00	31.77	-0.61
	States with Statute	40	17.85	19.53	
% PARK	States without Statute	8	2.48	2.93	-1.49
	States with Statute	40	2.45	2.74	
% DEFENSE	States without Statute	8	0.98	1.91	-0.19
	States with Statute	40	0.85	1.16	
Governmental Policy & Home Value					
AVERAGE PROPERTY TAX ON FARMLAND	States without Statute	8	102.18	114.6	-0.83
	States with Statute	40	67.47	63.83	
AVERAGE ACP ASSISTANCE	States without Statute	8	0.004	0.0043	-0.65
	States with Statute	40	0.0032	0.0029	
MEDIAN HOME VALUE	States without Statute	8	107,915	23,041	-1.85*
	States with Statute	40	90,490	24,578	
Price Index					
PRICE OF CROPS	States without Statute	8	0.893	0.07	-0.20
	States with Statute	40	0.884	0.06	
PRICE OF LIVESTOCK	States without Statute	8	0.84	0.09	-0.26
	States with Statute	40	0.87	0.11	
PRICE OF CAPITAL INPUT	States without Statute	8	0.75	0.03	-1.23
	States with Statute	40	0.74	0.02	
PRICE OF MATERIALS	States without Statute	8	0.96	0.11	-0.69
	States with Statute	40	0.99	0.10	

PRICE OF LAND INPUT	States without Statute	8	0.35	0.06	0.41
	States with Statute	40	0.36	0.07	

The t-value is associated with a means test in which the null hypothesis is that the difference of means is equal to zero;
* indicates significance at the 10% level for a 1-tailed test, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

As noted in Chapter 2, the major sponsors of the RTF laws were the state Farm Bureaus, who represented the interests of farmers and agricultural operators. Therefore, states with a large agricultural presence are more likely to adopt RTF statutes earlier because RTF laws generally are in favor of the interests of farmers.

Table 4-5 shows that the mean of *% CROPLAND* in the states with a RTF statute is higher than that in the states without a RTF statue, and the mean of *% URBAN* in the states with a RTF statute is lower than that in the states without a RTF statute. These findings are basically consistent with my expectations that the states adopting RTF statues eariler tend to have a larger agricultural presence.

In addition, the mean of the average property taxes on farmland in the states with a RTF statute is much lower than that in the states without a RTF statute. It seems to imply that states that heavily tax the agricultural industry are likely to adopt RTF laws later. In other words, states have a pro-agricultural policy tend to adopt RTF laws earlier. Furthermore, the mean of the home value in the states without a RTF law is higher than that in the states with a RTF law. Home value reflects the demand for urban land. Therefore, it may suggest that high demand for urban land postpones the passage of RTF laws.

Roughly speaking, the direction of difference in the mean in a simple comparison between the two groups is largely consistent with my expectations. However, the results need to be interpreted with caution because other than that of the home value, none of the t-values are statistically significant, largely because the number of states

in the group without RTF laws is too low.

4.4 Empirical Model

I use a fixed-effects model to estimate the effects of RTF laws and other independent variables on land use within a state. The basic model is:

$$y_{it} = x_{it}'\beta + \alpha_i + \varepsilon_{it}\,;\ i=1,2...I;\ t=1,2...T. \qquad (4\text{-}1)$$

where *i* indexes the state, and *t* the year of observation. There are 384 total observations from 48 states and 8 census years. There are only 8 time periods instead of 9 because one time period is lost when the lagged land-use variables are used. Let the dependent variable y_{it} be the percentage of a certain land use (e.g. *% CROPLAND*, *% URBAN*) in a state; x_{it} is a vector of independent variables including RTF law variables and other independent variables, and β is a column vector of unknown coefficients; α_i represents a vector of constants for each state, capturing unobserved state-specific effects that do not vary over time, such as soil quality, climate, etc.; ε_{it} is a random error term. One of the drawbacks of the fixed-effects method is that time-invariant variables may not be included because all the time-invariant information is captured by α_i; the effects of time-invariant variables may not be distinguished from α_i.

The regression results are reported in Table 4-6. The first two specifications examine the effect on the percentage of cropland – (1) uses *RTF LAW* and (2) uses *RTF YEARS* as measures of the legal regime governing agricultural nuisances. In specification 2, in order to separate the effect of *RTF LAW* from the time trend, I also include census year dummies. The third and fourth specifications examine the effect on % urban land. They are exactly the same as those in 1 and 2 except the dependent

variable.

Table 4–6: Regression Estimates of the State Level Effects

Dependent Variable:	(1) *% CROPLAND*	(2) *% CROPLAND*	(3) *% URBAN*	(4) *% URBAN*
RTF law variables:				
RTF LAW	0.15 (0.42)		-0.35 (0.33)	
RTF YEARS		-0.12** (0.06)		0.04 (0.05)
Land-use variables:				
LAGGED % FOREST	-0.13*** (0.04)	-0.16*** (0.03)	-0.19*** (0.03)	-0.18*** (0.03)
LAGGED % PASTURE	-0.05 (0.06)	-0.11** (0.05)	-0.13*** (0.04)	-0.12** (0.05)
LAGGED % PARK	-0.14* (0.08)	-0.29*** (0.08)	0.20*** (0.06)	0.19*** (0.06)
LAGGED % DEFENSE	-0.46 (0.29)	-0.59*** (0.26)	0.21 (0.23)	0.25 (0.22)
Governmental policy variables:				
AVERAGE PROPERTY TAX ON FARMLAND	-0.01*** (0.003)	-0.01*** (0.003)	0.004 (0.003)	0.002 (0.003)
AVERAGE ACP ASSISTANCE	2.98 (37.64)	51.74 (40.15)	-91.36*** (29.59)	-161.61*** (33.25)
Home value variable:				
MEDIAN HOME VALUE	-2.00E-05*** (7.13E-06)	-3.00E-05*** (7.03E-06)	2.50E-05*** (5.60E-06)	1.70E-05*** (5.82E-06)
Price index variables:				
PRICE OF CROPS	0.44 (0.80)	-0.60 (0.96)	-0.88 (0.63)	1.03 (0.79)
PRICE OF LIVESTOCK	5.06*** (0.85)	3.41*** (1.21)	-2.68*** (0.67)	-4.00*** (1.00)
PRICE OF CAPITAL INPUT	-4.70*** (1.24)	-10.77** (4.45)	0.14 (0.98)	0.37 (3.69)
PRICE OF MATERIALS	-0.12 (1.19)	7.24*** (1.78)	1.54 (0.94)	1.27 (1.48)
PRICE OF LAND INPUT	0.52 (0.48)	0.25 (0.50)	1.38*** (0.38)	1.06** (0.42)
Census year dummies:	No	Yes	No	Yes
R^2	0.9960	0.9967	0.9795	0.9814
F Value (d.f.)	69.90*** (323)	78.13*** (316)	75.02*** (323)	76.84*** (316)

Standard deviation are in parenthesis; asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels

The results show that *RTF LAW* is not statistically significant in either specification 1 or specification 3. That is probably because, as I note above, the effect of RTF laws cannot be observed immediately after the laws were passed. In addition, *% CROPLAND* and *% URBAN* are a "stock" concept, the sum of the numerous decisions of farmers to sell land. Therefore, the effects of RTF laws are probably cumulative. In this regard, the continuous RTF law variable *RTF YEARS* may be a better measure.

Variable *RTF YEARS* is significant and negatively signed in specification 2. The estimated coefficient of *RTF YEARS* is -0.12, meaning that one additional year of the existence of a RTF statute will decrease the cropland in a state by 0.12% of a state's total land. For example, Ohio had 1,0845 thousand acres of cropland in 1982, accounting for 46.66% of total land. Regardless other factors, Ohio would have approximately 28,000 acres less cropland each year with a RTF statue than without. *RTF YEARS* is positively signed in specification 4, but is not statistically significant. Therefore, no significant effect of RTF law is found on the urban land.

The results suggest that RTF laws may discourage cropland use, which is contrary to my prediction. Instead, the results support Prediction 2 that RTF laws are more likely to induce efficient private bargaining and therefore encourage farmland conversion when urban land prices are rising. Nevertheless, no significant effect is found on urbanization. It is worth noting that *RTF YEARS* is merely a count of number of years. Although I create census year dummies, they may not perfectly isolate the effects of the time trend from the effect of RTF laws. In other words, the effect of RTF laws found in specification 2 could be due to the time trend.

The four land-use variables are all negatively signed in specification 1 and specification 2, suggesting that these four land uses have negative impacts on the percentage of cropland, which agree with my predictions. Take specification 2 for example. The percentage of the cropland in a state will become 0.16% lower if the percentage of forest land is 1% higher in the previous census year; the percentage of the cropland will become 0.11% lower, if the percentage of the percentage of grassland and ranges is 1% higher in the previous census year; the percentage of the cropland will become 0.29% lower if the percentage of rural parks is 1% higher in the previous census year; and the percentage of the cropland will become 0.59% lower if the percentage of defense land is 1% higher in the previous census year. For example, the total land in Arizona is about 72,680 thousand acres. All other things being equal, the cropland in Arizona will decrease by 116 thousand acres, if the forest land increases by 727 thousand acre in the previous census year.

In specifications 3 and 4, *% FOREST* and *% PASTURE* are also negatively signed. Take specification 4 for example, the percentage of urban land in a state will increase by 0.18 and 0.12 respectively if the percentages of forest land and grassland are 1 % higher in the last census year. Nevertheless, *% PARK* is positively signed, indicating a positive effect on urban land. The percentage of urban land in a state will increase 0.19 if the percentage of rural parks is 1 % higher in the previous census year. Variable *% DEFENSE* is not statistically significant, indicating that the percentage of urban land does not have a significant effect on urban land.

Among the governmental policy variables, as I predict, *AVERAGE PROPERTY TAX* is negatively signed in specification 1 and specification 2, indicating that the property tax on farmland has a negative effect on cropland. If the average property tax

on farmland goes up 1 dollar per thousand acres, the percentage of cropland will accordingly decrease 0.01%. In specification 3 and specification 4, *AVERAGE PROPERTY TAX* is positively signed, but it is not statistically significant.

Variable *AVERAGE ACP ASSISTANCE* is only significant in specifications 3 and 4 and is both negatively signed, suggesting that governmental subsidies in agricultural production activities may discourage urbanization. One cent assistance per thousand acre farmland in the Agricultural Conservation Program will cause the percentage of urban land in a state to go down 1.61 %.

Variable *MEDIAN HOME VALUE* is negatively signed in specification 1 and specification 2 and positively signed in specification 3 and specification 4. Take specification 2 and specification 4 for example. A 1000 dollar increase in the median home value will cause the percentage of cropland to go down 0.03% and percentage of urban land to go up 0.017%. This result verifies the theoretical model's prediction that increasing urban land prices will lead to more urban land and less cropland.

Among all the price index variables, *PRICE OF LIVESTOCK* is significant in all four specifications. It is positively signed in specification 1 and specification 2 and negatively signed in specification 3 and specification 4, which corresponds to my prediction as an increase in the output prices of agricultural commodities will lead to more cropland and less urban land. These indices set the prices of Alabama in 1996 as 1. Thus, taking Alabama as an example, specifications 2 and 4 suggest that if the real prices of livestock in Alabama double the percentage of cropland will accordingly rise 3.41% and the percentage of urban land will go down 4.00 %.

Variable *PRICE OF CAPITAL INPUT* is negatively signed in specification 1 and specification 2, suggesting an increase in the prices of the capital inputs in agricultural

production will discourage farming. For example, specification 2 shows that if the prices of capital inputs in Alabama doubled its 1996's level, the percentage of cropland in Alabama will go down 10.77%. *PRICE OF LAND INPUT* is positively signed in specification 3 and specification 4, suggesting that higher land prices in agricultural production will lead to more urban land. For example, specification 4 suggests that if the prices of land inputs in Alabama doubled its 1996's level, the percentage of urban land in Alabama will go down 1.06%.

The other two price indices, *PRICE OF CROPS* and *PRICE OF MATERIALS* do not demonstrate significant effects on *% CROPLAND* and *% URBAN*. As noted above, this is probably because some crops and materials could be both inputs and outputs in the agricultural production process and therefore, the effects on land use are mixed.

Table 4-7 reports the elasticities of *% CROPLAND* with respect to all the independent variables by year[75], in other words, the ratios of the proportional change in *% CROPLAND* with respect to proportional change in the means of each independent variable in each time period.

Since the mean of *RTF YEARS* grows over time, the elasticity with respect to it also goes up over time. For example, the results show that in 1982, if the mean of *RTF YEARS* goes up by 1%, which is approximately equal to 6.4 days, the mean of *% CROPLAND* will then decrease by 0.21%. In contrast, if the mean of *RTF YEARS* goes up by 1% in 1997, which is approximately equal to 59.3 days, the mean of % CROPLAND will then decrease by 1.95%.

Among all the land-use variables, results show that cropland is more elastic with

[75] The elasticities are calculated as: E = estimated coefficient (in specification 2) * (mean of the X variable/ mean of *% CROPLAND*)

respect to forest-use land and pasture land, and least elastic with respect to defense land. For example, if the mean of *% FOREST* increases by 1% in 1997, the mean of *% CROPLAND* will then decrease by 0.26%, but if the mean of *% DEFENSE* increase by 1% in 1997, the mean of *% DEFENSE* will only decrease by 0.015%. The elasticities suggest land-use conversions occur more often among cropland, forest land and pasture land.

Table 4–7: Elasticities of Cropland Use

Variable Name	1964	1969	1974	1978	1982	1987	1992	1997
RTF law variables:								
*RTF YEARS***					-0.21	-0.765	-1.35	-1.95
Land-use variables:								
*LAGGED % PASTURE***	-0.099	-0.093	-0.086	-0.083	-0.081	-0.084	-0.084	-0.086
*LAGGED % FOREST****	-0.264	-0.257	-0.261	-0.253	-0.248	-0.250	-0.252	-0.259
*LAGGED % PARK****	-0.019	-0.026	-0.028	-0.030	-0.038	-0.042	-0.052	-0.054
*LAGGED % DEFENSE****	-0.024	-0.023	-0.017	-0.016	-0.016	-0.016	-0.015	-0.015
Governmental policy variables:								
*AVERAGE PROPERTY TAX ON FARMLAND****	-0.031	-0.037	-0.039	-0.037	-0.029	-0.032	-0.035	-0.035
AVERAGE ACP ASSISTANCE	0.019	0.016	0.006	0.010	0.006	0.004	0.006	0.004
Home value variable:								
*MEDIAN HOME VALUE****	-0.039	-0.039	-0.049	-0.056	-0.062	-0.067	-0.072	-0.079
Price index variables:								
PRICE OF CROP	-0.010	-0.010	-0.021	-0.018	-0.021	-0.022	-0.024	-0.026
*PRICE OF LIVESTOCK****	0.046	0.057	0.081	0.105	0.122	0.126	0.139	0.142
*PRICE OF CAPITAL INPUT***	-0.075	-0.096	-0.153	-0.181	-0.313	-0.380	-0.378	-0.459
*PRICE OF MATERIALS****	0.107	0.113	0.203	0.223	0.290	0.281	0.337	0.387
PRICE OF LAND INPUT	0.001	0.001	0.003	0.004	0.008	0.009	0.008	0.011

Asterisks indicate significance of the estimated coefficients at the 10% (*), 5% (**), and 1% (***) levels.

The elasticities of *% CROPLAND* with respect to governmental policy variables

and home value are relatively low. For example, if the mean of the average property taxes on farmland increase 1% in 1997, which equals to 0.83 real dollar per thousand acres, the mean of % CROPLAND will decrease by 0.035%. If the mean of the median home value goes up by 1 % in 1997, which equals to 1105 real dollar, then the mean of *% CROPLAND* will decrease by 0.079%. The results show that *% CROPLAND* is more elastic to property taxes on farmland than to ACP assistance, but this is largely owning to the fact that the size of property taxes is far greater than that of ACP assistance.

Among the price index variables, it is shown that *% CROPLAND* is more elastic to the prices of materials, capital input and livestock, and less elastic to the prices of crops and land input. For example, if the price of livestock increases by 1% in 1997, then the mean of *% CROPLAND* will increase by 0.14% accordingly, whereas if the price of land input increases by 1 % in 1997, the mean of *% CROPLAND* will only 0.011% accordingly. The inelasticity with respect to the price of crops probably can be explained by the fact that the price of crops has mixed effects on agricultural production because crops can be used as both outputs and inputs in an agricultural production process.

4.5 Robustness of Estimates

In order to test the robustness of the estimates, I alter the specifications discussed above to see whether such alterations will cause any major changes in the estimates. The dependent variables in specifications 5-8 (in Appendix C) are the same as those in specifications 1-4. Among the independent variables, I replace *MEDIAN HOME VLAUE* by *POPULATION DENSITY* and *URBAN POPULATION DENSITY* and also include the price index of labor input in agricultural production.

Variable *POPULATION DENSITY* is used to control for land prices. I expect that high population density generally leads to high land prices and therefore states with high population density tends to have more urban land and less cropland. Variable *URBAN POPULATION DENSITY*, on the one hand, also means high prices of urban land. But on the other hand, cities with high urban population are more employment centralized. Such cities tend to have less dispersed development (Burchfield et al. 2006, p.609). The convenience of living close to the metropolitan center reduces the appeal of moving to an initially rural area. Therefore, high urban population density may also lead to more cropland and less urban land. Variable *PRICE OF LABOR INPUT* is deemed as a production cost. Therefore, I expect that high labor costs will discourage agricultural production.

Results are reported in Appendix C. Same as in the previous specifications, *RTF LAW* is not statistically significant in either specification 5 or specification7. In addition, *RTF YEARS* becomes not significant in either specification 6 or specification 8, indicating that the effect of *RTF YEARS* found previously is robust. The results show that there is no significant effect of RTF laws on land use.

The signs of the land-use variables remain the same after I alter the specifications, but the effect of *LAGGED % PARK* on *% URBAN* becomes not significant and the effect of *LAGGED % DEFENSE* on *% URBAN* becomes significant. The effect of *AVERAGE PROPERTY TAX* on *% CROPLAND* remains unchanged, but results show that *AVERAGE PROPERTY TAX* has a negative effect on *% URBAN*, indicating that high property tax on farmland discourage urbanization. This effect is previously not seen, probably due to the high correlation between the property taxes on urban land and those on farmland.

Results also show that *POPLATION DENSITY* has significant negative effects on *% CROPLAND* and significant positive effects on *% URBAN*, and the effects of *URBAN POPULATION DENSITY* are exactly the opposite. These findings basically agree with my expectations. Among the price index variables, the signs of *PRICE OF LIVESTOCK*, *PRICE OF CAPITAL INPUT* and *PRICE OF MATERIALS* are unchanged, suggesting the estimates are quite robust. The estimates of *PRICE OF CROPS* are still insignificant, except that in specification 8 a positive effect is found on *% URBAN*. *PRICE OF LABOR INPUT* is only significant in specification 7 and has a negative effect on *% CROPLAND*.

4.6 Summary of the Empirical Results

In this chapter I use the state-level panel data to test the predictions from Chapter 3. I regress two land-use variable *% CROPLAND* and *% URBAN* on RTF variables and other independent variables such as the lagged land-use variables, governmental policy variables, home values, price indices of the inputs and outputs in agricultural production. Two different RTF variables are created and their effects are tested separately. The first RTF variable, *RTF LAW*, is a dummy variable, indicating whether a state has a RTF statute in a particular year. No significant effect of this variable is found on either *% CROPLAND* or *% URBAN*.

The second RTF variable *RTF YEARS* is continuous, representing the number of years since a comprehensive RTF statute is passed. Results show that states with longer existence of a RTF law tend to have lower percentage of cropland, which seem to refute my prediction that RTF laws encourage farming, but support Prediction 3 that RTF laws encourage farmland conversion for urban development. However, the empirical analysis only examines the aggregate effect of RTF laws on cropland. RTF

laws may have a strong impact on farmers' choices between different agricultural activities, which could overshadow the impact on the choices between agricultural use and urban use. For example, the adoption of RTF laws may encourage farmers to switch from growing crops to raising livestock or, from a more land-intensive activity to a less one. In such cases, although RTF laws encourage agricultural production activities, they do not necessarily increase farmland. Also, as noted above, the effect of *RTF YEARS* probably is not completely isolated from the effect of the time trend. The decreases in cropland may not be solely attributed to the effect of RTF laws.

In addition, no significant effect of *RTF YEARS* is found on urban land, and the robustness test also shows the effect on *% CROPLAND* is not robust. In other words, RTF laws may not have a significant effect on land use at all. In Chapter 2, I already note that the real differences between RTF laws and nuisance may not be significant because after the adoption of RTF laws, there are still numerous administrative regulations, industry standards that require the agricultural activities to be conducted in a reasonable manner.

CHAPTER FIVE – SUMMARY AND CONCLUSIONS

5.1 Summary of the Thesis

This thesis explores the effect of state Right-to-Farm laws on land use. As noted in the introduction, rural America has been transformed by economic development and urbanization. Land-use conflicts have become an acute issue in the United States, and therefore, it will be important to understand the actual effects on land use that the nuisance law regimes exert. The topic is also interesting because from a theoretical perspective, the effect of RTF laws on land use is still debatable and little empirical work has been done to date.

In Chapter 2, I examine the legal history of agricultural nuisances. Since agricultural nuisances were governed by the common law of nuisance before the adoption of state RTF statutes, I first examine the evolution of nuisance law and discuss some of the important common law doctrines.

Before the Civil War, American nuisance law was dominated by strict liability. Courts tended to favor nuisance complainants, strictly prohibiting spillover effects on other's property. Negligence or faultiness was not a basis for liability in nuisance actions. After the Civil War, industrialization in the United States gave rise to more land-use conflicts. American courts began to discard the rigid *sic utere tuo* maxim and introduced negligence into nuisance actions. Finally, the majority of courts developed the reasonableness test or the balancing test to determine whether a nuisance exists. Despite some minor variations, both tests allow courts to consider the particular facts of each individual case and require courts to conduct something akin to cost-benefit

analysis so as to balance the social utility of competing land uses. Among other things, the nature of locality is usually an important factor in nuisance determination. In addition, the exercise of the "coming to the nuisance" doctrine also became more flexible under American nuisance law. Today, almost all courts agree that "coming to the nuisance" cannot be used as an absolute defense for the defendant, but is merely a factor that courts may consider.

I then discuss the emergence of RTF laws and the major features of RTF laws. As long as an agricultural activity satisfies the required conditions under a RTF statute, the activity cannot be deemed as a nuisance. The common requirements under RTF laws include prior use, length of existence, non-negligence, conformity with industry standards and compliance with laws and regulations. Given the fact that the prior use requirement is equivalent to the "coming to the nuisance" doctrine, most RTF laws may be roughly regarded as a statutory version of the "coming to the nuisance" doctrine. Nevertheless, RTF laws also have other requirements such as non-negligence and GAAP that are not traditionally required by the "coming to the nuisance" doctrine.

In addition to making prior use as a defense against nuisance actions, RTF laws also change nuisance law in some other aspects. For example, the mechanical requirements of RTF laws make litigation outcomes more predictable to both defendants and the plaintiffs. Moreover, nuisance law is contingent on the *ex post* determination of the harm and benefits of the activity concerned. Courts are allowed to intervene after a land-use conflict arises. In contrast, RTF laws give a clearly defined *ex ante* property entitlement, and therefore, little judicial intervention is allowed after a land-use conflict arises. However, it is unclear how big the actual

differences are between nuisance law and RTF laws. It can be said that courts play a more important role before the passage of RTF laws whereas the reliance on the legislative and administrative regulation increases after the adoption of RTF laws. However, the actual criterion for declaring an activity a nuisance may not be greatly changed by the adoption of RTF laws.

Chapter 3 uses economic theories to examine RTF laws. The traditional Pigovian analysis implies that RTF laws will encourage agricultural commodity production because the social costs of agricultural activities are not fully internalized under RTF laws. Pitchford and Snyder (2003) build a model showing that the "coming to the nuisance" doctrine will lead to overinvestment in the preceding land use. If RTF laws can be viewed as a statutory version of the "coming to the nuisance" doctrine, Pitchford and Snyder's model then implies that RTF laws encourage farmland.

Merrill (1985) and Cooter and Ulen (2000) argue that mechanical property rules that require little *ex post* judicial judgment are better in inducing efficient private bargaining. Since RTF laws are more mechanical than nuisance law, their argument implies that there will be more private bargaining under RTF laws. Hence, RTF laws will probably encourage urbanization with rising land prices. However, Johnston (1995) has argued the opposite, claiming that contingent *ex post* entitlement such as nuisance law is more likely to induce efficient private bargaining. Johnston's theory suggests that RTF laws will actually discourage urbanization with rising urban prices.

My model examines how legal regimes may affect a farmer's choices in selling farmland. The model assumes that there could be some private bargaining between the farmer and the land developer on externalities, but due to the monitoring cost and the enforcement cost, private contracting cannot perfectly internalize all externalities.

Since property entitlements under RTF law are *ex ante*, judicial gap-filling of private contracts is not allowed after a land sale. Under RTF laws, the manner of farming practices is expected to be less friendly to urban uses, and therefore, the land value for urban use will be lower. Based on these assumptions, my model shows that farmers tend to sell less farmland for urban development under RTF laws than under nuisance law.

In Chapter 4, I first describe the ideal data and the available data and then use a fixed-effects model to test the predictions. Two land-use variables *% CROPLAND* and *% URBAN* are respectively regressed on RTF law variables and other independent variables. I find that one additional year of the existence of a RTF statute will decrease the percentage of cropland in a state by 0.12, suggesting RTF laws actually discourage cropland use, which is contrary to my prediction. Nevertheless, this negative effect on cropland may be attributed to the time trend rather than RTF laws. Moreover, the effect is not robust and no significant effect is found on urban land. Therefore, the empirical analysis suggests that RTF laws may not have a significant effect on land use, and at least they do not help preserve farmland.

5.2 Limitations and Future Work

Since land use policy is a very complex subject, more work needs to be done with respect to the effect of RTF laws on land use. My model in Chapter 3 only examines one aspect of the issue and some important factors are neglected. For example, it is unclear that to what extent RTF laws may increase the predictability of litigation outcomes. If RTF laws can reduce the uncertainty under nuisance law, they may also encourage private bargaining and thus encourage farmland conversion when urban land prices are rising. Moreover, I only model a one-time transaction between the

farmer and the developer. But when more parties are involved, things can be very different. Since the nature of locality is an important factor under nuisance law, the sequence of development may affect nuisance determination. This is another major distinction between nuisance law and RTF laws.

Also, I may have over-simplified RTF laws in my model. Some variations of RTF laws among different states could be critical. For example, some RTF laws have more stringent requirements on farming practices than others and therefore have different effect on land use. In addition, each component of RTF laws may have different effects on land use and thus needs to be considered separately.

With respect to the empirical analysis, better data are needed. As noted above, metropolitan area data will be much better for the study on urbanization and farmland conversion because land-use conflicts only occur at the urban fringes. The effect of RTF laws may lie in the geographical distribution of land uses, but not the total acreage of land uses. Such effects cannot be detected in the state-level land-use data.

Perhaps more importantly, the data should be on more specific land uses. Not all types of agricultural activities substantially interfere with urban use. My study only examines the effect of RTF laws on cropland use. Not finding any significant effect on cropland use does not necessarily mean that RTF laws have no effect on other agricultural activities. It will be more desirable to confine the empirical analysis to the agricultural activities that are more likely to be deemed as nuisances such as feedlots and chicken farms. It is reasonable to expect that the impact of RTF laws is greater on these activities than on cropland use.

APPENDIX A – DATA SOURCES

Variables	Time period	Source	Remarks
Year of the enactment of RTF statutes		Westlaw, LexisNexis	
State-level major land uses (total land, cropland, pasture, forest, defense, urban)	1959-1997	Economic Research Service, USDA	Link: http://www.ers.usda.gov/Data/MajorLandUses/
State total land in farm	1959-1997	Economic Research Service, USDA	Link: http://ers.usda.gov/data/FarmIncome/FinfidmuXls.htm
Property Taxes, including operator dwellings	1959-1997	Economic Research Service, USDA	Link: http://ers.usda.gov/data/FarmIncome/FinfidmuXls.htm
Agricultural Conservation Program, total gross assistance	1959-1997	U.S. Agricultural Statistics	Hardcopy
Median home value (adjusted)	1959-1997	U.S. Census Bureau	Link: http://www.census.gov/hhes/www/housing/census/historic/values.html
Price indices of production inputs and outputs	1959-1997	Economic Research Service, USDA	Contact: V. Eldon Ball
Consumer Price Index (all urban consumers)	1959-1997 (January of each year)	Bureau of Labor Statistics, USDL	Link: http://www.bls.gov/cpi/#tables

APPENDIX B – SUMMARY STATISTICS

Variable	Year	Mean	S.D.	Min	Max
% CROPLAND	1964	24.45	18.52	1.19	74.22
	1969	25.67	20.05	1.11	79.32
	1974	25.34	19.88	1.07	78.74
	1978	25.62	19.76	1.23	80.22
	1982	25.48	20.00	1.23	79.66
	1987	24.96	20.12	1.21	78.12
	1992	24.50	20.07	1.18	79.98
	1997	23.94	19.96	1.23	78.05
% URBAN	1964	3.18	4.89	0.08	22.88
	1969	3.51	5.47	0.08	24.00
	1974	3.84	5.78	0.10	25.43
	1978	4.79	6.68	0.12	27.43
	1982	5.25	7.09	0.14	28.73
	1987	5.61	7.07	0.15	29.53
	1992	6.03	8.09	0.18	34.46
	1997	6.56	8.56	0.21	36.06
% FOREST	1964	41.20	23.51	0.98	87.10
	1969	41.35	24.03	0.95	88.96
	1974	40.44	23.44	0.94	88.46
	1978	39.56	23.17	0.96	88.30
	1982	39.01	23.05	1.16	88.55
	1987	38.65	22.97	1.04	87.90
	1992	38.80	23.07	0.77	88.40
	1997	38.15	22.79	1.00	85.82
% PASTURE	1964	21.80	21.25	0.81	73.60
	1969	19.81	21.64	0.75	73.80
	1974	19.34	21.62	0.59	73.97
	1978	18.75	21.87	0.45	73.20
	1982	19.04	21.77	0.44	73.45
	1987	18.80	21.58	0.36	72.73
	1992	18.77	21.74	0.19	72.26
	1997	18.41	21.69	0.19	72.20
% PARK	1964	2.32	2.07	0.23	9.01
	1969	2.49	2.27	0.20	10.14
	1974	2.69	2.34	0.20	10.13
	1978	3.30	2.63	0.22	10.05
	1982	3.59	2.81	0.22	10.09

	1987	4.40	3.42	0.23	12.34
	1992	4.48	3.43	0.23	12.37
	1997	4.71	3.88	0.25	17.96

APPENDIX B – SUMMARY STATISTICS -- *Continued*

Variable	**Year**	**Mean**	**S.D.**	**Min**	**Max**
% DEFENSE	1964	1.29	1.26	0.04	5.73
	1969	0.93	1.32	0.01	5.64
	1974	0.91	1.31	0.01	5.60
	1978	0.90	1.31	0.01	5.60
	1982	0.87	1.29	0.01	5.60
	1987	0.79	1.21	0	5.54
	1992	0.78	1.15	0.001	4.82
	1997	0.65	0.82	0.01	4.36
AVERAGE PROPERTY TAX	1964	74.79	72.93	4.88	331.84
	1969	96.11	99.77	4.81	389.07
	1974	99.44	107.13	4.27	438.34
	1978	93.88	95.38	4.77	422.4
	1982	73.25	74.24	3.10	315.45
	1987	80.10	80.29	2.79	322.49
	1992	85.47	86.46	2.68	356.77
	1997	83.70	86.62	3.40	361.84
AVERAGE ACP ASSISTENCE	1964	0.009	0.005	0.001	0.022
	1969	0.008	0.005	0.001	0.020
	1974	0.003	0.002	0.0004	0.014
	1978	0.005	0.004	0.001	0.023
	1982	0.003	0.003	0.0004	0.016
	1987	0.002	0.002	0.0002	0.012
	1992	0.003	0.003	0.0003	0.014
	1997	0.002	0.002	0.0002	0.008
MEDIAN HOME VALUE	1964	56567.5	12501.16	35920	88540
	1969	59641.46	13719.42	39570	96340
	1974	72652.92	16300.99	48820	120140
	1978	85049.58	19941.51	57340	151580
	1982	93393.75	24967.72	61120	183800
	1987	98758.33	37719.11	59470	225050
	1992	104425.8	43499.83	60920	242140
	1997	110547.7	36178.56	67470	222990
PRICE OF CROPS	1964	0.41	0.05	0.28	0.51
	1969	0.42	0.05	0.31	0.56
	1974	0.87	0.17	0.56	1.27
	1978	0.78	0.08	0.58	0.96

	1982	0.89	0.06	0.78	1.12
	1987	0.90	0.11	0.74	1.19
	1992	0.98	0.11	0.82	1.33
	1997	1.05	0.15	0.82	1.60

APPENDIX B – SUMMARY STATISTICS -- *Continued*

Variable	**Year**	**Mean**	**S.D.**	**Min**	**Max**
	1964	0.33	0.05	0.24	0.45
	1969	0.43	0.05	0.34	0.59
	1974	0.60	0.08	0.47	0.95
PRICE OF	1978	0.79	0.09	0.65	1.05
LIVESTOCK	1982	0.91	0.10	0.72	1.23
	1987	0.92	0.11	0.77	1.20
	1992	1.00	0.14	0.81	1.33
	1997	1.00	0.10	0.81	1.29
	1964	0.17	0.004	0.16	0.19
	1969	0.23	0.004	0.22	0.24
	1974	0.36	0.02	0.33	0.45
PRICE OF CAPITAL	1978	0.43	0.01	0.40	0.47
INPUT	1982	0.74	0.02	0.71	0.82
	1987	0.88	0.02	0.82	0.93
	1992	0.86	0.02	0.78	0.89
	1997	1.02	0.02	0.98	1.07
	1964	0.36	0.05	0.25	0.46
	1969	0.40	0.05	0.26	0.52
	1974	0.71	0.08	0.55	0.87
PRICE OF	1978	0.79	0.08	0.61	1.00
MATERILAS	1982	1.02	0.10	0.76	1.30
	1987	0.97	0.11	0.75	1.28
	1992	1.14	0.13	0.86	1.55
	1997	1.28	0.15	0.98	1.70
	1964	0.06	0.03	0.02	0.14
	1969	0.14	0.06	0.04	0.26
	1974	0.31	0.12	0.09	0.60
PRICE OF LAND	1978	0.44	0.20	0.13	1.07
INPUT	1982	0.86	0.33	0.26	1.75
	1987	0.88	0.38	0.23	2.03
	1992	0.75	0.36	0.18	1.83
	1997	1.02	0.42	0.25	1.95

APPENDIX C – ROBUSTNESS OF ESTIMATES

Dependent Variable	(5) *% CROPLAND*	(6) *% CROPLAND*	(7) *% URBAN*	(8) *% URBAN*
RTF law variables:				
RTF LAW	0.05 (0.42)		-0.24 (0.21)	
RTF YEARS		-0.09 (0.06)		-0.02 (0.03)
Land-use variables:				
LAGGED % FOREST	-0.17*** (0.04)	-0.22*** (0.03)	-0.09*** (0.02)	-0.10*** (0.02)
LAGGED % PASTURE	-0.10* (0.06)	-0.17*** (0.05)	-0.05* (0.03)	-0.05* (0.03)
LAGGED % PARK	-0.13 (0.08)	-0.27*** (0.08)	0.03 (0.04)	0.02 (0.04)
LAGGED % DEFENSE	-0.51* (0.28)	-0.69*** (0.26)	0.27* (0.14)	0.26* (0.14)
Governmental policy variables:				
AVERAGE PROPERTY TAX	-0.007** (0.003)	-0.009*** (0.003)	-0.004** (0.002)	-0.004*** (0.002)
AVERAGE ACP ASSISTANCE	-24.10 (37.74)	6.13 (40.42)	-27.16 (18.54)	-60.35*** (21.41)
Population variables:				
POP DENSITY	-13.58*** (3.57)	-14.94*** (3.39)	34.62*** (1.75)	33.58*** (1.79)
URBAN POP DENSITY	0.57*** (0.20)	0.38** (0.19)	-1.20*** (0.10)	-1.12*** (0.10)
Price index variables:				
PRICE OF CROPS	-0.54 (0.80)	-0.87 (0.94)	0.50 (0.39)	1.41*** (0.50)
PRICE OF LIVESTOCK	4.45*** (0.94)	3.01** (1.20)	-2.03*** (0.46)	-2.78*** (0.64)
PRICE OF CAPITAL INPUT	-3.52*** (1.33)	-11.25** (4.41)	-0.50 (0.66)	-0.40 (2.33)
PRICE OF MATERIALS	0.81 (1.28)	7.57*** (1.76)	-0.01 (0.63)	-0.39 (0.93)
PRICE OF LAND INPUT	0.17 (0.44)	-0.17 (0.46)	0.74*** (0.22)	0.50** (0.25)
PRICE OF LABOR INPUT	-1.06 (0.11)	-1.45* (0.74)	0.09 (0.33)	-0.27 (0.40)
Census year dummies:	No	Yes	No	Yes

R^2	0.9961	0.9968	0.9923	0.9927
F Value	44.60***	46.83***	11.90***	10.91***
(d.f.)	(321)	(314)	(321)	(314)

Standard deviation are in parenthesis; asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels

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