Fence Laws: Liability Rules and Agricultural Development

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Abstract

This paper uses the evolution of fence laws in the American West to show that liability assignment can influence resource allocation and productivity. Local fence laws assign animal trespassing liability to either farmers or livestock owners. I compiled a dataset documenting all county-level fence law changes from 1850 to 1930 for states on the Great Plains. I compare adjacent counties with different fence laws to identify the causal effect of fence laws on agricultural development. Results show that changing liability assignments had asymmetric effects. Shifting the liability from livestock owners to farmers decreased rural population density and farmland areas. On the other hand, shifting liability from farmers to livestock owners increased share of farmland used for wheat and corn, which led to higher total value of farm output. Reducing farmers' liability also shifted the composition of land acquisition by increasing the share of land acquired under Homestead as opposed to cash purchase.

JEL Classifications: K11, D23, N41, N51, Q15

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1 Introduction

In his seminal article, Coase (1960) uses an example between a farmer and a cattle-raiser adjacent to each other to illustrate that the assignment of property damage liability does not affect the allocation of resources. Cattle may stray and destroy the crops on the farmer's land. Regardless of whether the farmer or the cattle-raiser is legally liable for the trespassing damage, the land allocation between the two types of production should reach the same equilibrium, as long as the liability is well-defined and enforced, and the transaction is costless. Coase' argument has since inspired a series of theoretical (Cheung, 1970; Demsetz, 1964) and empirical research (Besley, 1995; Alston, Libecap, and Schneider, 1996; Libecap, 2007) on property rights regulations. However, despite the wide application, most research focuses on the effect of establishing and enforcing property rights. Few empirical works study how the assignment of property damage liability may influence resource allocation.

This paper uses the historical evolution of fence laws in the American West to analyze the long-term effect of liability rules on resource allocation and productivity. Under the "fence-out" rule, farmers (crop growers) can claim damage from owners of the trespassing animals *only if* they have enclosed the land with fences that satisfy specific regulatory requirements, such as materials used, height and width, etc. Meanwhile, under the "fence-in" rule, livestock owners are liable for trespassing damages *regardless* of whether the farms are enclosed with fences. In other words, the liability for livestock trespassing is assigned to farmers in some areas and livestock owners in others. Ranchers and farmers have long contested fence regulations. Prolonged public debates and occasional violent conflicts between farmers and ranchers suggest that this supposedly innocuous rule had profound economic implications.

I compiled data on all county-level fence law changes from the first state (or territorial) legislature until 1930, covering all the states on the "Great Plains".[1] To the best of my knowledge, this is the first dataset that fully captures the legal environment on property rights protection during this period. I combine the fence law data with the decennial censuses and land patents from the Bureau of Land Management to quantify the effects of fence laws on settlement, land use, and productivity over the past century.

The baseline estimation compares adjacent counties with different regulatory changes across census years. Adjacent counties on the Plains have similar natural endowments but may be subject to different fence laws over time. The main identification challenge is that all the counties were subject to some type of fence law, and counties switched back and forth between different fence laws. Therefore, I define the treatment in terms of the direction of fence law *changes*: a county either shifted the liability from farmers to ranchers, or the other way around. By comparing adjacent counties that started off with the same regulation, but only one experienced a fence law change between the census years, I can plausibly identify the causal effects of the liability regulation on agricultural production.

[1] The "Great Plains" is referred to the areas located west of the Mississippi River and east of the Rocky Mountains. In this paper, the 12 Plain states include CO, IA, KS, MN, MO, MT, ND, NE, NM, OK, SD, and TX.

The results indicate that increasing rancher's liability changed the composition of land use and increased the share of farmland used for wheat and corn. On the extensive margin, increasing farmers' liability deterred settlement: it reduced the rural population density 7.6% and the share of farmland by 16.7%, with respect to the average. Meanwhile, the effects were not symmetric: for counties that shifted the liability from farmers to ranchers, population density and share of farmland did not change.

The changes in production decisions translated to changes in product values. The total value of farm products was 6.3% higher for counties that increased ranchers' liability. This increase is driven primarily by crop production, whose value increased by 8.5%. Increasing farmer's liability only increased output value from livestock, but not the total value of farm product. In both cases, the policy changes did not affect the land value in the short run.

Finally, I use the land patent data from the Bureau of Land Management to estimate whether fence laws shifted the composition of settlement, in particular between homesteaders and cash purchases. Results show that increasing rancher's liability led to a larger fraction of land acquired under the Homestead Act, while increasing farmer's liability had no effects on land acquisition through either channel.

This paper contributes to the growing literature on the role of property rights in economic development (Anderson and Hill, 2004; Besley and Ghatak, 2010; Edwards, Fiszbein, and Libecap, 2020), and more broadly, the long-term influence of legal frameworks on economic outcomes (La Porta, Lopez-de Silanes, and Shleifer, 2008; Acemoglu, Johnson, and Robinson, 2005). Default liability assignments imposed a high cost on one party while prohibiting private agents from negotiating and entering into alternative arrangements. It created high transaction costs, which are the usual sources of inefficiency and welfare loss (Demsetz, 1968). The historical case from the US frontier development suggests that the liability rules may distort resource allocation. More importantly, the results suggest that the effects are not symmetric, suggesting that better designed policies can increase total welfare.

By highlighting the effects of liability rules, this paper also contributes to contemporary policy discussions on property rights and liability assignments (Posner, 2005; Hazlett and Muñoz, 2009; Greenwood and Ingene, 1978). Many current policies still default property protection and damage liability to specific parties. The fence law example also suggests that regulations that determine liability rules are likely to cause sub-optimal outcomes.

Finally, I also contribute to a large literature on fence laws and agricultural development in the US. Fence laws have long been a contentious policy issue in the US (Sanchez and Nugent, 2000; Vogel, 1987). Many prairie farmers supported the fence law changes that held livestock owners responsible for trespassing damages (Bogue, 1963).[2] Empirical work using data from the Southern states suggests that fence laws that make stock owners liable for damages can significantly increase farm values and crop production (King, 1982; Kantor, 1998). Similarly, by drastically re-

[2] Ellickson (1991) found that in the 1990s, farmers and ranchers in California may appeal more to social norms rather than formal legal rules to resolve conflicts over property rights.

ducing the cost of protecting the land, the barbed wire also increased settlement, land value, and productivity (Hornbeck, 2010). This paper is the first to document the evolution of local fence law changes over the long run. The empirical strategy provides clear identification of the causal relationship between the fence laws and long-term development.

The rest of the paper is organized as follows. section 2 reviews the evolution of fence laws in the western states and documents historical accounts of how the laws affected farmers and livestock owners. section 3 provides a stylized model to motivate the empirical analysis. section 4 describes the county-level fence law data and provides descriptive evidence on the impact of fence laws. section 5 develops the empirical strategy and section 6 presents the main results. section 7 concludes.

2 Historical Background: Fence Laws on the Great Plains

Legislatures and courts used fence laws to establish liability rules and resolve conflicts between farmers and livestock owners. Some required farmers to enclose their land and allow livestock to run at large; others made livestock owners liable for all trespassing damages while farmers could leave their land unfenced. On the Great Plains, conflicts over fence laws arose as the settlement expanded west and the agricultural land moved closer to the open range for livestock (Webb, 1959; Hayter, 1963; Bennett and Abbott, 2017). Local fence laws changed over time. As a result, adjacent counties can have different fence laws, assigning the damage liability to farmers or livestock owners, which may also vary by type of animal, season, or even time of the day.

2.1 Three Types of Fence Laws

I classify the fence laws into three main groups, depending on the assignment of trespassing liability. To attract settlers to the frontier, early regulations on the Plains usually required farmers to enclose their land against trespassing livestock.[3] As the frontier expanded westward and the agricultural land pushed closer to grazing ground, conflicts between farmers and livestock owners increased. The growing agricultural interest started to push for fence laws that would impose the liability on livestock owners and thus relieve them from the high cost of fencing the land (Kawashima, 1994). Therefore, counties either (1) required livestock owners to restrain their animals, (2) or required farmers to enclose their land, or (3) assigned the liability to either party under different scenarios.

***Fence-in* by livestock owners:** Under the fence-in rule, livestock owners were liable for animal trespassing. Farmers could claim damages regardless of whether the land was enclosed by fences. It prohibited animals from roaming freely, so owners needed to restrain their animals, either with fences or by herding the animals. Because the fence-in rule assigned the liability to livestock

[3] This is not unique to the western frontier. For example, colonial law in Virginia and Georgia required land owners to fence their crops, while cattle and hogs were allowed to roam freely. See Kantor (1994) and Kawashima (1994).

owners, it was also known as "herd law" or "stock law". For example, the 1873 law for Nobles County, Minnesota[4] stated that:

> Section 1. It shall be unlawful for any person or persons to allow any cattle, sheep, swine, or other domestic animals [...] to run at large upon any public highway or upon the lands of any other person or persons in the county of Nobles and state of Minnesota, during any season of the year, unless they be carefully herded.
>
> Section 2. Any person or persons who shall violate or neglect the provisions of the first section of this act shall be liable for all damages that may ensue in consequence of the trespass of such animal or animals.

***Fence-out* by farmers:** Under the fence-out rule, farmers could claim trespass damage only if a lawful fence enclosed the land to keep animals out of the farm. The provision usually had specific criteria regarding what constitutes a "lawful fence". For farmers to claim damage, they must build a fence up to the standard specified in the law. Though this does not require or force farmers to build a fence, farmers could not recover any damage without a fence. Meanwhile, the fence-out law allows livestock can run at large and roam freely in the open range. In 1859, the Territory of Kansas adopted the following fence-out requirement:[5]

> Section 1. All fields and inclosures shall be inclosed with a fence, composed of posts and rails, posts and palings, posts and planks or palisades, rails alone, laid up in the manner commonly called a worm fence, or of turf, with ditches on each side, or a hedge, composed either of thorn or Osage orange.
>
> Section. 2. All such fences, composed of posts and rails, posts and palings, posts and planks or palisades, shall be at least four feet and a half high; the lower rail shall not be more than two feet from the ground; those composed of turf shall be at least four feet high, and trenches on either side, at least three feet wide at the top and three feet deep; and what is commonly called a worm fence shall be at least five feet high to the top of the rider, or, if not ridered, shall be five feet to the top rail, and the corners shall be locked with strong rails, poles or stakes; and a fence composed of hedge shall be of such hight and thickness as will be sufficient to protect such field or inclosure. [...]
>
> Section 4. If any horse, cattle or other stock shall break into any inclosure, the fence being of the height and sufficiency aforesaid, the owner of such animal shall make reparation to the party injured for the true value of the damages he shall sustain[...]

[4]"An Act to Prevent the Running at Large of Cattle or Other Domestic Animals within the County of Nobles", in Special Laws of the State of Minnesota, 15th Session of the State Legislature, Chapter LXV

[5]"An Act Regulating Inclosures", in General Laws of the Territory of Kansas, 5th Session of the Legislative Assembly, Chapter LXXVIII

***Partial* fence requirement:** While the above examples imposed unconditional fence rules that applied to all animals at all times, some regulations limit the regulation to certain time periods or specific species. For example, Iowa passed legislation in 1868[6] making livestock owners liable for trespassing damages done during the nighttime:

> Section 1. That any stock taken in the act of doing damage, between the hours of sunset and sunrise, may be distrained by the person or persons whose property is damaged [...] whether the fences surrounding such property are lawful or otherwise.

Similarly, in 1865, Colorado prohibited stallions, sheep, and hogs from running at large and owners of such animals were liable for damages.[7] Cattle, however, was not subject to the law:

> Section 1. That any person or persons owning or having in charge any stallion or stallions more than one year old, and shall permit the same to run at large, he or they shall be fined in a sum not less than twenty dollars nor more than one hundred dollars for each and every such offense, and any person or persons owning or having in charge sheep, hog or hogs, and shall permit the same to run at large without a herder or pasturer, he or they shall be fined in a sum not less than five nor more than ten dollars for each and every offense, and be responsible for any and all damage which they may commit [...]

Such regulations varied on the specifics, including time of the day, time of the year, or species. I classify such fence laws as "partial". In particular, when the fence law enumerate a list of animals prohibited from running at large, I consider the fence law to be "partial" when the list does not include cattle.

2.2 Supporters for Each Type of Fence Laws

Farmers claim that the fence-out rule discouraged settlement and investment in farmland, as fences were costly to construct and maintain. Public outcry and grievances over fence laws increased as the frontier expanded westward. Policymakers became concerned that the fence-out rule may likely deter future settlement in the west (Department of Agriculture, 1872). Correspondingly, when states tried to change the fence law and shift the liabilities from farmers to livestock owners, they usually cited attracting new settlers and improving farmland as the policy target. In the presidential address at the 1872 Kansas State Agricultural Society, supporters of the fence-in rule claim that:

> "if you were to enact a law which shall enable him to make the improvements desirable [...] without compelling him to inclose his crops with fences,

[6] "An Act to Protect Crops against the Invasions of Stock", in Acts and Resolutions Passed at the Regular Session of the 12th General Assembly of the State of Iowa, Chapter 144

[7] "An Act to Restrain Sheep, Hogs, and Stallions from Running at Large", in General Laws Passed at the 4th Session of the Legislative Assembly of the Territory of Colorado

> (now so expensive) against his neighbor's stock [...] it would bring to Kansas double, if not quadruple, the immigration that would otherwise come."

Unlike farmers, livestock owners were divided on whether they support the fence-in or fence-out rule. Large ranchers could benefit more from fences, while small livestock owners were more likely to be against the fence-in requirement. While costly, fences can be beneficial to animal husbandry. Enclosed livestock was less susceptible to contagious diseases. To improve their stock through breeding, ranchers also needed to fence in their herds against inferior bulls. Finally, like farmers, ranchers sometimes cultivated fodder crops to feed their stock and would prefer to have other animals restrained from trespassing their land (White, 1975). Such benefit accrued more to large ranchers, partly because it is more cost-effective to fence a large area. On the other hand, small livestock owners relied more on the open range to support their herds, so the fencing requirement would essentially limit their access to the free prairie land for feed and water.

2.3 Adoption and Evolution

Fence laws varied across counties. The regulations could be adopted either through statewide legislation or at the county level via special provisions. The regulation also evolved over time, exposing adjacent counties to different laws at different points in time. [8]

Statewide vs. County-level Adoption Statewide regulations in principle apply to all the counties, thus switching the whole state from one type of fence law to another overnight. For example, in 1850, Minnesota first adopted a fence-out rule, so livestock owners were not liable for damages unless the land was enclosed with a legal fence. However, by 1865, the state changed to a partial-in rule, making livestock owners liable for trespass damages during the night time, "from eight o'clock in the evening until sunrise", and shall pay for the damages "without regard to the sufficiency of the fences on such lands."

Fence laws can also vary at the county level through two channels. First, the state legislature can adopt a special act or exemptions for specific counties. For example, Colorado was under the fence-out rule since 1859. However, in 1864, the state legislature passed a special act for Douglas and Weld counties, stating that "no person farming or cultivating land within the limits of Douglas and Weld counties shall be required to fence or enclose the same against any stock running at large". In other words, the two counties became fence-in, while the rest of the state remained under fence-out rules. Second, states can allow counties to choose whether to adopt specific fence law provisions, usually through a petition or general elections. Consider the aforementioned partial rule passed in Iowa in 1868. The law also stated that "a majority of the board of supervisors in each organized county in this State shall determine whether the adoption of the provisions of this act shall be submitted to the legal voters of the county at the ensuing the people general election."[9]

[8] See Appendix B for detailed texts cited in this section.

[9] "An act to protect crops against the invasions of stock", Acts and Resolutions Passed at the Regular Session of the 12th

Frequent Fence Law Changes in the 19th Century Most fence law changes occurred during the 19th century. Figure 1(a) plots the share of counties with fence law changes each year.[10] For each state (or territory), the first fence law was usually adopted at the first or second legislative session (see Appendix Figure 3). This is consistent with the historical accounts that, as more people settled at the western frontier, a clear legal definition of property damage liability became an essential institutional tool to settle conflicts over property rights (Hayter, 1963).

Shifting Liability from Farmers to Ranchers Most Plain states first established fence-out rules when the frontier was sparsely populated with livestock owners taking advantage of the free grazing land.[11] However, as the frontier expanded west, the high cost of fencing became the main source of discontent of farmers. The farming community pushed for regulatory changes to shift the burden of constructing and maintaining fences to livestock owners. For example, Kansas initially established a fence-out rule in 1855. It shifted to a partial rule, first in 1858 that required hogs to be restrained and then in 1864, making livestock owners liable for all damages done at night. In 1874, when the state legislature allowed each county to adopt local fence laws, 39 percent of the counties immediately switched to the fence-in rule that assigned all trespassing liabilities to livestock owners. The number gradually increased over time, and by 1885, 58 percent of the counties were under the fence-in rule.

Figure 1(b) plots the share of counties under each type of fence law from 1850 to 1930.[12] Before 1860, most counties were under the fence-out rule that required farmers to enclose their land against trespassing. The fence laws started to shift in farmers' favor as the number of partial rules started to pick up by the early 1860s. The 1870s saw a more drastic change when more counties switched to full fence-in requirements, making ranchers liable for all damages. Fence laws stabilized by the turn of the century, with more than half of the counties settling for the fence-in rule.

General Assembly of the State of Iowa, Chapter 114

[10] This accounts for the expansion of the frontier with new counties being incorporated and adopted specific fence laws. See Appendix Figure 4 for the total count over time.

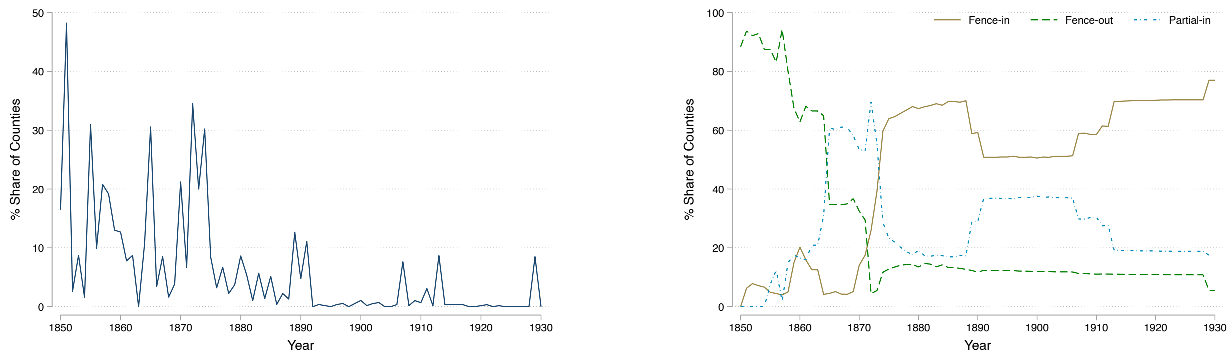
[11] The only exception is New Mexico, which started with a fence-in rule. See Appendix B for more discussion.

[12] See Appendix Figure 5 for the number of counties under each type of regulation.

Figure 1: Evolution of Fence Laws

(a) Share of Counties with Fence Law Changes

(b) Share of Counties by Types of Fence Law



2.4 Fence Cost and Barbed Wire

In the 19th century, fencing cost was one of the largest capital investment in agriculture. According to the report to the House of Representatives in 1872, the cost of fences was nearly equal to the total amount of the national debt, or the value of all farm animals in the United States (U.S. House, 1872).

The high fencing cost was one cause for the growing discontent of frontier farmers. The high cost was exacerbated as the frontier moved further into the timber-less prairie where fencing materials were scarce. Historians point out that "the scarcity of timber for fencing and other farm construction prevented whole areas of the prairie from being settled" (Rice, 1937). Crumbling fences could not protect the farm against livestock trespassing. It is not unusual for such devastation to lead to permanent hostility and brutal conflicts between neighbors (Hayter, 1963).

The introduction and wide adoption of barbed wire in 1875 did not resolve all the conflicts over fencing rules, despite that it largely reduced fencing cost, especially in the Great Plains with less timber supply (Hornbeck, 2010). Historical accounts show after the introduction of barbed wire, "there ensued a conflict, violent and sanguinary, between fence men and non-fence men" (Webb, 1959). The increasing conflicts may be driven by the westward expansion of farming: people could now settle in places that were too expensive to fence before barbed wire, thus putting farmers closer to stock raisers in the western states. The conflicts spread throughout the Great Plains, ranging from skirmishes between neighbors to large-scale "fence cutter wars". Local sentiment can be so strong that many did not oppose cutting others' fences and the "lawless element of the fence-cutters were held up in glowing colors"(Hayter, 1939). In addition to the conflicts between farmers and ranchers, other groups were also influenced by the adoption of barbed wire. Cowboys may lose their jobs when a ranch became effectively fenced with barbed wire; small stock owners were unhappy about illegal fences on public land that kept them away from water sources.

It is also worth noting that most fence law changes predated the introduction of barbed wire around 1875. More importantly, the 1870s saw the shift of trespassing liabilities from farmers to livestock owners, as the fence-in requirement that made livestock owners liable for damages became the dominant form of fence laws.

3 Theoretical Framework: Producer's Problem

A producer is endowed with one unit of farmland, which can be used to produce either grains or livestock, indexed by $c \in \{g, l\}$. Farmlands are perfect substitutes in the production of either output, but vary in exogenous productivity A_c for each output. The producer chooses to allocate the fraction of land S_c and variable inputs V_c to each product c and produce Q_c units of output, or

$$Q_c = A_c Q_c(S_c, V_c) \tag{1}$$

Fence liabilities determines how much of the total product can the farmer receive from the farm. For example, if farmers are liable to build fences, they would lose some output to the damage and only receive a fraction of the output. Conversely, if ranchers a liable to restrain their livestock, they would need to pay for the damages and thus also only receives a fraction of the output. Let R denote the fence law, and $\tau_c(R)$ be fraction of the total output the producer can receive for product c. Thus, under the fence law regime R, the producer can receive $\tau_c(R)Q_c$ units of output for product c.

The producer is a price-taker in both the input and the product market. Given input prices r_c and output prices p_c in the grain or livestock market, the producer chooses the fraction of land S_c allocated to grain versus livestock, and the corresponding variable inputs V_c, to maximize the total profit. The land allocation is subject to the constraint that the total area of land does not exceeds the total endowment.

The producers' problem can be written as:

$$\begin{aligned} \max_{S_c, V_c} \Pi = & \sum_{c \in (g,l)} p_c \tau_c(R) A_c Q_c(S_c, V_c) - \sum_{c \in (g,l)} r_c V_c \\ & \text{s.t.} \sum_{c \in (g,l)} S_c \leq 1 \end{aligned} \tag{2}$$

Consider two counties with the same natural conditions, face the same inputs and output market, but opted to have different fence laws. Let $\bar{A}_c$, $\bar{r}_c$ and $\bar{p}_c$ denote the common productivity and prices. The optimal land allocation, variable inputs, and the corresponding maximum outputs can thus be expressed as

$$
\begin{aligned}
S_c^* &= S(\bar{p}_c, \bar{r}_c, \bar{A}_c, \tau_c(R)) \\
V_c^* &= V(\bar{p}_c, \bar{r}_c, \bar{A}_c, \tau_c(R)) \\
Q_c^* &= Q_c(S^*, V^*)
\end{aligned}
\tag{3}
$$

Given the same prices and productivity, the land allocation, variable inputs, and total output would differ across the two counties only if the liability regime R is different.

This simple model abstracts from potential productivity gains through agglomeration or specialization. For example, if a county produces mostly corn, one might expect to have more suppliers for crop-specific inputs (i.e. fertilizers, irrigation), or more technology diffusion (i.e. agricultural experiment station). However, for the late 19th century western frontiers, I assume the agglomeration effects to be negligible for counties in close proximity.

4 Data

In this section, I discuss the data for fence law and outcome measures. I then provide some descriptive evidence on the evolution of fence laws over time. The inter-temporal variation of the fence laws motivated the comparison of adjacent counties with different fence laws. In the last part, I discuss the sample construction to utilize the discontinuity across county boundaries.

4.1 Fence Law Data

I first collect data on all fence laws from state (or territorial) session laws for states on the Great Plains. The fence law data is the first comprehensive collection of the historical evolution of state and county-level fence laws and codified both the assignment of liability and specific requirements that can influence the transaction cost when recovering damages. The preliminary analysis includes 568 regulatory changes (both statewide and at the county level) across 8 states.[13]

The session laws document all the legislative actions during each state legislative session, which occurs once every one or two years. This covers both the statewide adoption and special provisions for individual counties. Thus, the session laws track all the adoption, amendments, and repeals of fence laws for each county. The data expands from the first legislative session to 1930. When states allowed individual counties to adopt fence laws through petition or general election, as discussed in subsection 2.3, the final adoption decisions were not recorded in the session laws. For such cases, I use the reports from state agricultural associations or similar organizations to collect county-level fence law adoptions.

I used two sources to verify the data. First, I checked the session law data against state statutes, which collected all regulatory changes adopted at the past legislative sessions. This assures that the session law data did not miss any changes or adoptions. Second, because court rulings may

[13]Preliminary results include eight states: IA, KS, MN, NE, CO, SD, ND, NM

also influence the adoption, I search through state case laws regarding fences.[14] This ensures that relevant regulations were not overthrown by the court. In a few cases, the courts provided clarification on certain clauses. Appendix A provides more details on the data collection and verification process.

Fence laws exhibited substantial variation across counties and over time. Figure 2 shows the fence law changes in New Mexico from 1880 to 1900. Adjacent counties can have different fence laws at any given point in time; for each individual county, it may also change the fence laws, sometimes within a relatively short period. Appendix Figure 2 displays the county-level fence laws from 1870 to 1920 for all the states covered in the analysis.

Figure 2: Fence Laws in New Mexico

(a) 1880 (b) 1890 (c) 1900

4.2 Outcome and Suitability Measures

I collect the main outcome variables, including population, land use pattern, land value, and farm output, from the Census of Population and Census of Agriculture from 1860 to 1930 (Haines et al., 2018). These data provide a consistent measure of agricultural production at the county level over the long run. Because the western states experienced frequent county border changes, yet all fence laws are defined at the county level, I kept the census measure at the original county level and did not homogenize the borders to a baseline year.

The natural conditions also influences agricultural production decisions. In producers' problem, this is captured by the crop-specific productivity term A_c. I use the "agro-climatically attainable yield" from the Global Agro-Ecological Zones (GAEZ) project created by the Food and Agriculture Organization (FAO) to measure each county's natural endowment for different types of agricultural products.[15] I aggregated the data at the county level and calculated the average

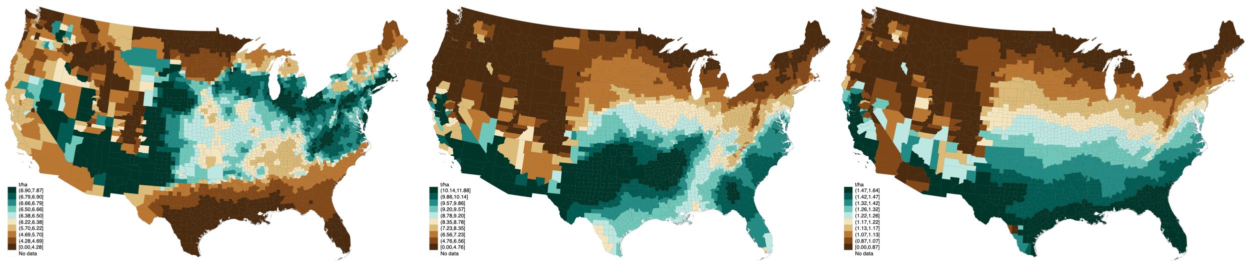
[14] Digitized state case laws are available at The CaseLaw Access Project, https://case.law/. This database is hosted by Harvard Law School and includes all official, book-published state and federal United States case law.

[15] The FAO first collects a set of input measures, including the soil types and conditions, the elevation, and climatic variables (i.e. rainfall, temperature, sun exposure). The input measures are then fed through an agronomic model to predict the attainable yield for each type of crop (Fischer et al., 2021; Costinot and Donaldson, 2016; Nunn and

yield level for each county. For the analysis, I focus on three main types of crops: wheat and corn for grain production and alfalfa as a proxy for fodder. Throughout, I use the yield measure under irrigation and intermediate input intensity.

Figure 3: Suitability Measures

(a) Wheat (b) Corn (c) Alfalfa



Note: The maps plots the average agro-climatically attainable yield, measured in tons per hectare, for each type of crop. Values are calculated using 1900 county borders. For the analysis, the average yield for each county is calculated separately for each census year using the corresponding county borders.

4.3 Bureau of Land Management Land Patent Data

Fence laws may also influence the selection and sorting in settlement. The primary distinction is between homestead and cash purchases. Homesteaders with small plots may have different preferences than large ranches acquired through cash purchase. However, the county-level Census of Agriculture does not contain information on the type of settlement, i.e. cash purchase versus homestead; it also does not have detailed measures on the concentration of land, which influences the severity of externality.[16]

I use the individual General Land Office patent files from the Bureau of Land Management to measure land acquisition types. The land patents were issued to all the land transferred from the federal government to individuals, states, and corporations. Each patent records the time of issuance, acreage covered under the patent, location of the land, and the type of transaction (i.e. homestead vs cash purchase). This allows me to measure the composition of land ownership for each county.

Figure 4 shows the number of patents issued and the acreage covered under each type. For the analysis, I focus on land patent issued before 1940. The data contains 2.8 million patents in the 11 states covered in this paper.[17] Land claimed under the Homestead Acts accounts for 36.8 percent of the total number of patents issued before 1940, or 37.8 percent of all the land

Qian, 2011). The GAEZ data reports yield levels for different input scenarios. I use "intermediate" input intensity with "irrigated" water supplies for all the crops in the analysis.

[16] For example, a county with large ranches and few shared boundaries would face fewer trespassing problems than a county with a lot of small adjacent homesteading plots.

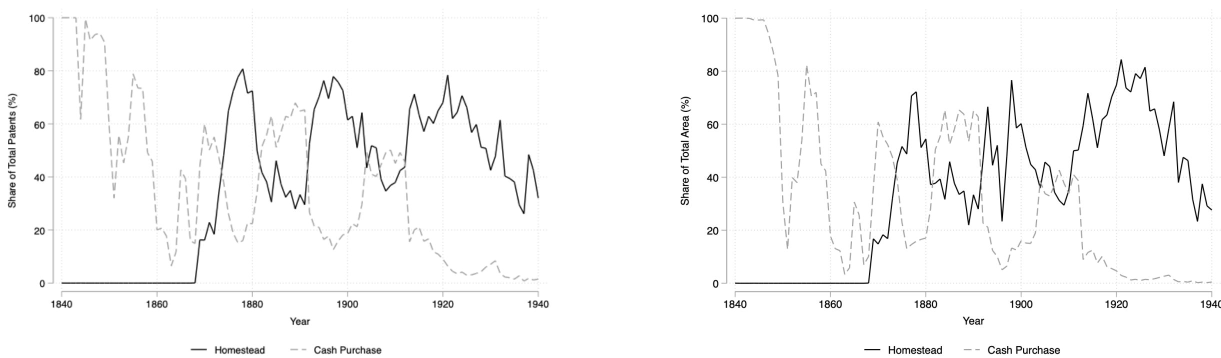
[17] The BLM data covers 11 out of the 12 states in the sample. Notably, land patent data does not cover Texas, which does not have federal land to dispose of.

transfers.[18] Meanwhile, 41.4 percent of patents were obtained through cash purchase, or 29.8 percent of the land areas.[19]

Figure 4: Evolution of Land Patent

(a) % Number of Patent Per Year

(b) % Patented Area Per Year



5 Identification Strategy

The empirical analysis leverages the county-level policy variation to identify fence laws' causal effects on agricultural production. The solutions for the producer's problem described in section 3 suggests that, for counties with similar natural conditions and faces the same market prices, the differences in land allocation and the corresponding gaps in output can be attributed to the differences in fence laws. The empirical strategy thus relies on the comparison of adjacent counties.

Because of the timing and changes in fence laws, the empirical setting is different from standard differences-in-difference with a one-shot policy change. In the following section, I first discuss the identification challenges introduced by the data. I then describe the sample construction necessary to resolve the identification challenges, and finally, specify the empirical model for estimation.

5.1 Staggered Adoption with Non-Absorbing Treatment States

While the county-level fence law data provides rich variation in the legal environment, it also introduces two main identification challenges. First, the treatment timing is staggered, and the treatment effects are likely to vary over time. As discussed in subsection 2.3, both the initial adoption and subsequent changes occurred at different points in time. The effects on agricultural production can also change over time as people adapt to the regulations. Recent studies (Goodman-Bacon, 2021; Sun and Abraham, 2021) point out that the traditional difference-in-

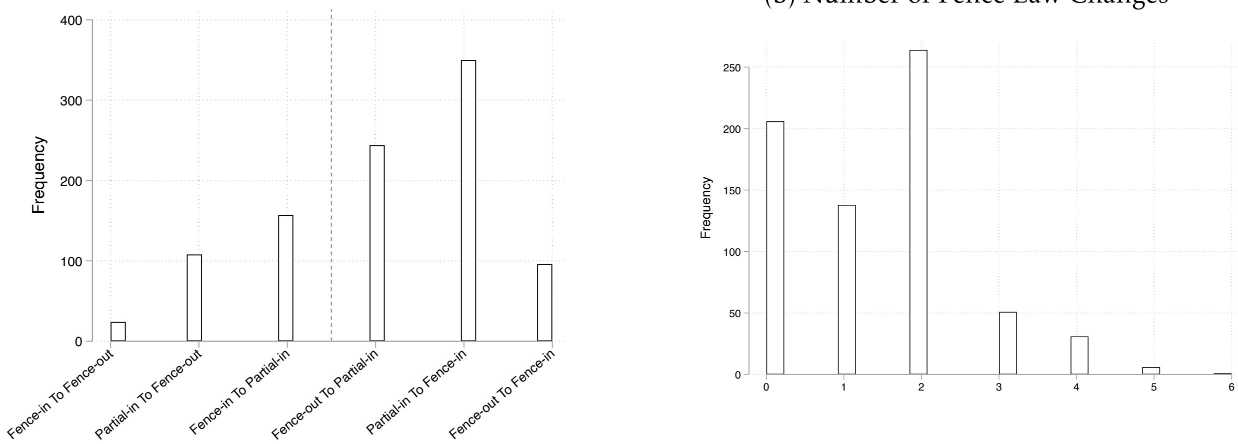
[18]This includes both the original 1862 Homestead Act and following amendments, such as the 1873 Timber Culture Act, the 1877 Desert Land Act, the 1909 Enlarged Homestead Act, etc.

[19]Appendix C plots the total number acreage covered by the land patent over time. It also presents the evolution of land transfer from the federal government to private holdings in each state over time.

differences estimation cannot recover the dynamic treatment effects with staggered adoption and heterogeneous treatment effects.

Second, and more importantly, the treatment is not an absorbing state. Counties switched back and forth between the three types of fence laws (fence-in, partial, and fence-out). Figure 5(a) plots the count fence law changes between each pair. Changes in all six pairs are present in the data. In addition, a large number of counties changed the fence laws multiple times. Figure 5(b) shows the distribution of fence law changes after the initial adoption. Among the 697 counties in the sample, less than 30 percent kept the original fence law; half of the counties in the sample changed the fence laws at least twice after the initial adoption.

Figure 5: Treatment is a Non-absorbing State



(a) Fence Law Status Changed

(b) Number of Fence Law Changes

Note: The count exclude the initial adoption.

5.2 Sample Construction

Given the definition of treatment variables, the sample used for the main estimation is limited to a specific subset of county-pairs. To be included in the final estimation, a county-pair need to satisfy the following conditions:

(1) For a given census year, the adjacent counties have the same fence law

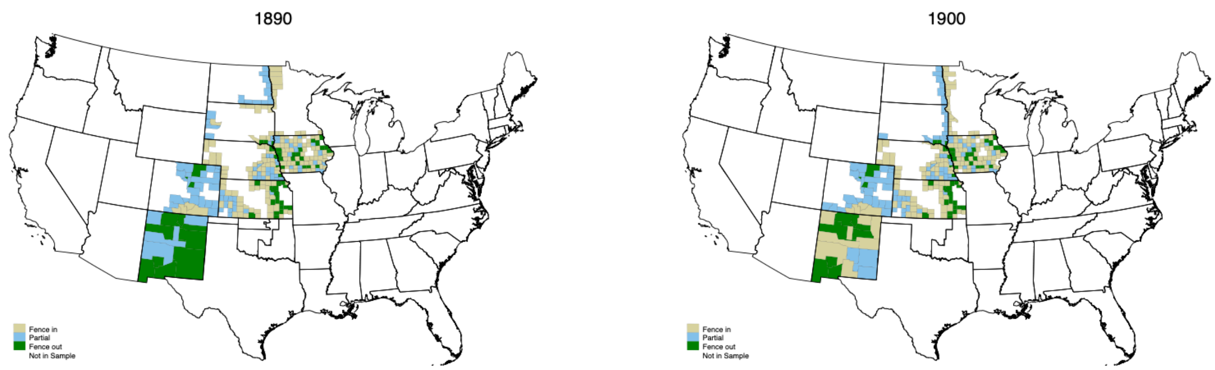
(2) In the following census year, only one county in the pair experienced a regulation change

Figure 6 displays the adjacent county pairs with different fence laws for 1890 and 1900 as an example. For each year t, I organize the data so that each pair p contains two observations, one for each of the county c in the pair. Each pair contains four observations across two consecutive census years, two for each county.[20] The sample consists of 350 pairs of adjacent counties from 1850 to 1930. The actual sample size varied from year to year depending on the coverage of the

[20]Only two pairs entered the data twice, so the total number of observation is 708, for 350 pairs.

Census. Appendix Figure 6 plots the adjacent counties with different fence laws between 1860 and 1920.

Figure 6: Adjacent Counties with Different Fence Laws



5.3 Main Specification

Because counties experienced different paths of the regulatory change, the empirical setting does not satisfy the assumptions for standard event study design. Instead, the baseline specification focuses on short-term effects of regulatory changes by comparing adjacent counties with and without fence law changes across two continuous census years.

For each county, I define two sets of categorical variables that indicate the "relative" shifts in liabilities created by fence law changes since the last census. I then compare the adjacent counties that started off with the same regulation but only one experienced a fence law change between the census years. The baseline specification is:

$$y_{cpt} = \alpha_{pt} + \sigma_c + \beta_\tau D^{\tau}_{cpt} + \epsilon_{cpt} \tag{4}$$

where y_{cpt} is the outcome variable for county c in pair p at census year t. The regression includes county fixed effects (σ_c) and border-pair by time fixed effects (α_{pt}). Though the ideal way is to include county-pair by year fixed effects, limited by the sample size, I opt to use the state-pair by year fixed effects instead. This assumes that, for example, all the counties along the New Mexico-Colorado border share the same trend, which is different from the pairs along the Kansas-Colorado border. In other words, the analysis uses variation comes from within the state-border-pairs across two continuous census years.

$\tau \in \{\text{Ranchers}, \text{Farmers}\}$ are categorical variables indicating the direction of liability shifts, which are defined as:

$$D^{\text{Ranchers}}_{cpt} = \begin{cases} 0 & \text{No Fence Law Change} \\ 1 & \text{Increase Ranchers' Liability} \end{cases}$$

$$D^{\text{Farmers}}_{cpt} = \begin{cases} 0 & \text{No Fence Law Change} \\ 1 & \text{Increase Farmers' Liability} \end{cases}$$

For each pair of adjacent counties, the coefficient β_τ captures the effect of adopting a specific fence law by comparing the outcomes of the one county whose fence law remained unchanged with the neighbor that started off with the same law but switched to a different fence law. Specifically, β_{Ranchers} compares counties that did not experience fence law change with the adjacent counties that shifted part or all of the liability to ranchers (e.g. changed from fence-out to partial or to fence-in). Similarly, β_{Farmers} captures the reverse change, comparing counties that did not experience fence law change to their neighbors that shifted more liability to farmers (e.g. changed from fence-in to partial or fence-out).

There are two advantages of defining the treatment in terms of how liability *shifted* between census years. First, by grouping the regulation changes in terms of relative shifts, i.e. whether the fence law change increased farmers' liability or ranchers liability, this reduces the number of coefficients from 5 (six pair-wise categories, see Figure 5(a)) to 1, which can be more reliably estimated with the sample. Second, the outcome from the Census of Agriculture lagged significantly behind regulatory changes. As discussed in subsection 2.3, fence law adoption started under the territorial government. However, counties did not enter the decennial census until the state was admitted to the union. Thus, there is no "pre-treatment" outcomes if treatment is defined as the current fence law status. When using the relative *shifts* in liabilities, outcomes for the county pair before the regulation change became the pre-treatment observation.

The baseline model is akin to a two-period difference-in-differences analysis, assuming adjacent counties would share the same trend absent fence law changes. Implicitly, this requires the marginal cost and revenue for different modes of production (farming versus ranching) to be the same for the adjacent counties. I assume that there is no difference in labor cost, production technology, and market access between adjacent counties. In the next section, I empirically test and show that the natural endowment was the same.

6 Estimation Results

6.1 Balance Test of Natural Endowment

I first show that adjacent counties have comparable natural conditions. This is to empirically test that, in the solutions to producers' problem (3), adjacent counties have the same crop-specific productivity A_c. I use the average agro-climatically attainable yield as a proxy for A_c. Because the attainable yield measure is a function of natural endowment, this measure is time-invariant. Therefore, as oppose to estimating the baseline model Equation 4, I conduct a simple t-test to compare the average attainable yields across the borders.

Table 1 shows that, for the three main types of crops, the differences between the average attainable yields across adjacent counties are not statistically different from zero. In other words, the crop-specific productivity A_c is indeed the same for adjacent counties.

Table 1: Fence Law Changes Not Endogenous to Natural Endowment

	(1) Corn	(2) Wheat	(3) Alfalfa	(4) Grass
Difference between Adjacent Counties	2.943	-0.085	0.495	0.127
	(7.764)	(3.935)	(0.851)	(0.377)
Mean	798.06	638.17	115.01	80.11
% wrt Mean	0.37	0.01	0.43	0.16
Observations	350	350	350	350

Note: Dependent variables are the average attainable yield (tons per hundred hector) for each crop, with irrigated water source and intermediate input level. Standard errors are clustered at the border-pair level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2 Land Use and Settlement

The optimal land allocation, given by $S_c^* = S(\bar{p}_c, \bar{r}_c, \bar{A}_c, \tau_c(R))$, implies that with the same productivity and prices, fence laws influence land allocation across crops.

Panel A in Table 2 shows that shifting the liability from farmers to ranchers substantially increased the land area used for grain (wheat and corn) production. Compared to adjacent counties without fence law changes, counties that shifted the liability from farmers to ranchers increased the wheat acreage by 2.3%. Considering that the average share of farmland used for wheat is 11%, this translates to a 20.7% increase. It had a similar, albeit smaller, impact on corn production. The land area used for corn increased by 17.3% with respect to the average. The increase in grain production was not accompanied by a reduction in fodder, where counties that increases rancher's liability did not see changes in acreage used for fodder crops.

Shifting more liability to farmers had the opposite effects: when farmers faced a higher risk of trespassing damage, the farmland used for wheat and corn was reduced by 11.1% and 17.3% with respect to the average. Moreover, it also reduces the share of farmland used for fodder crop by 3.2%, or a 34.9% reduction with respect to the mean.

Table 2: Effects on Land Use by Crop Type

A: Shift Liability from Farmers to Ranchers			
	Share of Farmland (%) Used for		
	(1) Wheat	(2) Corn	(3) Foddeer
Increase rancher's liability	2.297***	1.624***	0.592
	(0.714)	(0.598)	(0.502)
Mean	11.11	17.25	9.24
% wrt Mean	20.68	9.42	6.40
Border-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Observations	450	450	327

B: Shift Liability from Rancher to Farmers			
	Share of Farmland (%) Used for		
	(1) Wheat	(2) Corn	(3) Foddeer
Increase farmer's liability	-1.761**	0.196	-3.226***
	(0.868)	(0.729)	(0.886)
Mean	11.11	17.25	9.24
% wrt Mean	15.86	1.13	34.90
Border-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Observations	450	450	327

Note: Dependent variables are acreage as percent of total farmland area. Standard errors are clustered at the county level. Fodder crop includes hay, alfalfa and grass. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

On the extensive margin, I quantify the effects of changing fence laws on the settlement by estimating the baseline model with population density, share of land area used as farmland, and the ratio between improved and unimproved farmland. Panel A in Table 3 shows that increasing rancher's liability did not affect any of the settlement measures. However, the effects of the fence law change were not symmetric. Panel B of Table 3 shows that the effects of shifting the liability from ranchers to farmers discourages settlement. Such policies would reduce the population density by 7.5% (with respect to the mean), and reduce the share of areas in farmland by 9.04%. In the short run, increasing farmer's liability did not change the ratio of improved to unimproved land. Thus, consistent with the narrative evidence in subsection 2.2, the cost of enclosing farmland deterred settlement, while the shifting the liability and requiring ranchers to enclose livestock did not change settlement outcomes.

Table 3: Effects on Settlement

A: Shift Liability from Farmers to Ranchers			
	(1) Population Density	(2) Farmland/County Area, %	(3) Improved land/Total Farmland, %
Increase rancher's liability	0.034	2.210	2.313
	(0.079)	(1.821)	(1.451)
Mean	2.73	53.94	58.27
% wrt Mean	1.24	4.10	3.97
Border-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Observations	706	708	672

B: Shift Liability from Rancher to Farmers			
	(1) Population Density	(2) Farmland/County Area, %	(3) Improved land/Total Farmland, %
Increase farmer's liability	-0.204**	-9.043***	-1.140
	(0.097)	(2.218)	(1.831)
Mean	2.73	53.94	58.27
% wrt Mean	7.46	16.76	1.96
Border-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Observations	706	708	672

Note: Standard errors are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.3 Livestock Production

In addition to crop production, liability rules also affected livestock production decisions. Table 4 shows the effects of fence laws on the density of cattle, sheep, and swine. Counties that shifted more liability to ranchers saw a small reduction in cattle density, but no noticeable effects on sheep or swine. On the other hand, counties that moved in the opposite direction and increased the liability on farmers saw a similar but insignificant increase in cattle density. This lack of instant responses in livestock density is expected, considering that switching the primary mode of production between farming and ranching may take a long period of time.

Table 4: Effects on Livestock Production

A: Shift Liability from Farmers to Ranchers			
	Livestock Density (heads per acre)		
	(1) Cattle	(2) Sheep	(3) Swine
Increase rancher's liability	-0.215*	-0.035	-0.172
	(0.121)	(0.195)	(0.478)
Mean	3.28	1.77	8.16
% wrt Mean	6.57	1.99	2.11
Border-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Observations	689	687	689

B: Shift Liability from Rancher to Farmers			
	Livestock Density (heads per acre)		
	(1) Cattle	(2) Sheep	(3) Swine
Increase farmer's liability	0.242	-0.153	-0.295
	(0.152)	(0.246)	(0.602)
Mean	3.28	1.77	8.16
% wrt Mean	7.39	8.60	3.62
Border-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Observations	689	687	689

Note: Standard errors are clustered at the county level. Livestock density is defined as number of livestock per acre of land in the county, since livestock do not have to live on the farmland, and often were let lose on public land. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.4 Output and Land Value

Finally, I looked at the effects on farm output and farmland value. To allow enough time for the regulatory changes to influence the final product value, I limit the sample to counties where the fence law had been adopted for at least three years.

Shifting liability from farmers to ranchers had a positive impact on production values. Counties that increased livestock owners' liability saw the total value of farm output increase by $65.3, or 6.3% above the average. The increase was driven primarily by the value of crops. The total value of livestock also increased, though at a smaller and statistically insignificant level. Similar to previous cases, the effects were not symmetric. Shifting liability from ranchers to farmers did not dampen the total value of output. It did not change the value of crops, but it increased the value of livestock product by $41.5 per acre.

In either case, the changes in the value of output did not translate to higher land values: while the point estimate is positive, the effect of increasing rancher's liability on farm value is not significant. This could be driven partly by the structure of the analysis: the baseline analysis compared the results of adjacent counties across census years, which is a relatively short window given the slow-moving nature of land values.

Table 5: Effects on Output and Farm Value

A: Shift Liability from Farmers to Ranchers				
	Average Value (per acre)			
	(1)	(2)	(3)	(4)
	Total Output	Crop	Livestock	Farmland
Increase rancher's liability	65.320**	74.020**	7.004	1.539
	(30.588)	(32.625)	(14.654)	(0.977)
Mean	1030.77	862.29	512.49	37.13
% wrt Mean	6.34	8.58	1.37	4.15
Border-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	689	672	689	672
B: Shift Liability from Rancher to Farmers				
	Average Value (per acre)			
	(1)	(2)	(3)	(4)
	Total Output	Crop	Livestock	Farmland
Increase farmer's liability	4.037	16.591	41.570**	-0.433
	(38.704)	(41.288)	(18.362)	(1.234)
Mean	1030.77	862.29	512.49	37.13
% wrt Mean	0.39	1.92	8.11	1.17
Border-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	689	672	689	672

Note: Values are measured in 1920 dollars. Standard errors are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.5 Land Patent: Settlement Type and Land Concentration

I conduct the same analysis using the land patent data from the Bureau of Land Management. The land patent records the type of transaction, in particular, whether the land was acquired under the Homestead Acts or through cash purchases. This allows me to test whether fence laws shift the composition of landholding types and land concentration.

One advantage of the land patent data is that the records extend further back into history than the Census. Because land patents were issued whenever a plot was transferred from the federal government to private ownership, the records were available long before areas were organized as states and entered the Census record. This allows me to admit more counties into the sample whose fence law changes pre-dated the earliest census year available. Similar to the previous analysis, I first limit the sample to adjacent counties. In addition, to avoid the case with multiple fence law changes and persistent effects from previous laws, I further restrict the "treatment" counties to be the ones with only one policy change, and the policy change lasted for more than five years.

I estimate the same baseline specification separately for Homestead patent and cash purchases. Table 6 shows that, as argued by policymakers, shifting liabilities from farmers to ranchers increased settlement, particularly by attracting more homesteaders. For counties that increase rancher's liability, the share of new land patents acquired under the Homestead Act increased by 6.2%. New land acreage acquired by homesteaders increased by almost the same portion. It did not, however, displace cash purchases. On average, the share of patents or land areas covered under new cash purchase patents remained unchanged. The effects, again, are not symmetric. Shifting liabilities from ranchers to farmers appeared to discourage homestead settlement, though the results are not statistically significant.

This result is qualitatively similar to the ones estimated using the Census of Agriculture in Table 3. Increasing rancher's liability would increase settlement and the reverse depressed settlement. The differences may be driven by the different periods covered. For counties still under territorial government, land patent data extended further back, so results in Table 6 capture the effects during early settlement periods, particularly land acquisition by individual owners. Meanwhile, counties only enter the Census after the state was admitted into the union, so the results from Table 3 reflect more of the continuous population flow and land improvement, measured by population density and share of farmland areas.

Table 6: Effects on New Patent Issued under Homestead and Cash Purchase

A: Shift Liability from Farmers to Ranchers				
	Homestead		Cash Purchase	
	(1)	(2)	(3)	(4)
	% New Patent	% Acreage	% New Patent	% Acreage
Increase Rancher's Liability	6.202***	6.096***	-0.921	-1.263
	(0.844)	(0.859)	(0.946)	(0.946)
Mean	18.67	18.77	17.82	16.76
% wrt Mean	33.22	32.48	5.17	7.54
Border-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	15952	15952	15952	15952

B: Shift Liability from Rancher to Farmers				
	Homestead		Cash Purchase	
	(1)	(2)	(3)	(4)
	% New Patent	% Acreage	% New Patent	% Acreage
Increase Farmer's Liability	-0.385	-0.896	1.460	0.253
	(0.960)	(1.003)	(1.018)	(1.024)
Mean	22.70	23.39	17.02	16.03
% wrt Mean	1.70	3.83	8.58	1.58
Border-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	12108	12108	12108	12108

Note: Standard errors are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

7 Conclusion

This paper uses the spatial and inter-temporal variation in local fence laws to investigate the effects of liability rules on agricultural productivity. Comparing counties that changed the liability for livestock trespassing between ranchers and farmers, I show that reducing farmers' liability encouraged agricultural development: it increased rural population and the share of improved land. Moreover, shifting the liability from farmers to ranchers also changed the intensive margin of agricultural production. It encouraged farmers to use more land for wheat and corn production. These counties eventually saw higher output values, though the productivity gains were not reflected in land values. The effects were not symmetric. Except for land use, shifting the liability from ranchers to farmers did not appear to influence any of the other outcome measures.

Understanding the implications of liability rules has direct policy implications today. Growing evidence from the development literature suggests that property rights and liability rules may distort market allocation and create persistent inefficiency. This chapter complements the literature by providing empirical evidence to quantify the effect of a particular type of liability rule. The results highlight both the importance of liability rules, as well as the potential economic damage created by the institutional failure.

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Appendices

A State Session Law Data collection

Why Session Law Session laws compiled all the laws passed at each legislative session, which occurred annually or every other year. The session laws document the precise time and content of the regulatory change, for all the adoption, repeal, and amendments. In other words, the session laws provide a complete history of the regulatory changes. In comparison, statutory codes are published much less frequently (sometimes states did not revise the statutory code for decades), which only reflect a snapshot of the regulations at the time of publication. Because statutes usually do not track the evolution of each act, this does not provide the timing of each change and omits all the repealed acts. More importantly, many county-level regulations were adopted in the "Special Session", which were usually not included in the statutory revisions. Thus, the aggregated state statutes masked would mask a substantial number of county-level fence law variations.

Variable Construction All historical fence laws have been digitized and are available via HeinOnline Session Laws Library.[21] To locate the fence law in each session, I used multiple words to ensure results covered all potential fence-related issues. Specifically, I searched for "fence", "enclosure", "run at large", "trespass", "stock", "cattle", "hog", "horse", "mule", "animals" in each session and checked all the results to determined whether it is a fence-related act.[22]

For each act, I hand-code the variables that describe the fence laws based on the text. The main variable of interest is the assignment of liability: fence-in, fence-out, or partial. In addition, I also code additional requirements that can influence the cost of seeking compensation for damages. For example, whether the law required a third-party assessor to evaluate the damage, whether the injured landowner can hold and sell the trespassing animal for compensation, whether adjacent landowners need to share the cost for partition fences, or whether there are fines or criminal punishment in addition to the civil damage.

B Fence Law Sample Text

Below are the original text of the legislatures cited in subsection 2.3.

B.1 Minnesota, 1850-1865

1850: Chapter LIII, "An Act to permit certain animals to run at large" Section 1. That all neat cattle, sheep, horses, (except stallions of the age of two years,) and hogs shall be permitted to run at large in this territory, at all times of the year, and the owner thereof shall not be liable for the

[21] The only exception is Dakota Territory, which is available on North Dakota Legislative Council website (https://www.ndlegis.gov/assembly).

[22] I used "wild-card" terms in the actual search to include word-root variations. For example, I sued "fenc*", which would return results for "fence, fences, fencing".

damage which any such animal may do, unless the same be done upon enclosed ground, with a legal and sufficient fence, in which case such owner shall be liable in an action of trespass for all the damages done.

1865: Chapter L, "An Act to provide for distraining beasts doing damage during the night time"" Section 1. It shall be lawful for the owner or occupant of lands to distrain all beasts doing damage upon his or her lands during the night time, from eight o'clock in the evening until sunrise; and when any such distress shall be made, the person distraining shall keep such beasts in some secure place other than the public pound until his damages shall be appraised, and within twenty-four hours after such distress, unless the same shall be made on Sunday, in which case before the Tuesday morning thereafter, he shall apply to a justice of the peace of the town, who shall appoint three disinterested inhabitants of such town to appraise the damages.

Section. 2. It shall be lawful to make such distress at any time before such beast doing damage as aforesaid shall have escaped from said lands, and without regard to the sufficiency of the fences on such lands.

Section. 10. In case the owner or occupant of lands when owner liable shall not distrain the beasts doing damage as provided in this act, then the owner of such beasts shall be liable in an action at law for all damages done by such beasts during the night time, without regard to the sufficiency of the fences on the lands in which damage is done.

B.2 Colorado, 1859-1864

1859: Chapter XXLLL, "An Act concerning enclosures and trespassing animals" Section 1. That any structure, hedge or ditch, in the nature of a fence, used for purposes of enclosure, which is such as good husbandmen generally keep, and as shall on the testimony of practical agriculturists appear to be sufficient, shall be deemed a lawful fence.

Section 2. If any domestic animal break into an enclosure, the person injured thereby shall receive the amount of damage done, if it should appear that the fence through which said animal broke, was lawful; but not otherwise.

1864:"An Act for the protection of farmers against the depredations of stock in the counties of Douglas and Wald" Section 1. That no person farming or cultivating land within the limits of Douglas and Weld counties shall be required to fence or enclose the same against any stock running at large or herded within said counties. All persons owning or having charge of stock, whether cattle, horses, mules, asses, sheep or hogs, shall be required to herd or confine the same in secure enclosures during the season for growing crops, from the time of planting until said crops are gathered. The owner or any other person having charge of any stock that may be kept within the limits of the counties named in section first of this act, from and after the adoption of this act, shall he liable for all damages which may be done any crops planted, growing, or standing in the fields, or gathered in stacks or cribs; Provided, That such damage or destruction have been caused by the carelessness or neglect of such owners or agents. That in case of any crops being injured or destroyed by any animal or animals, as in violation of this act, the owner or agents of such crops may seize such animal or animals so found trespassing and hold the same as security for the payment in full for damages sustained by such owner or agent, such damages shall be adjudged and collected b. an action of debt, before any court of competent jurisdiction within the county where such damage may have been done.

B.3 Territory of New Mexico, 1851

Unlike other Plain states, New Mexico already had considerable farming development when the territorial government was formed in 1851. Therefore, New Mexico is the only state included in the preliminary analysis where first established fence-in rule. In 1851, the first legislative assembly of the Territory of New Mexico, the legislators explicitly cited the high fencing cost as a reason not to enclose cultivated land[23]

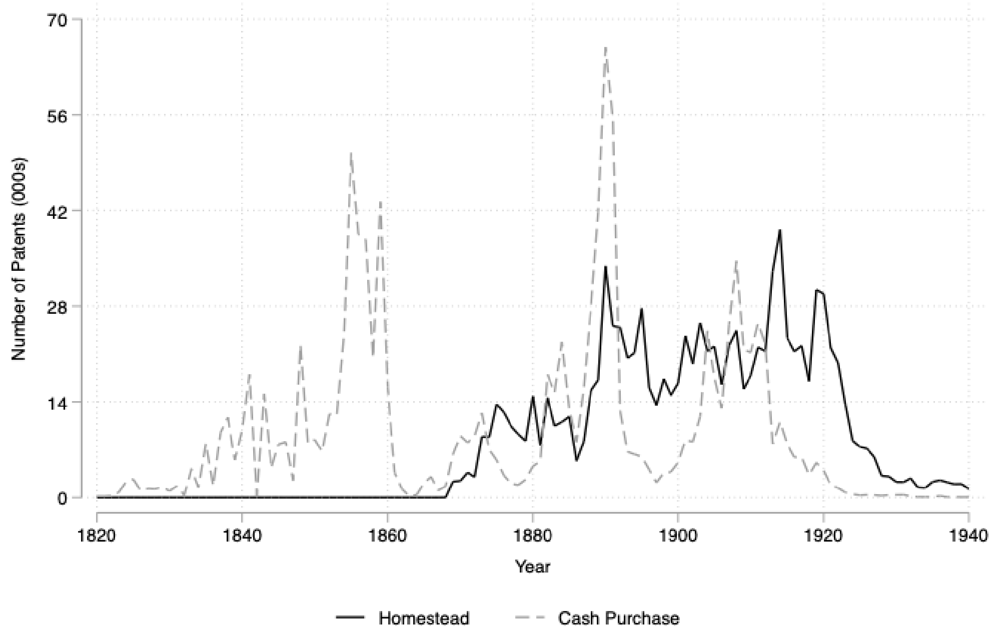
> It being impracticable or absolutely impossible for the fields in the territory to be fenced in, all animals shall be kept under a shepherd, so that no injury may result to the fields; and in case any damage should result, they shall be paid by the persons causing it.

[23]"An Act Relative to Water and Ditches and Other Branches of Agriculture", Laws of the Territory of New Mexico, Passed by the First Legislative Assembly, 1851

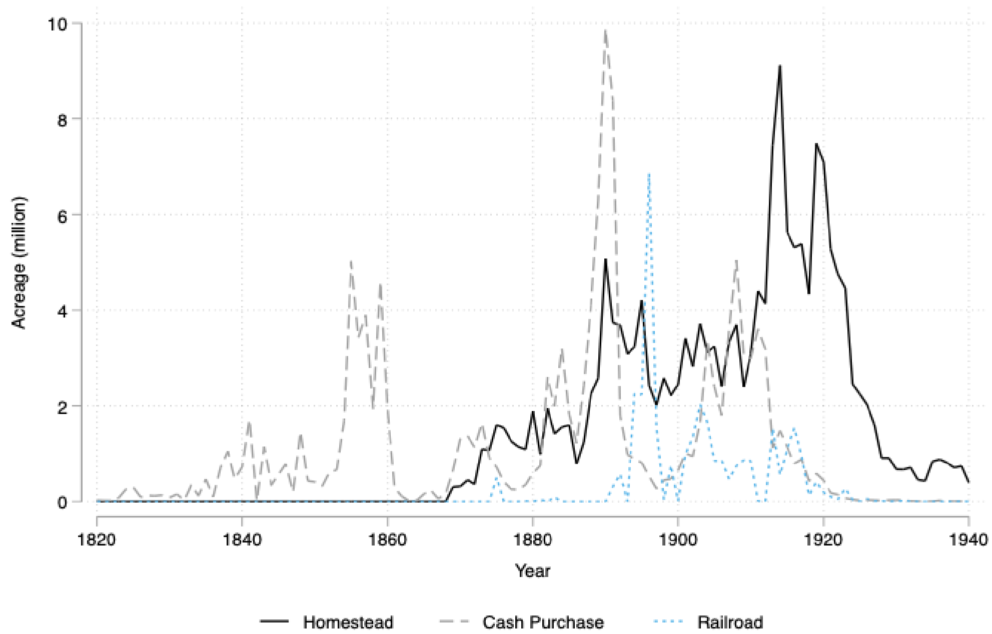
C Land Patent Data

Appendix Figure 1: Evolution of Land Patent

(a) Count of Patent Issued Per Year

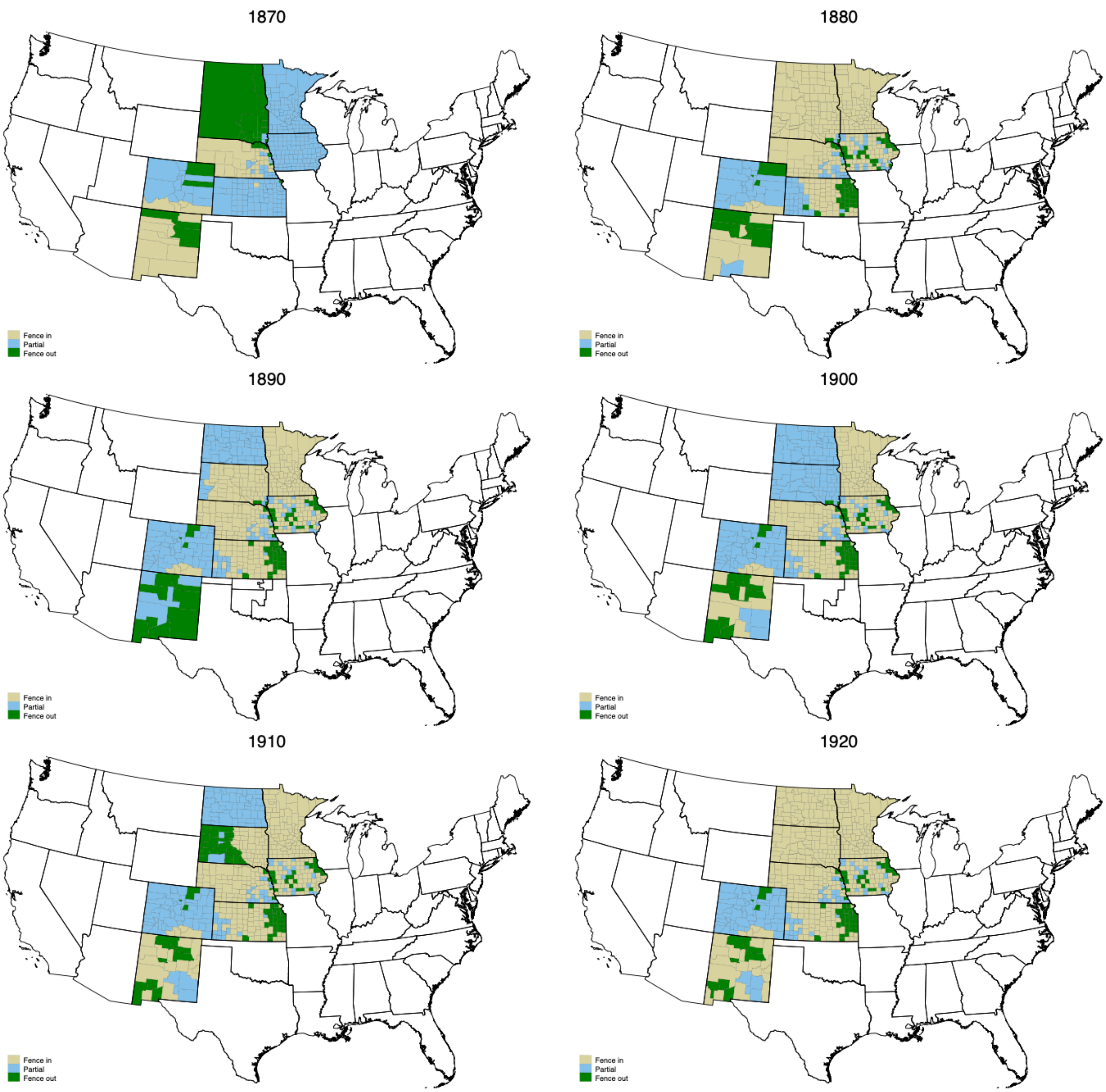


(b) Total Patented Area Per Year

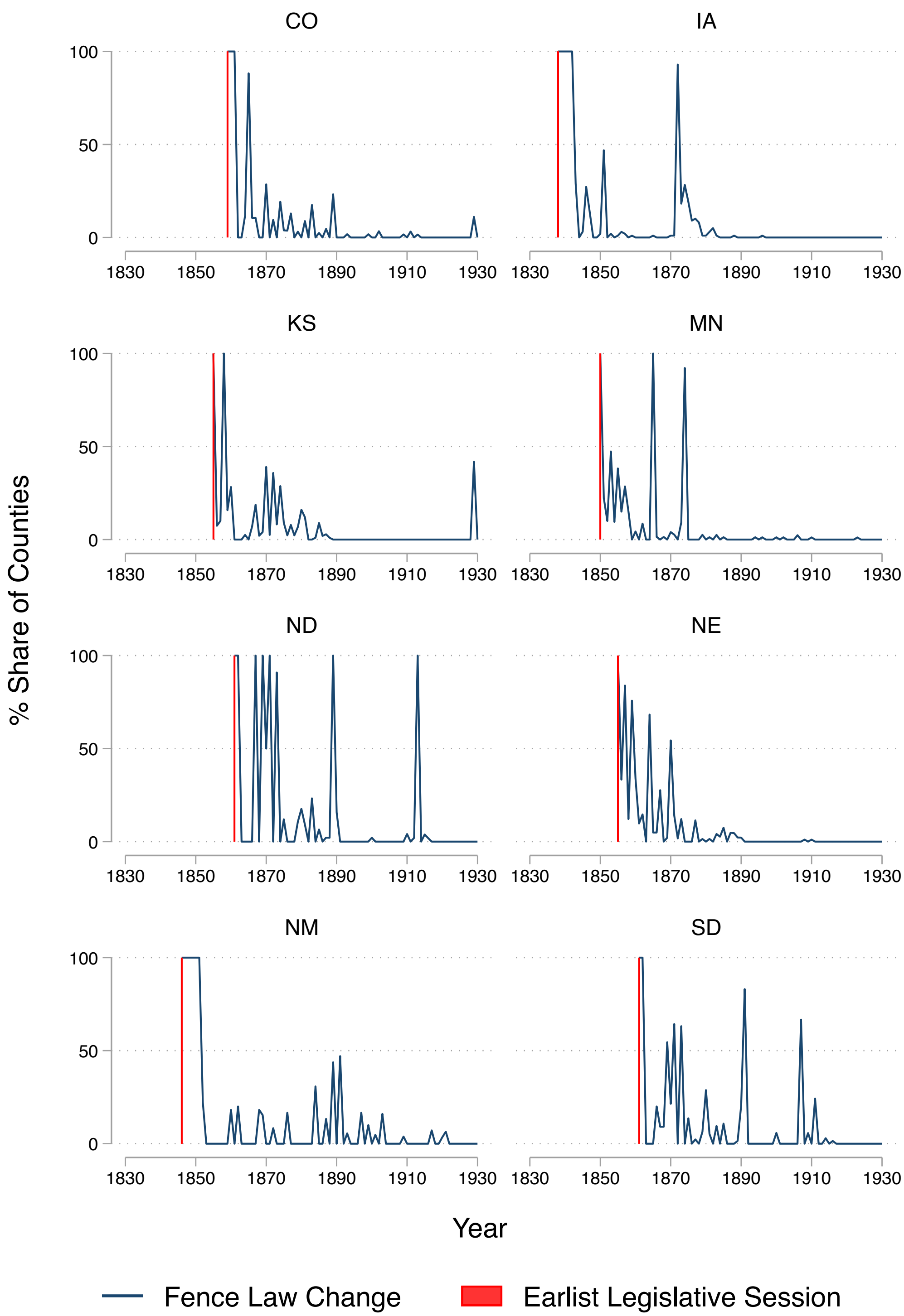


D Spatial Distribution of Fence Laws over Time

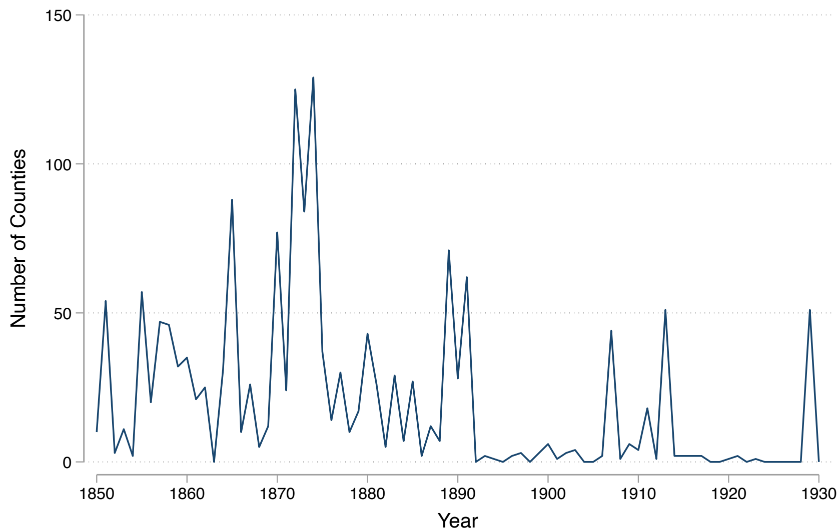
Appendix Figure 2: Evolution of Fence Laws



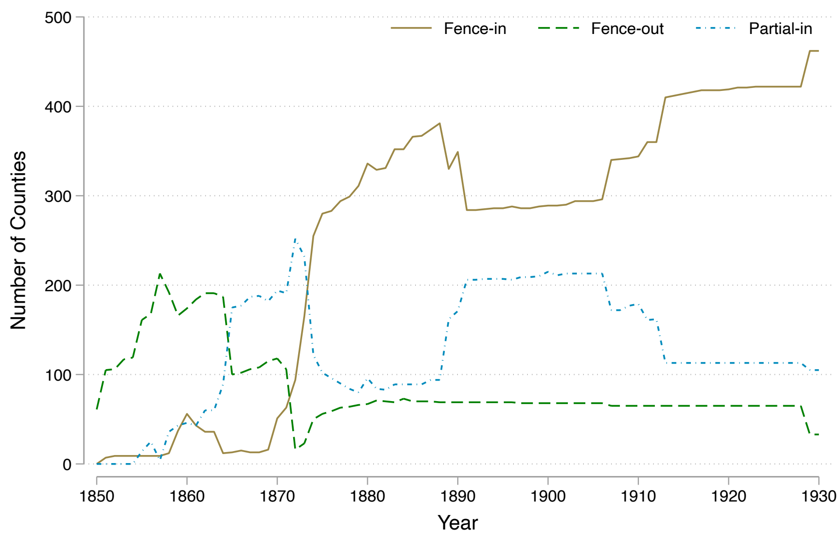
Appendix Figure 3: Share of Counties with Fence Law Changes, by State



Appendix Figure 4: Number of Counties with Fence Law Changes



Appendix Figure 5: Number of Counties under Each Type of Fence Law



Appendix Figure 6: Adjacent Counties with Different Fence Laws