Kansas agricultural land turnover

by

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B.S., Kansas State University, 2021

A THESIS

submitted in partial fulfillment of the
requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2023

Approved by:

Major Professor
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Abstract

Agricultural land represents approximately 80% of assets on the farm balance sheet, while serving as the principal input in agricultural production. Access to land is critical for the success of farmers, especially those considered new and beginning. The overall market for agricultural land can be broken into two primary submarkets: the rental market and ownership market. As such, literature on the ownership market largely focuses on prices or estate planning, with little regard to transaction volumes or frequency and the determinants of a transaction. Transaction volumes and frequency have been studied in the financial and real estate literatures, largely motivated by efficiency and liquidity concerns. Farmland markets are unique in that they operate imperfectly with high transaction costs and relatively few open market transactions. Transactions off the open market include inheritance and private sales. Policies that decrease the amount of land that is transacted may lead to economic or efficiency losses in farmland markets.

While this study is motivated by the first-order efficiency and equity implications of farmland turnover, nearly all of the previous real estate and corporate finance research that analyzed transactions volume was largely motivated by market liquidity. This study thus begins by examining this literature and clarifying how turnover relates to broader concepts of market efficiency, before an empirical examination of farmland turnover. Utilizing individual Kansas agricultural land transactions since 1985 aggregated to the county level, the rate of turnover is calculated, determinants of turnover are identified, and sale-type differences surrounding arms-length transactions and use of land are explored.

We find that farm income indicators, indicators of the general US economy, and demographic factors all generally predict farmland turnover. Current farm economy indicators have a weak and inconsistent relationship with turnover, but several lagged indicators of high farm income predict either higher or lower turnover. A strong general or nonfarm economy

is related to higher turnover. As our model estimates net effects, we cannot identify whether turnover is driven by exits driven by financial stress or planned retirement, for which farm income and general economy indicators would have different effects. However, we do establish that these factors are relevant to turnover and find evidence that the expectations or financial conditions that drive turnover are formed over several years. Demographic factors are also relevant, with higher average age related to higher turnover but more operators over 65 related to lower turnover. This jointly provides evidence that relatively older operators demand land, but that retirement-aged operators have incentives to hold land for inheritance.

At a foundational level in the literature, this research provides new insights into an understudied area of the U.S. agricultural land market. Understanding the frequency at which agricultural land transacts is critical to developing and amending many policies. The implications of policies aimed at reducing or eliminating stepped-up basis, increasing land access for new and beginning farmers, and many others, can be informed by an understanding of the factors that affect this key component of the market. Further research motivated from this work may expand to causal identification of, analysis of policy changes, or inclusion of additional geographies.

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Acknowledgments

I would first like to thank my parents, Mark and Bobbie Hinds, and the rest of my family for loving, supporting, and pushing me through my education. Thank you for always encouraging me to follow my passion.

My fullest gratitude goes to Casandra Rodriguez for her patience, reassurance, understanding through this process, and continuing to support my further education with our upcoming move to pursue my PhD.

Mitchell Moorehead and Cordon Rowley, thank you for escaping to the duck marsh and lakes with me, being an open ear, and driving me to always do better.

My sincere gratitude goes to my major professor: Dr. Jennifer Ifft. Thank you for pushing me academically, supporting my thesis work, instilling the importance of collaboration through attending conferences, and for being a great mentor in my academic studies.

To my committee, Drs. Allen Featherstone and Jisang Yu, thank you for sharing your experience, knowledge, and advice during this project.

Dr. Leah Tsoodle and Robin Reid, thank you for assisting with, and sharing your experience with the transactions data.

Thank you Drs. Logan Britton, Nelson Villoria, and Adriana Valcu-Lisman (USDA ERS) for your guidance in research, assistance in the graduate admissions process, and emboldening my desire to teach and produce meaningful research.

For encouraging me to pursue academia and guiding my teaching philosophy, I thank the late Dr. Barry Flinchbaugh.

Thank you to Drs. Jason Bergtold and Audrey Joslin for the opportunity to participate in research as an undergraduate, while fostering my interest in interdisciplinary research.

To the faculty of Kansas State's Agricultural Economics Department, thank you for always supporting me as a student and giving me the skills and experience to continue my education.

To my peers, I appreciate our study sessions, idea sharing and development discussions, and for the fostered friendships.

Thank you to the many friends that I have made at Kansas State, the Kansas Department of Agriculture, and throughout my time in school, for the continued support and enduring friendships.

Finally, a special appreciation goes to my late grandfather, Dr. Frank C. Hinds for being a role model in my academic career as someone who left a lasting impact as a researcher, mentor, and friend on his students and colleagues.

Chapter 1

Introduction

Land serves as the foundation for all agricultural activities, which are required to produce food, and thus a necessity for life. More than forty percent of land (900.2 million acres) in the United States is in farmland (NASS, 2019). Of this farmland, nearly ninety percent is used for growing crops or is in permanent pasture (NASS, 2019). However, the area devoted to agriculture has been gradually declining, with acres declining 1.6% from 2012, 5.7% since 1997, and 11% since 1949 (Bigelow, 2017; NASS, 2019). Given this reduction in land, concerns have been raised regarding access to agricultural land. Programs such as the 'Increasing Land Access Program' through the USDA's Farm Service Agency (FSA) have been created, citing "Land access is critical to the success of agriculture" (USDA - FSA). The National Young Farmers Coalition says that "Finding secure access to land is the number one barrier preventing a generation of growers from entering the field." (National Young Farmers Coalition, 2020). Further, policies that influence turnover may have efficiency implications for the farmland market. In this chapter we review the literature and policy debates related to efficiency and equity of land or business turnover and the handful of existing studies that directly analyze timberland or farmland turnover.

1.1 Efficiency Concerns Relating to Taxation

At the federal level, long-term capital gains taxes apply to an asset held more than 365 days while short-term capital gains are taxed as normal income and apply to assets held for 365 days or less. As agricultural land is typically an appreciating, long-term capital asset, it is subject to long-term capital gains taxes. The actual application of capital gains tax to agricultural land is complex. For many owners, land is held through or sold shortly prior to their passing. If sold while the owner is alive, the realized gains are taxed, with the gain's basis being the value at time of acquisition. However, if the property is passed on to heirs, their basis is generally the fair market value of the land at the time of passing. This step-up in basis reduces the tax liability of the inheritor by using the new (higher) basis at their time of acquisition as opposed to the original basis of the estate. If the inheritor then sells the property after holding it at least one year, their capital gains tax liability will be calculated using their stepped-up basis. Recent discussions around altering capital gains taxation will have direct efficiency implications for the farmland market.

Documented in the agricultural markets (Hennessy, 1999; Pietola et al., 2009) and other markets, (e.g., small business (de O. Cavalcanti and Erosa, 2007), capital gains trigger a "lock-in" effect in the markets they apply to. A "lock-in" effect is when there is an incentive to not participate in the market (e.g., a disincentive to sell) resulting in less asset turnover. de O. Cavalcanti and Erosa (2007) found that taxes on capital gains result in distortions in the small business market and the inefficient turnover of small businesses. This idea can be applied to the agriculture industry and land turnover, where new producers may be more efficient than older producers, and if a "lock-in" effect exists, producers would hold onto real estate, potentially preventing access to newer/younger producers. Pietola et al. (2009) found that selling decisions of agricultural land are significantly affected by capital gains taxes in Finland through a simulation of the effects of tax rate changes on willingness to sell. If a "lock-in" effect applies to the U.S. agricultural land market, as Pietola et al. (2009) implies, then inefficiencies in the market may be inflating prices through disincentivizing transactions.

While estate taxes had historically been significant in estate/succession planning, since the 1980s the tax has been applicable to fewer operations as higher exemptions have been implemented. Today, less than 1% of estates and specifically, agricultural estates, are subject to federal estate taxes (McDonald, 2021; McEowen, 2020). This has led to an increase in focus on the stepped-up basis and minimizing capital gains for heirs in estate/succession planning by seeking higher estate valuations. The estate tax used to counteract the step-up basis's incentive to seek high valuations of estates, as an increase in valuation would result in a higher estate tax liability (Soled et al., 2019). Thus, the changes to the federal estate tax structure have increased the influence of capital gains and stepped-up basis on the agricultural land market, which in turn may create market inefficiencies.

1.2 Land Access and Equity

There are two ways to access land for agricultural production: renting and owning. However, agricultural land is largely concentrated among large operators. As a result of farm consolidation and economies of scale, nearly sixty percent of domestic agricultural land is controlled by operations of 2,000 acres or more, even as these operations are only four percent of the operations in the United States (NASS, 2019).

While renting is intuitively easier to access due to lower capital requirements, there exist structural hurdles that a perspective tenant must clear. In the United States, most leased agricultural land is owned by non-operators, with only 38% of these non-operators being retired farmers (Bigelow et al., 2016). These non-operating landlords hold 80% of rented acres and are also more likely to have inherited property than land owned by operators. In the rental market, relationships between landowners and tenants are essential, and even more so for non-operator landlords. Landlords typically have few tenants, 99% of landlords have three or fewer tenants, and have long-term relationships with those tenants. More than 80% of acres have been leased to the same tenant for three or more years while over 38% have been leased to the same tenant for over ten years (Bigelow et al., 2016). Tenants with a long leasing relationship may even pay lower rents (Taylor and Featherstone, 2018). This results in challenges for beginning and young operators, that have not had as much time to develop relationships, when it comes to accessing land to rent.

With many barriers to access in the rental market, this leaves another option for land access: ownership. Unlike other agricultural inputs, owned-farmland markets are imperfect as participants face high transaction costs and many transactions are not completed on the open market but rather through private sales or inheritance. The 2014 Tenure, Ownership, and Transition of Agricultural Land (TOTAL) Survey showed that between 2015 and 2019, about ten percent of land in farms was expected to transfer. Of this land, expected land transfer methods were distributed across trusts (37%), wills (12%), gifts or other disposal (14%), sales to relative (14%), and sales to non-relatives (23%) (Bigelow et al., 2016). These expectations indicate that less than a quarter of land transfers would be easily accessible, since gifts, wills, trusts, and sales to relatives are guided by the landowner.

1.3 Contribution

Studies relating to market efficiency in an agricultural land context have been motivated by market liquidity. By measuring transaction frequency in the market for institutional commercial timberland properties, Mei (2018) sought to understand investor decisions and the "liquidity" of timberland as an investment. Plogmann et al. (2022) analyzed farmland disinvestment decisions in Germany through a real options model that measures a landowner's value of an opportunity to divest. Empirically, the author's measurement (indicator) of liquidity, through turnover, is inversely related to land prices. Previous research on commercial real estate transactions has found the opposite relationship Fisher et al. (2004). Kionka et al. (2021) analyzed volume based turnover and days between transactions, as measures of liquidity. Their results confirm low turnover rates in Germany for agricultural land.

This study first establishes farmland turnover as a direct outcome of interest due to efficiency and equity concerns. Next, previous research on real estate turnover is reviewed. This literature is large focused on market liquidity, a broad measure of market efficiency, for which is only partially characterized by turnover. Next, we aggregate data on Kansas farmland sales from 1985-2021. Utilizing ordinary least squares regression and agricultural land transactions aggregated by county, we find determinants of county-level agricultural land turnover. Two main contributions to the literature result from our study. First, we identify turnover as relevant, stand-alone outcome of interest in studies of farmland markets. Second, we conduct a novel analysis of determinants of agricultural land turnover in Kansas, a major U.S. agricultural state with diverse production conditions.

Chapter 2

Literature Review

2.1 Background

Being a significant portion of farm assets, a large body of research has considered farmland price determinants, succession/estate planning, rental rates, and ownership/tenure trends. Price determinant models generally use either a hedonic or capitalization model (Nickerson and Zhang, 2014). Hedonic modeling is frequently used to determine the intrinsic value of land and sale characteristics in a sale price (Bigelow et al., 2020; Tsoodle et al., 2006). Capitalization models utilize expected returns from a parcel to determine a parcel's current value. These models range from discounted cash flow models that utilize factors including annual returns, inflationary measures, and capital gains tax as in Lee and Rask (1976) to vector autoregression models (VAR) as in Featherstone and Baker (1987).

The transactional costs of farmland transfers vary based on method of transfer and ownership tenure. As a generally appreciating asset, sellers of farmland face capital gains taxation following a successful sale, contributing to the transactional cost. Capital gains taxation creates a barrier of disincentivizing asset trading, which distorts the turnover of businesses through a "lock-in-effect" (de O. Cavalcanti and Erosa, 2007). Inheritors of agricultural real estate do not face capital gains taxation at the time of inheritance but will face this tax if they choose to sell. However, their tax liability is decreased due to the tax code allowing for a "step up" in basis. Without this rule, the basis for calculating an inheritor's tax liability upon selling an inherited asset would be based on the original purchaser's acquisition cost. However, this "stepped-up" basis reduces an inheritor's tax liability by granting a new basis equal to the fair market value at the time of inheritance.

For estates holding agricultural land, the federal estate tax is another incidence of a transactional cost. This estate tax and "step-up" in basis for capital gains historically balanced out valuations in estate/succession planning (Soled et al., 2019). Estates would seek a lower valuation to reduce their estate tax liability while not going so low as to cause heirs to receive too low of a basis. However, the threshold to trigger this tax continues to raise with fewer than one percent of agricultural estates being subject to filing for federal estate tax and even fewer having a federal estate tax liability (McDonald, 2021).

2.1.1 Liquidity

While this study is motivated by the direct efficiency and equity implications of farmland turnover, most existing studies that consider farmland and general real estate market turnover are motivated by liquidity concerns (Kionka et al., 2021; Mei, 2018; Plogmann et al., 2022). The relationship between the time it takes for an asset to sell, its fair market price, and the actual selling price can be described as the asset's liquidity (Morawski, 2009). Liquidity is an elusive concept that has been loosely defined as acknowledged by Hicks (1962); Johnson (1962); Morawski (2009). An asset's liquidity requires both time and price elements. An asset that receives a discount (or premium) without regard to time cannot be described by liquidity. Utilizing Morawski's definition (as an attempt to clarify the term), a liquid asset is one in which faces little difference between the fair market price and transacted price when sold immediately, whereas an illiquid asset must face a discount to be sold immediately. However, given enough time, an illiquid asset may sell at its fair market value. Thus, "A perfectly liquid asset (X) can be sold at its current fair value immediately," (Morawski, 2009).

A market's liquidity relies on three primary characteristics: breadth, depth, and resilience (Morawski, 2009). This paper closely follows Morawski's definitions of these characteristics, of which were developed through an analysis of literature on liquidity. Market breadth describes the difference in valuation between sellers and buyers in a market. Morawaski is careful to note that this difference may be abstract and the valuation is both objective and subjective. The depth of a market represents the number of participants in a market. Participant's willingness to pay has no effect on this characteristic as that is a portion of market breadth. Low depth in a market is commonly referred to as thinness. Market resilience measures how quickly the market's price level recovers following some imbalance, such as a large transaction. In addition to these three characteristics, Ametefe et al. (2016) contends that tightness and immediacy are also characteristics of liquidity. However, these terms are the costs related to trading, without regards to transaction size, and the discount associated with a quick trade, respectively. Thus, these are more suited to describe measures of relative liquidity rather than as characteristics of market liquidity.

A few studies on farm- and timberland have considered turnover (transaction frequency), which is an indicator of the depth of a market, i.e. Kionka et al. (2021); Mei (2018). However, "trading volume or turnover may yield misleading results when applied to real estate markets" (Morawski, 2009). This is due to inconsistencies in the distribution of transaction size making up the turnover ratio. Further, "thinness" of agricultural land markets is commonly used to describe low transaction volumes or turnover (Bigelow et al., 2016; Sherrick and Barry, 2003).

Liquidity Measures

Measures of depth are used in studies of financial markets (Amihud, 2002; Brockman and Chung, 2002; Chordia et al., 2000, 2009; Huberman and Halka, 2001; Kyle, 1985; Pagano, 1989), commercial and residential real estate (Fisher et al., 2007, 2003; Hwang et al., 2016), and farm- and timberland (Kionka et al., 2021; Plogmann et al., 2022). Studies utilizing breadth include (Amihud and Mendelson, 1991; Brockman and Chung, 2002; Chordia et al., 2000; Huberman and Halka, 2001) within financial markets, (Cheng et al., 2010a,b;

Krainer and LeRoy, 2002; Lin and Vandell, 2007) in commercial and residential real estate, and (Kionka et al., 2021; Mei, 2018; Plogmann et al., 2022) in farm- and timberland. Resilience is analyzed by (Amihud, 2002; Amihud et al., 2015; Chordia et al., 2009; Kyle, 1985; Pagano, 1989) when studying financial markets, (Hwang et al., 2016) when studying commercial and residential real estate, and (Kionka et al., 2021) when studying farmland.

Liquidity Outcomes

Liquidity related outcomes in the financial market literature look at liquidity cost (Amihud, 2002; Amihud and Mendelson, 1991; Amihud et al., 2015; Silber, 1975), temporal pricing (Chordia et al., 2009), parameters (Kyle, 1985), commonality (Brockman and Chung, 2002; Chordia et al., 2000), temporal change in liquidity (Huberman and Halka, 2001), and equilibrium analysis (Pagano, 1989). Outcomes related to liquidity in real estate literature look at transactional frequency (Fisher et al., 2004), price indices and trading volumes ((Fisher et al., 2007, 2003), and the risk and cost of liquidity (Cheng et al., 2010a,b; Hwang et al., 2016; Krainer and LeRoy, 2002; Lin and Vandell, 2007). In farm- and timberland markets, related outcomes focus on transactional frequency and turnover determinants (Kionka et al., 2021; Mei, 2018; Plogmann et al., 2022).

Liquidity and Turnover

Measuring liquidity in farmland and real estate markets provides insights that are useful for better understanding price behavior, investment, succession planning, and operating decisions. Turnover, as previously discussed, is an incomplete indicator of liquidity However, explaining how long property is held and what triggers transactions to occur is also of primary interest. An explanation of what causes a successful sale of agricultural land is critical to analyzing and developing policies that indirectly or directly influence farmland markets, including those surrounding land access and tax policies. This research presents a foundation for explaining these triggers.

Current studies that use turnover as a primary outcome of interest largely focus on indicators of liquidity from a sellers' (or future seller's) perspective, rather than from a buyer's perspective. This research thus does not address farmland access, especially for new and beginning farmers who are challenged in finding land to buy or rent (Ahearn and Newton, 2009). Although new and beginning farmers also have the ability to rent (and are likely to do so due to capital constraints), less than 40% of farmland is rented with over 80% of these acres being leased to the same tenant for more than three years (Bigelow et al., 2016). While there is an inverse relationship between an operator's age and percentage of acres rented, 80% of landlords are non-operators (not active in production) (Bigelow et al., 2016). These non-operating landlords significantly value tenant relationships with 41% of their rented acres being to the the same tenant for more than ten years (Bigelow et al., 2016).

A few analyses have been conducted utilizing surveys and measuring turnover rates of U.S. agricultural land. Utilizing results from the 1988 Agricultural Economics and Land Ownership Survey (AELOS), Barkley (1989) found that each year, 4.2% of parcels and 3.5% of land in the rural United States transfers, with 88.4% of acres and 61.8% of parcels being agricultural. At the state level, Sherrick and Barry (2003) summed yearly Illinois farmland transfers (greater than 5 acres) between 1979 and 1999 and divided them by acres of land in farms, as reported by USDA NASS to determined the annual arm's length turnover rate for agricultural land in Illinois. Their results show a minimum arm's length turnover rat of 0.38%, maximum rate of 1%, and average rate of 0.73%. More recently, the 2014 Tenure, Ownership, and Transition of Agricultural Land (TOTAL) Survey results show that between 2015 and 2019, 10% of farmland in the United States was expected to transfer, with 5,000,000 acres expected to transfer in Kansas (Bigelow et al., 2016). A 2017 survey from Iowa indicated that within the next five years, 13% of farmland was expected to transfer ownership, with only 7% of the expected transferred acres being sold to those outside of their family (Zhang et al., 2018). However, we are not aware of any studies seeking to explain the determinants of U.S. agricultural land turnover rates, county-level or otherwise.

Chapter 3

Conceptual Model

A landowner's decision and ability to timely dispose of a parcel is the result of dynamics between the landowner's, parcel's, and market's characteristics. A landowner's financial standing, usability of the parcel, demographics (e.g. age), interest in the parcel by heirs, etc. determine if a landowner will choose to hold or exit their position in a parcel. Parcel characteristics including soil quality, location factors, climatic history, and historic returns not only affect the usability of the parcel for the landowner but the appeal and value to potential buyers. The ability for a landowner to sell a property is a function of these parcel characteristics in addition to market characteristics, including the number of market participants (and their willingness to pay), size and volume of transactions, and price stability.

The successful match between a buyer requires that their valuations, and thus reservation prices overlap. "The reservation prices are the prices at which potential buyers and sellers stop negotiating or searching for a better deal and consummate a transaction" (Fisher et al., 2003). To understand the relationship between reservation prices and transaction frequency, we can look at the search model used in Fisher et al. (2003). The authors' graph the distributions of buyer and seller reservation prices in the market, with market participants on the vertical axis and reservation prices on the horizontal axis. If these distributions overlap for exactly one buyer and one seller, then a successful transaction may occur. The larger the overlap, the more potential successful transactions. As previously mentioned, an array of endogenous and exogenous factors may change a buyer or seller's valuation of a parcel, and thus the distribution of reservation prices will shift. Since factors may shift both supply and demand, measuring the determinants of turnover rates allows one to analyze net equilibrium effects within the market.

These factors include changes in capital constraints, both farm and off-farm, expectations for farm profits, availability of off-farm income relating to the state of the general nonfarm economy, demographics of the buyer/seller, among others. For example, if a number of operators in a county are exiting the profession and lack interested heirs in their land assets, there may be a left shift in the seller distribution. That is, the distribution of seller reservation prices shifts to a lower average reservation price. In turn, *ceteris paribus*, one can expect an increase in successful transactions, increasing transaction frequency, and thus, an increase in the quantity of land transacted or *turnover*.

Market participants develop expectations of profitability and capital constraints through current, and past, farm income and commodity prices. This combination of current and historic financial well being, or financial stress, affects decisions to exit, enter, or expand. Farmland owner-operators that want to remain may be forced to sell, or exit, if farm income is low over several years. However, farmland owner-operators that want to retire may wait for periods of high farm income, when farmland prices are higher, to exit. Likewise, farm operators experiencing high income may overcome capital constraints to purchase farmland. Non-operating owners may also sell during high income periods. Generally, both past and current farm income may influence the decision to buy or sell in different directions.

The state of the general economy affects nonfarm income, which increasingly impacts operator decisions. If nonfarm income decreases, operators may have less capital to purchase additional land or may choose to decrease their operation and possibly sell land. Many farm operators rely on nonfarm income for household needs (El-Osta et al., 1995) or servicing farm debt (Briggeman, 2011). High nonfarm income may induce non-operators to invest in farmland; generally a strong nonfarm economy is considered to increase farmland demand (Blank et al., 2012). Nonfarm income and urban development pressure have both been shown to be related to agricultural land values (Goodwin et al., 2003; Mishra and Moss, 2013).

Other factors that affect decisions to acquire or dispose of land include demographics, such as age, history with a parcel, locational factors, and more. As discussed in 1.2, farmland requires significant capital to acquire, increasing the difficulty for younger or less experienced/newer operators in accessing owned land. Inversely, as operators gain experience and age, the likelihood of capital accumulation and concurrently the ability to purchase land increases. However, each operator will eventually face the decision to continue operating. If they decide to exit operations, they then must decide if they will hold onto land, sell to friends or family, or sell to any interested buyer. Many of these factors are difficult to directly observe, let alone interpret correlations, but this study identifies observable factors that hypothetically influence turnover but have an indeterminate impact.

Chapter 4

Data

This study assembled data from a range of sources in order to encompass the breadth of factors that have a theoretical impact on farmland turnover and sales decisions. All nominal prices were converted to real 2015 prices utilizing the *Consumer Price Index: Total All Items for the United States (CPALTT01USA661S)* from Federal Reserve Economic Data (FRED)Federal Reserve Economic Data (2023a). Non-transaction related data was initially aggregated into a balanced panel of 105 Kansas counties for the years 1985-2020. A list of variables, their sources, and associated summary statistics are located in A.

4.1 Farm Census Data

Farm demographics, land in farms used for measuring turnover levels, and operator demographics were gathered through two sources of United States Census of Agriculture data. For Census years 2002 and later, data was gathered via the USDA NASS Quick Stats service. For previous Census years, Haines et al. (2018)'s repository files were utilized. Since the Census of Agriculture is conducted every five years, non-census years were interpolated to allow for a balanced panel. Census data was utilized over yearly survey data due to the availability of county-level data. These demographic and control variables were able to be interpolated under the assumption that any trend or change would be relatively gradual and reasonably approximated by a linear trend. This is unlike price and weather data, which can fluctuate on an annual basis.

Throughout the study period, different terms have been used to describe the same/similar data points in the Ag Census. These data points were matched with care for concordance, given available information. One such example is that in 2017, USDA replaced the term "operator" with "producer." This study considers their respective data points equal (no data change occurred) and utilizes the term "operator." Several categories were combined if their categorical configurations allowed for equal comparison across Census years. For example, in some years, operators by age was sorted into variables representing a range of five years. Two variables were combined to allow for like-comparison with Census years that had a range of ten years if the resulting range of years was equal.

Several variables were transformed to proportions to allow for accurate comparisons across counties. This includes demographic variables such as the proportion of operators in an age group relative to all operators in a county, as well as farm economy variables such as the proportion of a county's agricultural land that is irrigated. Transforming these variables to the share of counties in the county within a category allows for relative distributions to be analyzed alongside the absolute magnitude of the variable.

4.2 Cattle Prices

Feeder and slaughter cattle prices were accessed through the Livestock Marketing Information Center (LMIC) (2023). This annual dataset includes slaughter prices for Kansas (steers and heifers) and Texas (steers), as well as Western Kansas feeder prices (steers and heifers) by weight class. LMIC uses an average of weekly prices to create an annual price, which we converted into 2015 dollars. These variables were all lagged for years one through five to account for the expectations of operators. Additionally, three and five year rolling averages were included that contained both, previous years prices as well as a version with past prices and a current year price. Similar to lags, these variables were added to account for the accumulation of expectations across years, with the latter set also incorporating current expectations through the use of current information.

4.3 Commodity Prices and Inventories

USDA annual survey data was gathered using the USDA NASS Quick Stats database for state-level commodity prices and cattle inventories. Commodity prices included annual, Kansas corn and wheat prices, while cattle inventories included the January 1 Kansas cattle on feed inventory and annual Kansas calf crop. Prices were converted into 2015 dollars. Lags and rolling averages were also created for these prices and inventories in an identical manner to the aforementioned cattle prices.

4.4 Local-Demographic and Economic Variables

County-level demographic and economic data was sourced through the Bureau of Economic Analysis's Personal Income and Employment by Major Component (CAINC4) dataset. This annual set includes measures such as per-capita income, population, farm income, farm proprietor's income, and nonfarm proprietor's income. This dataset was adjusted for inflation to 2015 dollars Additionally, we utilized the Market Yield on U.S. Treasury Securities at 7-Year Constant Maturity, Quoted on an Investment Basis (RIFLGFCY07NA) from Federal Reserve Economic Data (2023b) to serve as an interest rate that is representative of the overall economy and investor confidence.

4.5 Kansas Agricultural Land Sales Data

Soil-type intra-parcel level sales data for agricultural land sales in Kansas from 1985 to 2021, collected by the Property Valuation Division of the Kansas Department of Revenue, was utilized to create dependent variables for analysis. Original soil-type observations were aggregated to form unique observations based on a parcel's identification number and the sale date. Observations which had invalid transaction validity codes were removed from the analysis, as the actual transfer of land could not be confirmed. Following from Sherrick and Barry (2003), small transactions (five or fewer agricultural acres) and transactions without agricultural land were also dropped from the dataset. Additionally, transactions were divided into three categories: arm's length non-arm's length, and unclassified, based upon their transfer validity codes. See B for information regarding these codes and their treatments. Individual agricultural land transactions were then aggregated into county-year observations for the following three categories: total acres, arm's length acres, and non-arm's length acres. Unclassified transactions are included in total acres but were not of specific interest in answering the research questions and thus, did not receive their own model. An additional transformation divided these variables by the total agricultural land in the county according to the U.S. Agricultural Census to calculated their relative turnover rates. These turnover rates serve as the three dependent variables analyzed in this study.

For years 1985 through 2020, there is the potential for 3,780 county-year observations. Due to possible county reporting challenges or the dropping of certain sales as previously described, certain observations resulted in a "missing" value. The process for managing these challenges can be found in 5.1

A limitation for future research and applications of this dataset is that it only includes sales data. Any other transfer of land, such as inheritance, is not captured in this data. However, this poses little concern for analyzing the incidence of sales and market accessibility since inherited land is not sold. Thus, measuring transactions of this type answers a related but separate research question relating to land that is *not accessible*.

4.6 Weather

Standard Precipitation Index (SPI) provides for a standardized comparison for a region's precipitation levels (Vose et al., 2023). Observations were originally paired by county-month-year-index category, with a value representing the percent of a county at a given time that falls into the given category. The index categories range from abnormally high moisture to abnormally low moisture. These categories were transformed into numeric representations where normal is zero=0, the highest category of wetness is -5, and the highest category of dryness is +5. The result of adding the products of the percent of a county in a category and their respective weights results in a county's relative dryness or wetness, with an increase of abnormality being weighed greater than a lesser degree of abnormality. These were then aggregated to form a county-year observation with an index of degree of wetness/dryness. Simply, the *weightedareaspi* in a county (c) for a given year (y), is equal to 1 divided by 12 (months in the year) (m_y) times the sum of each month's, within that year, sum of the percent (p) of the county affected by each weighting category (w) times each category's weight (w).

$$weightedareaspi_{cy} = \frac{1}{m} \sum_{n=1}^{m=12} \sum_{w=-5}^{v=5} p_{cynw} w$$

s.t. w,n $\in \mathbb{Z}$(4.1)

Precipitation serves as one indicator for growing/production conditions. If a county experiences prolonged dryness, this may be a sign of drought, which stresses production. To better understand the effects of historical precipitation levels, lags, one to ten years, and rolling averages (three, five, and ten years) were calculated in the manner that commodity prices were. These variables are useful in capturing how expectations are derived from past experience.

Chapter 5

Methodology

5.1 Panel Creation

Independent variables were aggregated into a balanced panel consisting of county-year pairs for the 105 counties for years 1985 until 2020, with a total of 3,780 observations. Once aggregated, years prior to 1985 and after 2020 were dropped, to match the available data for land sales. Due to county reporting and data constraints, the first year of data (1985) was also eliminated. Some counties began reporting in the middle of the year which resulted in a number of transactions being unreported. Additionally, five counties were removed because they were missing more than five observations for total acres sold (totalagacres): Franklin, Johnson, Linn, Reno, and Shawnee. This led to a total of 3,500 county-year observations, 3,495 observations for total agricultural transactions, 3,491 observations for arm's length transactions, and 3,464 observations for nonarm's length transactions.

5.2 Empirical Model

The available data allows for three different sets of dependent variables to be analyzed through a general turnover model: total, arms-length, and non-arms length. Due to data limitations, our measure of turnover is scaled by total land in farms (similar to Sherrick and Barry (2003)), as reported in the Census of Agriculture. Full tax parcel data would be required to calculate the "true" turnover rate. However, scaling the data is essential for consistent comparison across counties, as the amount agricultural land in each county is different. The three types of turnover T of type v for county c are measured as follows

$$T_v c = \frac{\text{Total acres transacted of type } v \text{ from Kansas agricultural land sales data}}{\text{Interpolated total land in farms from Census of Agriculture}}. \tag{5.1}$$

The percent of agricultural land transacted in a county c, by transaction type v, during a given year y is a result of effects from the farm economy FE_{cy}, nonfarm economy NFE_{cy}, demographics D_{cy}, other factors (control variables) X_{cy}, and an error term ε_{cyv}. This model is estimated using ordinary least squares (OLS). Standard errors are clustered by county to account for within-county correlation.

$$T_{cyv} = FE_{cy} + NFE_{cy} + D_{cy} + X_{cy} + \varepsilon_{cyv} \tag{5.2}$$

5.3 Variable Selection

After creating lags and rolling averages, we had nearly 250 variables. See A for a full list of variables, their sources, and summary statistics. Had all variables been utilized in the regressions, the resulting model would likely be overfit. When models are overfit, the explanatory variables have a tendency to predict variation in error, rather than describe the relationship between dependent and independent variables. Thus, a reduction in explanatory variables was necessary. Least Absolute Shrinkage and Selection Operator (LASSO) and Elastic Net are useful in variable selection when there are many possible covariates that need to be reduced. These methods seek to "shrink" coefficients of selection variables to zero. When a coefficient is successfully reduced to zero, it is not recommended for inclusion in future models. Each method varies in the respective penalty terms but the results are similar. A base group of variables were initially selected to represent the farm economy, nonfarm economy, and demographics based on economic theory, along with controls for "decades" and USDA NASS Ag Districts (E). These economic and control variables were selected to always be included in each model as baselines for each variable group and to partially account for spatial and temporal issues. Coefficients and further model information may be found in C. The below table shows the summary statistics for these 'always included' variables, excluding "decades" and ag districts.

Table 5.1: *Summary Statistics: Always Included Variables*

VARIABLES	N	Mean	SD	Min	Max
ops_over_65	3,500	0.306	0.074	0.114	0.564
ops_avg_age	3,500	56.13	3.115	47.36	65.16
yrs_on_present_farm_avg	3,500	24.17	2.122	16.7	30.7
population	3,500	19,733	49,959	1,210	524,246
treasury_yld_7yr	3,500	4.625	2.348	0.72	8.71
s_ks_steers_r	3,500	114.6	18.12	88.71	154.5
ks_corn_price_r	3,500	3.924	1.044	2.512	7.268
farm_inc_1000000_r	3,500	20.57	20.99	-14.3	220.9
nonfarm_prsnl_inc_1000000_r	3,500	702.4	2,110	35.33	26,436

We utilized four different methods of LASSO and Elastic Net: (1) linear LASSO with cross-validation selection, (2) linear LASSO with adaptive selection, (3) square-root LASSO with cross-validation selection, and (4) linear Elastic Net with cross-validation. Additionally, LASSOs were specified to cluster standard errors by county. These four models were ran to guide variable selection utilizing the base model (v = overall turnover). A table displaying each model and their selected penalty terms (lambda and alpha) can be found in C. Additionally control variables were selected for inclusion if all four models chose them. This resulted in 20 base variables and 29 control variables being selected out of an initial 246. Had we utilized variables selected by any three of the four models, we would have had 46 control variables. Table 5.2 below shows the respective results of these four models with x representing a selected variable (non-zero coefficient).

Table 5.2: Variables With Nonzero Coefficients

	(1)	(2)	(3)	(4)	Selected by 3	Selected by 4
full_owner_acres	x		x	x	Yes	
full_owner_farms	x	x	x	x	Yes	Yes
part_owner_owned_acres	x	x	x	x	Yes	Yes
part_owner_total_farms	x	x	x	x	Yes	Yes
tenants_farms	x	x	x	x	Yes	Yes
woodland	x	x	x	x	Yes	Yes
ops_25_34	x	x	x	x	Yes	Yes
ops_55_64	x	x	x	x	Yes	Yes
ops_anydays_off_farm	x		x	x	Yes	
ops_occupation_other	x	x	x	x	Yes	Yes
female_farms	x		x	x	Yes	
yrs_on_present_farm_0_2	x	x	x	x	Yes	Yes
yrs_on_present_farm_3_4	x	x	x	x	Yes	Yes
equine_inventory	x	x	x	x	Yes	Yes
lag_1_weightedareaspi	x		x	x	Yes	
lag_2_weightedareaspi	x		x	x	Yes	
lag_3_weightedareaspi	x		x	x	Yes	
lag_4_weightedareaspi	x		x	x	Yes	
lag_5_weightedareaspi	x		x	x	Yes	
lag_6_weightedareaspi	x		x	x	Yes	
lag_7_weightedareaspi	x		x	x	Yes	
lag_8_weightedareaspi	x		x	x	Yes	
lag_10_weightedareaspi	x		x	x	Yes	

	(1)	(2)	(3)	(4)	Selected by 3	Selected by 4
weightedareaspi_avgpre10	x			x		
ks_calfcrop	x	x	x	x	Yes	Yes
ks_cattleonfeed_jan1	x	x	x	x	Yes	Yes
ks_wheat_price_r	x	x	x	x	Yes	Yes
nonfarm_proprtors_inc_1000000_r	x	x	x	x	Yes	Yes
lag_3_f_steers_400500_r	x		x	x	Yes	
lag_5_f_steers_400500_r	x	x	x	x	Yes	Yes
lag_2_f_steers_500600_r	x	x	x	x	Yes	Yes
lag_3_f_steers_600700_r	x	x	x	x	Yes	Yes
lag_4_f_heifers_600700_r	x	x	x	x	Yes	Yes
lag_1_ks_corn_price_r	x	x	x	x	Yes	Yes
lag_3_ks_corn_price_r	x	x	x	x	Yes	Yes
lag_1_ks_wheat_price_r	x		x	x	Yes	
lag_5_ks_wheat_price_r	x		x	x	Yes	
ks_wheat_price_r_avg3	x			x		
lag_1_ks_calfcrop	x	x	x	x	Yes	Yes
lag_3_ks_calfcrop	x	x	x	x	Yes	Yes
lag_4_ks_calfcrop	x	x	x	x	Yes	Yes
lag_5_ks_calfcrop	x		x	x	Yes	
share_pastureland	x	x	x	x	Yes	Yes
share_irr_acres	x		x	x	Yes	
share_full_owner_acres	x	x	x	x	Yes	Yes
share_part_owner_owned_acres	x	x	x	x	Yes	Yes
share_tenants_acres	x	x	x	x	Yes	Yes
cropland			x			

	(1)	(2)	(3)	(4)	Selected by 3	Selected by 4
lag_3_ks_cattleonfeed_jan1			x			
lag_3_f_steers_500600_r				x		

Preselected base variables and constant not shown.

Table 5.3: *Summary Statistics: LASSO Selected Variables*

VARIABLES	N	Mean	SD	Min	Max
full_owner_farms	3,500	301	186.6	43	1,146
part_owner_owned_acres	3,500	118,895	40,100	494	290,106
part_owner_total_farms	3,500	219.3	101.9	26	715.4
tenants_farms	3,500	61.73	33.27	0	247
woodland	3,500	6,168	6,374	0	32,814
ops_25_34	3,500	0.0841	0.0365	0.00475	0.215
ops_55_64	3,500	0.233	0.0468	0.107	0.418
ops_occupation_other	3,500	277.5	195.1	28	1,469
yrs_on_present_farm_0_2	3,500	0.0406	0.0185	0	0.134
yrs_on_present_farm_3_4	3,500	0.0558	0.0185	0	0.15
equine_inventory	3,500	550.4	572.5	0	5,542
ks_calfcrop	3,500	1.43E+06	69,535	1.26E+06	1.55E+06
ks_cattleonfeed_jan1	3,500	2.18E+06	353,139	1.40E+06	2.63E+06
ks_wheat_price_r	3,500	5.206	1.364	3.16	7.722
nonfarm_proprtors_inc_1000000_r	3,500	62.85	241.6	2.219	4,600
lag_5_f_steers_400500_r	3,500	166.4	35.62	95.43	276.4
lag_2_f_steers_500600_r	3,500	151.8	31.3	91.54	248.6
lag_3_f_steers_600700_r	3,500	140.9	27.39	90.71	221.8
lag_4_f_heifers_600700_r	3,500	131.5	25.16	85	204.3
lag_1_ks_corn_price_r	3,500	3.96	1.067	2.512	7.268
lag_3_ks_corn_price_r	3,500	4.17	1.28	2.512	7.734
lag_1_ks_calfcrop	3,500	1.43E+06	69,815	1.26E+06	1.55E+06
lag_3_ks_calfcrop	3,500	1.43E+06	79,094	1.26E+06	1.61E+06
lag_4_ks_calfcrop	3,500	1.44E+06	81,220	1.26E+06	1.61E+06
share_pastureland	3,500	0.374	0.166	0.0214	0.883
share_full_owner_acres	3,500	0.218	0.0729	0	0.562
share_part_owner_owned_acres	3,500	0.265	0.0456	0.0411	0.556
share_tenants_acres	3,500	0.109	0.0577	0	0.416

Relating to market participant's expectations affecting turnover, nearly one third of the variables selected by all four models were lagged variables. This is supportive of the idea that operator decisions are based on past, current, and future (expected) factors.

5.4 Ordinary Least Squares (OLS)

29 variables that were selected by four or more selection models were chosen for inclusion in regressions. Previously mentioned base variables (20) were added. Of these base variables, we attempt to partially account for spatial differences through the inclusion of district variables. Nine districts were created based upon USDA NASS Ag Districts, resulting in eight variables (ninth excluded to avoid perfect multicollinearity). Additionally, four ”decade” variables were created, each nine years. Similar to ag districts, only three were utilized in regressions to avoid perfect multicollinearity. These Ordinary Least Squares (OLS) regression was run for each turnover model (v = overall turnover, arm's length turnover, and nonarm's length turnover). Each model's standard errors were clustered by county. Robustness checks were also conducted which dropped county grouping by ag district in favor of county fixed effects, dropped variables without cross-sectional variation among counties in favor of year fixed effects, and a combination of both were then ran.

Chapter 6

Results

Results from the three turnover models can be seen in Appendix table D.1. It is important to note that although coefficients may appear small, annual county turnover rates are also small (low). Full results may be found in Appendix D. County maps for mean and standard deviations of the three dependent variables can be found in Appendix F. Maps and graphs for select variables of interest are located in Appendix G and Appendix H Additional models will be presented in following sections. These three models will: remove decade effects and add yearly fixed effects, remove Ag District effects and add county fixed effects, and remove both decade and Ag District effects while adding yearly and county fixed effects, respectively. Any variables without cross sectional variation are also removed when including yearly fixed effects.

6.1 Primary Results

Our farm economy variables of interest varied in statistical significance, magnitude, and effect. A county's farm income is statistically significant for both arm's length and non-arm's length transactions but is positively associated with arm's length turnover, while negatively associated with non-arm's length turnover. Farm income is not statistically significant for total turnover, suggesting different market dynamics when land is sold to family or friends.

Table 6.1: *Primary Results*

VARIABLES	(1) total_ag_turnover	(2) arms_ag_turnover	(3) nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00126	0.00272*	-0.00122*
	(0.00140)	(0.00142)	(0.000624)
ks_corn_price_r	0.0880**	0.00935	0.0723***
	(0.0343)	(0.0305)	(0.0123)
s_ks_steers_r	-0.00261	-0.00159	-0.000950
	(0.00303)	(0.00253)	(0.00107)
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	-0.000184	-3.21e-05	-0.000176*
	(0.000146)	(7.76e-05)	(8.88e-05)
treasury_yld_7yr	0.331***	0.272***	0.0533***
	(0.0314)	(0.0299)	(0.0115)
Demographics			
population	4.28e-06	5.99e-07	4.82e-06
	(5.12e-06)	(2.81e-06)	(3.08e-06)
ops_avg_age	0.165***	0.128***	0.0242
	(0.0383)	(0.0420)	(0.0153)
ops_over_65	-2.763*	-2.731**	0.225
	(1.396)	(1.325)	(0.654)
yrs_on_present_farm_avg	-0.100***	-0.0485*	-0.0475***
	(0.0270)	(0.0246)	(0.0143)
Constant	4.854*	1.687	2.860***
	(2.661)	(2.773)	(1.015)
Observations	3,495	3,491	3,464
R-squared	0.302	0.280	0.189

Control variables not shown. Standard errors, clustered by county, in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The current Kansas corn price is statistically significant and and positively related to total and non-arm's length turnover. This suggests that when corn prices are up, some owners may sell land to family or friends to capitalize on other's increased demand to expand production. The price of Kansas slaughter steers was not statistically significant for any model. These farm commodity prices are generally correlated with overall land prices. As such, absent of non-arm's length turnover and farm income, our results differ from Plogmann et al. (2022), in that they found rising land prices to increase landowner reservation prices, thus reducing the possible number of successful land transactions *ceteris paribus*, which negates findings in commercial real estate by Fisher et al. (2004). However, further analysis with a pricing variable is required to fully validate these findings.

Nonfarm economy variables provide useful insights into the role of off-farm income and the general economy on the well being of operators. Seven year treasury yields were significant across models, suggesting that the general economy affects agricultural land transactions. The positive coefficient is interesting, since higher treasury yields are linked to increased investor confidence. Generally, this means investors seek higher risk investments, relative to treasury bonds. Across models, a county's nonfarm personal income is shown to be inversely related with turnover. This may be best interpreted as when nonfarm personal income decreases, operators reliant on off-farm income may be more likely to sell, but was only statistically significant for non-arm's length turnover. If operators are reliant on off-farm income, than a reduction in this income could limit their budget constraints, thus reducing turnover.

Demographic variables were of particular interest due to the possible impacts of operator retirements and estate planning. Average age of operators is positively related to turnover across models, but less so, and not statically significant, for non-arm's length turnover. Intuitively, older operators have had more time to amass capital, better positioning them to purchase additional acres. Likewise, older operators may be more likely to exit or retire from farming and sell land. Likewise, non-arm's length transactions may actually see a decrease as the average age of operators in a county, possibly due to holding land for estate planning/tax minimization purposes.

The share of operators over 65 is statically significant and negatively related with total turnover and arm's length turnover but positively related (not statistically significant) to non-arm's length turnover. This result partially supports are prediction that that older operators may choose to hold onto land for tax benefits of their heirs rather than increase sales. However, further testing is needed to understand the relationship between this age group and non-arm's length turnover. The average number of years that an operator has farmed their current farm was statistically significant for and inversely related to turnover across models. These were expected results given that as the number of years an operator operates, the effects of established operators, including being more likely to be successful and amass capital, and likelihood of holding current land was expected to decrease turnover rates. When looking at all statistically significant variables of interest, the coefficients for arm's length turnover were always of greater magnitude than those on non-arm's length turnover. This, combine with a much lower R-squared, suggests that our observed variables explain less of the variation in non-arm's length turnover.

6.2 Additional Results

For robustness checks, three additional models were ran: year fixed effects (table 6.2.1), county fixed effects (table 6.2.2), and both year and county fixed effects (table 6.2.3).

6.2.1 Year Fixed Effects

A year fixed effects model was utilized to see if unobserved time variant factors common to the entire state influence relationships between variables of interest and turnover. When looking at the below results, magnitudes remain similar and signs don't change for nearly all variables that were statistically significant in the primary results. The one exception is that the share of operators in the county over 65 years old is no longer statistically significant.

Table 6.2: *Year FE Results*

VARIABLES	(1) total_ag_turnover	(2) arms_ag_turnover	(3) nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00158	0.00314**	-0.00126*
	(0.00145)	(0.00146)	(0.000671)
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	-0.000185	-2.97e-05	-0.000182*
	(0.000145)	(7.61e-05)	(9.21e-05)
Demographics			
population	4.38e-06	5.69e-07	5.07e-06
	(5.11e-06)	(2.78e-06)	(3.21e-06)
ops_avg_age	0.147***	0.114**	0.0187
	(0.0416)	(0.0451)	(0.0161)
ops_over_65	-1.655	-1.713	0.357
	(1.493)	(1.372)	(0.737)
yrs_on_present_farm_avg	-0.102***	-0.0507**	-0.0459***
	(0.0281)	(0.0249)	(0.0148)
Constant	-5.158**	-5.015**	0.228
	(2.023)	(2.190)	(0.778)
Observations	3,495	3,491	3,464
R-squared	0.311	0.288	0.195

Control variables not shown. Standard errors, clustered by county, in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

6.2.2 County Fixed Effects

County-specific factors, such as soil quality or development potential, may influence farmland turnover. In our next specification, we remove agricultural district effects and include county fixed effects. This model yielded largely similar results to the primary results. However, nonfarm personal income is not longer statistically significant. Additionally, the estimated magnitude at which the share of operators in a county over 65 affects total and arm's length turnover is larger. Finally, the average years that operators have operated their current farm became non statistically significant for total and arm's length turnover.

Table 6.3: *County FE Results*

VARIABLES	(1) total_ag_turnover	(2) arms_ag_turnover	(3) nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00140	0.00240**	-0.000939*
	(0.000982)	(0.00104)	(0.000554)
ks_corn_price_r	0.0887***	0.0139	0.0684***
	(0.0336)	(0.0307)	(0.0124)
s_ks_steers_r	-0.00248	-0.00161	-0.000717
	(0.00311)	(0.00258)	(0.00110)
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	2.51e-05	1.80e-05	-2.08e-05
	(0.000171)	(0.000142)	(0.000103)
treasury_yld_7yr	0.311***	0.248***	0.0576***
	(0.0321)	(0.0311)	(0.0126)
Demographics			
population	-6.12e-06	-2.55e-06	-3.09e-06
	(1.54e-05)	(1.23e-05)	(8.16e-06)
ops_avg_age	0.152***	0.116**	0.0270
	(0.0440)	(0.0458)	(0.0213)
ops_over_65	-3.888***	-3.690***	0.0259
	(1.389)	(1.380)	(0.640)
yrs_on_present_farm_avg	-0.0231	0.0193	-0.0451***
	(0.0278)	(0.0289)	(0.0108)
Constant	2.794	-0.443	2.983**
	(2.922)	(2.915)	(1.169)
Observations	3,495	3,491	3,464
R-squared	0.363	0.348	0.301

Control variables not shown. Standard errors, clustered by county, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

6.2.3 Year and County Fixed Effects

A final check was done by combining the previous two models. By dropping yearly variables (and decades), as well as districts and adding year and county fixed effects, we control for time and county-specific unobserved factors that influence turnover, but at the cost of substantially reducing the amount of identifying variation for our key variables of interest.

Table 6.4: *Year FE and County FE Results*

VARIABLES	(1) total_ag_turnover	(2) arms_ag_turnover	(3) nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00157	0.00266**	-0.000953
	(0.000986)	(0.00105)	(0.000617)
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	4.29e-05	3.55e-05	-2.27e-05
	(0.000171)	(0.000143)	(0.000108)
Demographics			
population	-7.87e-06	-4.33e-06	-3.02e-06
	(1.54e-05)	(1.23e-05)	(8.41e-06)
ops_avg_age	0.135***	0.107**	0.0171
	(0.0464)	(0.0486)	(0.0225)
ops_over_65	-2.213	-2.295	0.363
	(1.500)	(1.450)	(0.749)
yrs_on_present_farm_avg	-0.0286	0.0118	-0.0424***
	(0.0290)	(0.0295)	(0.0113)
Constant	-6.183***	-6.250***	0.391
	(2.229)	(2.349)	(0.991)
Observations	3,495	3,491	3,464
R-squared	0.372	0.355	0.307

Control variables not shown. Standard errors, clustered by county, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Chapter 7

Conclusion

This objective of this study was to gain an understanding of one measure of land access: turnover rates. Land access is critical to incoming generations of agricultural operators. While renting land is an option, relationships result in long rental tenure and many landlords and tenants renewing leases for many years. This limited access branches into the other method of accessing land: ownership. Successful sales, or land turnover, are a measure of actual opportunities for new and existing farmland operators and owners to acquire land for ownership. Most of the existing literature on real estate turnover is motivated by liquidity, which is concerned with the price and time elements of market efficiency. This study is primarily motivated by the first-order efficiency and equity implications of farmland turnover.

Farmland owners are motivated to sell land based on both expected farm and nonfarm income, as well as demographic factors related to operator age and experience. Potential farmland buyers are influenced by the same factors. Utilizing Kansas agricultural land transaction data aggregated at the county level and measures of the farm economy, nonfarm economy, and county demographics, an ordinary least squares (OLS) regression was run for three classifications of turnover: total agricultural land turnover, arm's length agricultural land turnover, and non-arm's length agricultural land turnover. Separating arm's length transactions from non-arm's length transactions yields results that may show a possible influence of estate planning on land turnover.

The results of this unique study, although limited in geographic scope to a major agricultural state, demonstrate that the current and historic farm economy, the nonfarm economy, and demographics factors are all related to land turnover. While land turnover does not imply land access, one cannot be a purchaser of land without transactions occurring in the market. Thus, turnover rates set the stage for measuring access to land ownership. This research can inform further studies on causal drivers of land transactions and turnover rates, the effects of policy changes on land turnover, and agricultural land turnover over a broader geographical area.

Access and use of agricultural land is critical for new and beginning producers, producers looking to expand operations, and for national and global food security.

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Appendix A

Full Variable List

Table A.1: Variable List

VARIABLES	MEANING	REGION	SOURCE
year	Observation year		
fips	Observation county		
total_farms	Number of farms	County	Agricultural Census
full_owner_acres	Number of acres, full owners	County	Agricultural Census
full_owner_farms	Number of farms, full owners	County	Agricultural Census
irr_acres	Number of irrigated acres	County	Agricultural Census
total_acres	Number of acres in farms	County	Agricultural Census
part_owner_owned_acres	Number of owned acres, part owners	County	Agricultural Census
part_owner_rented_acres	Number of rented acres, part owners	County	Agricultural Census
part_owner_total_acres	Number of total acres, part owners	County	Agricultural Census
part_owner_total_farms	Number of total acres, part owners	County	Agricultural Census
pastureland	Number of acres in pastureland	County	Agricultural Census
tenants_acres	Number of acres, tenants	County	Agricultural Census
tenants_farms	Number of farms, tenants	County	Agricultural Census
cropland	Number of acres in cropland	County	Agricultural Census
woodland	Number of acres in woodland	County	Agricultural Census
avg_farm_size_acres	Average farm size in acres	County	Agricultural Census
equine_inventory_farms	Number of farms with equine inventory	County	Agricultural Census
ops_25_34	Operators between the ages of 25 and 34	County	Agricultural Census
ops_35_44	Operators between the ages of 35 and 44	County	Agricultural Census
ops_45_54	Operators between the ages of 45 and 54	County	Agricultural Census
ops_55_64	Operators between the ages of 55 and 64	County	Agricultural Census
ops_over_65	Operators 65 years and older	County	Agricultural Census
ops_under_25	Operators under 25 years	County	Agricultural Census
ops_avg_age	Average operator age	County	Agricultural Census

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
ops_over200days_off_farm	Operators with over 200 days worked off farm	County	Agricultural Census
ops_anydays_off_farm	Operators with any days worked off farm	County	Agricultural Census
ops_occupation_farming	Operators, primary occupation farming	County	Agricultural Census
ops_occupation_other	Operators, primary occupation not farming	County	Agricultural Census
female_acres	Number of acres, female	County	Agricultural Census
female_farms	Number of farms, female	County	Agricultural Census
yrs_on_present_farm_ge_10	Share of operators on present farm, ten or more year	County	Agricultural Census
yrs_on_present_farm_0_2	Share of operators on present farm, two years or less	County	Agricultural Census
yrs_on_present_farm_3_4	Share of operators on present farm, three to four years	County	Agricultural Census
yrs_on_present_farm_5_9	Share of operators on present farm, five to nine years	County	Agricultural Census
yrs_on_present_farm_avg	Average tenure of operators on present farm	County	Agricultural Census
equine_inventory	Equine inventory	County	Agricultural Census
weightedareaspi	Continous measure of categorical precipation (SPI), positive is dry and negative is wet	County	NOAA
lag_1_weightedareaspi	weightedareaspi, lagged 1 year	County	NOAA
lag_2_weightedareaspi	weightedareaspi, lagged 2 years	County	NOAA
lag_3_weightedareaspi	weightedareaspi, lagged 3 years	County	NOAA
lag_4_weightedareaspi	weightedareaspi, lagged 4 years	County	NOAA
lag_5_weightedareaspi	weightedareaspi, lagged 5 years	County	NOAA
lag_6_weightedareaspi	weightedareaspi, lagged 6 years	County	NOAA
lag_7_weightedareaspi	weightedareaspi, lagged 7 years	County	NOAA
lag_8_weightedareaspi	weightedareaspi, lagged 8 years	County	NOAA
lag_9_weightedareaspi	weightedareaspi, lagged 9 years	County	NOAA
lag_10_weightedareaspi	weightedareaspi, lagged 10 years	County	NOAA
weightedareaspi_avgpre3	Average (lag_1_weightedareaspi : lag_3_weightedareaspi)	County	NOAA
weightedareaspi_avgpre5	Average (lag_1_weightedareaspi : lag_5_weightedareaspi)	County	NOAA
weightedareaspi_avgpre10	Average (lag_1_weightedareaspi : lag_10_weightedareaspi)	County	NOAA
weightedareaspi_avg3	Average (weightedareaspi, lag_1_weightedareaspi : lag_2_weightedareaspi)	County	NOAA
weightedareaspi_avg5	Average (weightedareaspi, lag_1_weightedareaspi : lag_4_weightedareaspi)	County	NOAA

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
weightedareaspi_avg10	Average (weightedareaspi, lag_1_weightedareaspi : lag_9_weightedareaspi)	County	NOAA
ks_calfcrop	Calf crop inventory	State	NASS Annual Survey
ks_cattleonfeed_jan1	Cattle on feed inventory	State	NASS Annual Survey
per_capita_prsnl_income	Per capita personal income	County	BEA
population	Population	County	BEA
total_employment	Total employment	County	BEA
cpi2015	CPI, base year 2015	National	FRED
agdistrict_grouped	Numerical grouping of counties by NASS Ag District		
nonarms_ag_dry	Non-arm's length transacted agricultural acres, dryland	County	Kansas Agricultural Land Sales
nonarms_ag_irr	Non-arm's length transacted agricultural acres, irrigated	County	Kansas Agricultural Land Sales
nonarms_ag_native	Non-arm's length transacted agricultural acres, native grass	County	Kansas Agricultural Land Sales
nonarms_ag_tame	Non-arm's length transacted agricultural acres, tame grass	County	Kansas Agricultural Land Sales
nonarms_ag_acres	Non-arm's length transacted agricultural acres, total ag acres	County	Kansas Agricultural Land Sales
nonarms_total_mkt		County	Kansas Agricultural Land Sales
nonarms_total_acres	Non-arm's length transacted agricultural acres, total acres	County	Kansas Agricultural Land Sales
arms_ag_dry	Arm's length transacted agricultural acres, dryland	County	Kansas Agricultural Land Sales
arms_ag_irr	Arm's length transacted agricultural acres, irrigated	County	Kansas Agricultural Land Sales
arms_ag_native	Arm's length transacted agricultural acres, native grass	County	Kansas Agricultural Land Sales
arms_ag_tame	Arm's length transacted agricultural acres, tame grass	County	Kansas Agricultural Land Sales
arms_ag_acres	Arm's length transacted agricultural acres, total ag acres	County	Kansas Agricultural Land Sales
arms_total_mkt		County	Kansas Agricultural Land Sales
arms_total_acres	Arm's length transacted agricultural acres, total acres	County	Kansas Agricultural Land Sales
total_ag_dry	Total transacted agricultural acres, dryland	County	Kansas Agricultural Land Sales
total_ag_irr	Total transacted agricultural acres, irrigated	County	Kansas Agricultural Land Sales
total_ag_native	Total transacted agricultural acres, native grass	County	Kansas Agricultural Land Sales
total_ag_tame	Total transacted agricultural acres, tame grass	County	Kansas Agricultural Land Sales
total_ag_acres	Total transacted agricultural acres, total ag acres	County	Kansas Agricultural Land Sales
total_total_mkt		County	Kansas Agricultural Land Sales

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
total_total_acres	Total transacted agricultural acres, total acres	County	Kansas Agricultural Land Sales
total_ag_turnover	Total turnover = total_ag_acres / total_acres	County	Transformation
nonarms_ag_turnover	Non-arm's length turnover = nonarms_ag_acres / total_acres	County	Transformation
arms_ag_turnover	Arm's length turnover = arms_ag_acres / total_acres	County	Transformation
treasury_yld_7yr	Market Yield on U.S. Treasury Securities at 7-Year Constant Maturity, Investment Basis	National	FRED
s_tx_steers_r	Real price, Texas stocker steers ($/cwt)	State	LMIC
s_ks_steers_r	Real price, Kansas stocker steers ($/cwt)	State	LMIC
s_ks_heifers_r	Real price, Kansas stocker heifers ($/cwt)	State	LMIC
f_steers_400500_r	Real price, West Kansas feeder steers, 400-500lb ($/cwt)	State	LMIC
f_steers_500600_r	Real price, West Kansas feeder steers, 500-600lb ($/cwt)	State	LMIC
f_steers_600700_r	Real price, West Kansas feeder steers, 600-700lb ($/cwt)	State	LMIC
f_steers_700800_r	Real price, West Kansas feeder steers, 700-800lb ($/cwt)	State	LMIC
f_steers_8001000_r	Real price, West Kansas feeder steers, 800-1,000lb ($/cwt)	State	LMIC
f_heifers_400500_r	Real price, West Kansas feeder heifers, 400-500lb ($/cwt)	State	LMIC
f_heifers_500600_r	Real price, West Kansas feeder heifers, 500-600lb ($/cwt)	State	LMIC
f_heifers_600700_r	Real price, West Kansas feeder heifers, 600-700lb ($/cwt)	State	LMIC
f_heifers_700800_r	Real price, West Kansas feeder heifers, 700-800lb ($/cwt)	State	LMIC
ks_corn_price_r	Real price, Kansas corn ($/bu)	State	NASS Annual Survey
ks_wheat_price_r	Real price, wheat ($/bu)	State	NASS Annual Survey
farm_inc_1000000_r	Real farm income ($1,000,000)	County	BEA
farm_proprtors_inc_1000000_r	Real farm proprtors income ($1,000,000)	County	BEA
nonfarm_proprtors_inc_1000000_r	Real nonfarm proprtors income ($1,000,000)	County	BEA
nonfarm_prsnl_inc_1000000_r	Real nonfarm personal income ($1,000,000)	County	BEA
per_capita_prsnl_income_r	Real per capita personal income	County	BEA
prsnl_inc_1000000_r	Real personal income ($1,000,000)	County	BEA
lag_1_s_tx_steers_r	s_tx_steers_r, 1 year lag	State	LMIC
lag_2_s_tx_steers_r	s_tx_steers_r, 2 year lag	State	LMIC
lag_3_s_tx_steers_r	s_tx_steers_r, 3 year lag	State	LMIC

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
lag_4_s_tx_steers_r	s_tx_steers_r, 4 year lag	State	LMIC
lag_5_s_tx_steers_r	s_tx_steers_r, 5 year lag	State	LMIC
s_tx_steers_r_avgpre3	Average (s_tx_steers_r, lag_1_s_tx_steers_r : lag_2_s_tx_steers_r)	State	LMIC
s_tx_steers_r_avgpre5	Average (s_tx_steers_r, lag_1_s_tx_steers_r : lag_4_s_tx_steers_r)	State	LMIC
s_tx_steers_r_avg3	Average (lag_1_s_tx_steers_r : lag_3_s_tx_steers_r)	State	LMIC
s_tx_steers_r_avg5	Average (lag_1_s_tx_steers_r : lag_5_s_tx_steers_r)	State	LMIC
lag_1_s_ks_steers_r	s_ks_steers_r, 1 year lag	State	LMIC
lag_2_s_ks_steers_r	s_ks_steers_r, 2 year lag	State	LMIC
lag_3_s_ks_steers_r	s_ks_steers_r, 3 year lag	State	LMIC
lag_4_s_ks_steers_r	s_ks_steers_r, 4 year lag	State	LMIC
lag_5_s_ks_steers_r	s_ks_steers_r, 5 year lag	State	LMIC
s_ks_steers_r_avgpre3	Average (s_ks_steers_r, lag_1_s_ks_steers_r : lag_2_s_ks_steers_r)	State	LMIC
s_ks_steers_r_avgpre5	Average (s_ks_steers_r, lag_1_s_ks_steers_r : lag_4_s_ks_steers_r)	State	LMIC
s_ks_steers_r_avg3	Average (lag_1_s_ks_steers_r : lag_3_s_ks_steers_r)	State	LMIC
s_ks_steers_r_avg5	Average (lag_1_s_ks_steers_r : lag_5_s_tx_steers_r)	State	LMIC
lag_1_s_ks_heifers_r	s_ks_heifers_r, 1 year lag	State	LMIC
lag_2_s_ks_heifers_r	s_ks_heifers_r, 2 year lag	State	LMIC
lag_3_s_ks_heifers_r	s_ks_heifers_r, 3 year lag	State	LMIC
lag_4_s_ks_heifers_r	s_ks_heifers_r, 4 year lag	State	LMIC
lag_5_s_ks_heifers_r	s_ks_heifers_r, 5 year lag	State	LMIC
s_ks_heifers_r_avgpre3	Average (s_ks_heifers_r, lag_1_s_ks_heifers_r : lag_2_s_ks_heifers_r)	State	LMIC
s_ks_heifers_r_avgpre5	Average (s_ks_heifers_r, lag_1_s_ks_heifers_r : lag_4_s_ks_heifers_r)	State	LMIC
s_ks_heifers_r_avg3	Average (lag_1_s_ks_heifers_r : lag_3_s_ks_heifers_r)	State	LMIC
s_ks_heifers_r_avg5	Average (lag_1_s_ks_heifers_r : lag_5_s_tx_heifers_r)	State	LMIC
lag_1_f_steers_400500_r	f_steers_400500_r, 1 year lag	State	LMIC
lag_2_f_steers_400500_r	f_steers_400500_r, 2 year lag	State	LMIC
lag_3_f_steers_400500_r	f_steers_400500_r, 3 year lag	State	LMIC
lag_4_f_steers_400500_r	f_steers_400500_r, 4 year lag	State	LMIC

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
lag_5_f_steers_400500_r	f_steers_400500_r, 5 year lag	State	LMIC
f_steers_400500_r_avgpre3	Average (f_steers_400500_r, lag_1_f_steers_400500_r : lag_2_f_steers_400500_r)	State	LMIC
f_steers_400500_r_avgpre5	Average (f_steers_400500_r, lag_1_f_steers_400500_r : lag_4_f_steers_400500_r)	State	LMIC
f_steers_400500_r_avg3	Average (lag_1_f_steers_400500_r : lag_3_f_steers_400500_r)	State	LMIC
f_steers_400500_r_avg5	Average (lag_1_f_steers_400500_r : lag_5_f_steers_400500_r)	State	LMIC
lag_1_f_steers_500600_r	f_steers_500600_r, 1 year lag	State	LMIC
lag_2_f_steers_500600_r	f_steers_500600_r, 2 year lag	State	LMIC
lag_3_f_steers_500600_r	f_steers_500600_r, 3 year lag	State	LMIC
lag_4_f_steers_500600_r	f_steers_500600_r, 4 year lag	State	LMIC
lag_5_f_steers_500600_r	f_steers_500600_r, 5 year lag	State	LMIC
f_steers_500600_r_avgpre3	Average (f_steers_500600_r, lag_1_f_steers_500600_r : lag_2_f_steers_500600_r)	State	LMIC
f_steers_500600_r_avgpre5	Average (f_steers_500600_r, lag_1_f_steers_500600_r : lag_4_f_steers_500600_r)	State	LMIC
f_steers_500600_r_avg3	Average (lag_1_f_steers_500600_r : lag_3_f_steers_500600_r)	State	LMIC
f_steers_500600_r_avg5	Average (lag_1_f_steers_500600_r : lag_5_f_steers_500600_r)	State	LMIC
lag_1_f_steers_600700_r	f_steers_600700_r, 1 year lag	State	LMIC
lag_2_f_steers_600700_r	f_steers_600700_r, 2 year lag	State	LMIC
lag_3_f_steers_600700_r	f_steers_600700_r, 3 year lag	State	LMIC
lag_4_f_steers_600700_r	f_steers_600700_r, 4 year lag	State	LMIC
lag_5_f_steers_600700_r	f_steers_600700_r, 5 year lag	State	LMIC
f_steers_600700_r_avgpre3	Average (f_steers_600700_r, lag_1_f_steers_600700_r : lag_2_f_steers_600700_r)	State	LMIC
f_steers_600700_r_avgpre5	Average (f_steers_600700_r, lag_1_f_steers_600700_r : lag_4_f_steers_600700_r)	State	LMIC
f_steers_600700_r_avg3	Average (lag_1_f_steers_600700_r : lag_3_f_steers_600700_r)	State	LMIC
f_steers_600700_r_avg5	Average (lag_1_f_steers_600700_r : lag_5_f_steers_600700_r)	State	LMIC
lag_1_f_steers_700800_r	f_steers_700800_r, 1 year lag	State	LMIC
lag_2_f_steers_700800_r	f_steers_700800_r, 2 year lag	State	LMIC
lag_3_f_steers_700800_r	f_steers_700800_r, 3 year lag	State	LMIC
lag_4_f_steers_700800_r	f_steers_700800_r, 4 year lag	State	LMIC
lag_5_f_steers_700800_r	f_steers_700800_r, 5 year lag	State	LMIC

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
f_steers_700800_r_avgpre3	Average (f_steers_700800_r, lag_1_f_steers_700800_r : lag_2_f_steers_700800_r)	State	LMIC
f_steers_700800_r_avgpre5	Average (f_steers_700800_r, lag_1_f_steers_700800_r : lag_4_f_steers_700800_r)	State	LMIC
f_steers_700800_r_avg3	Average (lag_1_f_steers_700800_r : lag_3_f_steers_700800_r)	State	LMIC
f_steers_700800_r_avg5	Average (lag_1_f_steers_700800_r : lag_5_f_steers_700800_r)	State	LMIC
lag_1_f_steers_8001000_r	f_steers_8001000_r, 1 year lag	State	LMIC
lag_2_f_steers_8001000_r	f_steers_8001000_r, 2 year lag	State	LMIC
lag_3_f_steers_8001000_r	f_steers_8001000_r, 3 year lag	State	LMIC
lag_4_f_steers_8001000_r	f_steers_8001000_r, 4 year lag	State	LMIC
lag_5_f_steers_8001000_r	f_steers_8001000_r, 5 year lag	State	LMIC
f_steers_8001000_r_avgpre3	Average (f_steers_8001000_r, lag_1_f_steers_8001000_r : lag_2_f_steers_8001000_r)	State	LMIC
f_steers_8001000_r_avgpre5	Average (f_steers_8001000_r, lag_1_f_steers_8001000_r : lag_4_f_steers_8001000_r)	State	LMIC
f_steers_8001000_r_avg3	Average (lag_1_f_steers_8001000_r : lag_3_f_steers_8001000_r)	State	LMIC
f_steers_8001000_r_avg5	Average (lag_1_f_steers_8001000_r : lag_5_f_steers_8001000_r)	State	LMIC
lag_1_f_heifers_400500_r	f_heifers_400500_r, 1 year lag	State	LMIC
lag_2_f_heifers_400500_r	f_heifers_400500_r, 2 year lag	State	LMIC
lag_3_f_heifers_400500_r	f_heifers_400500_r, 3 year lag	State	LMIC
lag_4_f_heifers_400500_r	f_heifers_400500_r, 4 year lag	State	LMIC
lag_5_f_heifers_400500_r	f_heifers_400500_r, 5 year lag	State	LMIC
f_heifers_400500_r_avgpre3	Average (f_heifers_400500_r, lag_1_f_heifers_400500_r : lag_2_f_heifers_400500_r)	State	LMIC
f_heifers_400500_r_avgpre5	Average (f_heifers_400500_r, lag_1_f_heifers_400500_r : lag_4_f_heifers_400500_r)	State	LMIC
f_heifers_400500_r_avg3	Average (lag_1_f_heifers_400500_r : lag_3_f_heifers_400500_r)	State	LMIC
f_heifers_400500_r_avg5	Average (lag_1_f_heifers_400500_r : lag_5_f_heifers_400500_r)	State	LMIC
lag_1_f_heifers_500600_r	f_heifers_500600_r, 1 year lag	State	LMIC
lag_2_f_heifers_500600_r	f_heifers_500600_r, 2 year lag	State	LMIC
lag_3_f_heifers_500600_r	f_heifers_500600_r, 3 year lag	State	LMIC
lag_4_f_heifers_500600_r	f_heifers_500600_r, 4 year lag	State	LMIC
lag_5_f_heifers_500600_r	f_heifers_500600_r, 5 year lag	State	LMIC
f_heifers_500600_r_avgpre3	Average (f_heifers_500600_r, lag_1_f_heifers_500600_r : lag_2_f_heifers_500600_r)	State	LMIC

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
f_heifers_500600_r_avgpre5	Average (f_heifers_500600_r, lag_1_f_heifers_500600_r : lag_4_f_heifers_500600_r)	State	LMIC
f_heifers_500600_r_avg3	Average (lag_1_f_heifers_500600_r : lag_3_f_heifers_500600_r)	State	LMIC
f_heifers_500600_r_avg5	Average (lag_1_f_heifers_500600_r : lag_5_f_heifers_500600_r)	State	LMIC
lag_1_f_heifers_600700_r	f_heifers_600700_r, 1 year lag	State	LMIC
lag_2_f_heifers_600700_r	f_heifers_600700_r, 2 year lag	State	LMIC
lag_3_f_heifers_600700_r	f_heifers_600700_r, 3 year lag	State	LMIC
lag_4_f_heifers_600700_r	f_heifers_600700_r, 4 year lag	State	LMIC
lag_5_f_heifers_600700_r	f_heifers_600700_r, 5 year lag	State	LMIC
f_heifers_600700_r_avgpre3	Average (f_heifers_600700_r, lag_1_f_heifers_600700_r : lag_2_f_heifers_600700_r)	State	LMIC
f_heifers_600700_r_avgpre5	Average (f_heifers_600700_r, lag_1_f_heifers_600700_r : lag_4_f_heifers_600700_r)	State	LMIC
f_heifers_600700_r_avg3	Average (lag_1_f_heifers_600700_r : lag_3_f_heifers_600700_r)	State	LMIC
f_heifers_600700_r_avg5	Average (lag_1_f_heifers_600700_r : lag_5_f_heifers_600700_r)	State	LMIC
lag_1_f_heifers_700800_r	f_heifers_700800_r, 1 year lag	State	LMIC
lag_2_f_heifers_700800_r	f_heifers_700800_r, 2 year lag	State	LMIC
lag_3_f_heifers_700800_r	f_heifers_700800_r, 3 year lag	State	LMIC
lag_4_f_heifers_700800_r	f_heifers_700800_r, 4 year lag	State	LMIC
lag_5_f_heifers_700800_r	f_heifers_700800_r, 5 year lag	State	LMIC
f_heifers_700800_r_avgpre3	Average (f_heifers_700800_r, lag_1_f_heifers_700800_r : lag_2_f_heifers_700800_r)	State	LMIC
f_heifers_700800_r_avgpre5	Average (f_heifers_700800_r, lag_1_f_heifers_700800_r : lag_4_f_heifers_700800_r)	State	LMIC
f_heifers_700800_r_avg3	Average (lag_1_f_heifers_700800_r : lag_3_f_heifers_700800_r)	State	LMIC
f_heifers_700800_r_avg5	Average (lag_1_f_heifers_700800_r : lag_5_f_heifers_700800_r)	State	LMIC
lag_1_ks_corn_price_r	ks_corn_price_r, 1 year lag	State	NASS Annual Survey
lag_2_ks_corn_price_r	ks_corn_price_r, 2 year lag	State	NASS Annual Survey
lag_3_ks_corn_price_r	ks_corn_price_r, 3 year lag	State	NASS Annual Survey
lag_4_ks_corn_price_r	ks_corn_price_r, 4 year lag	State	NASS Annual Survey
lag_5_ks_corn_price_r	ks_corn_price_r, 5 year lag	State	NASS Annual Survey
ks_corn_price_r_avgpre3	Average (ks_corn_price_r, lag_1_ks_corn_price_r : lag_2_ks_corn_price_r)	State	NASS Annual Survey
ks_corn_price_r_avgpre5	Average (ks_corn_price_r, lag_1_ks_corn_price_r : lag_4_ks_corn_price_r)	State	NASS Annual Survey

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
ks_corn_price_r_avg3	Average (lag_1_ks_corn_price_r : lag_3_ks_corn_price_r)	State	NASS Annual Survey
ks_corn_price_r_avg5	Average (lag_1_ks_corn_price_r : lag_5_ks_corn_price_r)	State	NASS Annual Survey
lag_1_ks_wheat_price_r	ks_wheat_price_r, 1 year lag	State	NASS Annual Survey
lag_2_ks_wheat_price_r	ks_wheat_price_r, 2 year lag	State	NASS Annual Survey
lag_3_ks_wheat_price_r	ks_wheat_price_r, 3 year lag	State	NASS Annual Survey
lag_4_ks_wheat_price_r	ks_wheat_price_r, 4 year lag	State	NASS Annual Survey
lag_5_ks_wheat_price_r	ks_wheat_price_r, 5 year lag	State	NASS Annual Survey
ks_wheat_price_r_avgpre3	Average (ks_wheat_price_r, lag_1_ks_wheat_price_r : lag_2_ks_wheat_price_r)	State	NASS Annual Survey
ks_wheat_price_r_avgpre5	Average (ks_wheat_price_r, lag_1_ks_wheat_price_r : lag_4_ks_wheat_price_r)	State	NASS Annual Survey
ks_wheat_price_r_avg3	Average (lag_1_ks_wheat_price_r : lag_3_ks_wheat_price_r)	State	NASS Annual Survey
ks_wheat_price_r_avg5	Average (lag_1_ks_wheat_price_r : lag_5_ks_wheat_price_r)	State	NASS Annual Survey
lag_1_ks_calfcrop	ks_calfcrop, 1 year lag	State	NASS Annual Survey
lag_2_ks_calfcrop	ks_calfcrop, 2 year lag	State	NASS Annual Survey
lag_3_ks_calfcrop	ks_calfcrop, 3 year lag	State	NASS Annual Survey
lag_4_ks_calfcrop	ks_calfcrop, 4 year lag	State	NASS Annual Survey
lag_5_ks_calfcrop	ks_calfcrop, 5 year lag	State	NASS Annual Survey
ks_calfcrop_avgpre3	Average (ks_calfcrop, lag_1_ks_calfcrop : lag_2_ks_calfcrop)	State	NASS Annual Survey
ks_calfcrop_avgpre5	Average (ks_calfcrop, lag_1_ks_calfcrop : lag_4_ks_calfcrop)	State	NASS Annual Survey
ks_calfcrop_avg3	Average (lag_1_ks_calfcrop : lag_3_ks_calfcrop)	State	NASS Annual Survey
ks_calfcrop_avg5	Average (lag_1_ks_calfcrop : lag_5_ks_calfcrop)	State	NASS Annual Survey
lag_1_ks_cattleonfeed_jan1	ks_cattleonfeed_jan1, 1 year lag	State	NASS Annual Survey
lag_2_ks_cattleonfeed_jan1	ks_cattleonfeed_jan1, 2 year lag	State	NASS Annual Survey
lag_3_ks_cattleonfeed_jan1	ks_cattleonfeed_jan1, 3 year lag	State	NASS Annual Survey
lag_4_ks_cattleonfeed_jan1	ks_cattleonfeed_jan1, 4 year lag	State	NASS Annual Survey
lag_5_ks_cattleonfeed_jan1	ks_cattleonfeed_jan1, 5 year lag	State	NASS Annual Survey
ks_cattleonfeed_jan1_avgpre3	Average (ks_cattleonfeed_jan1, lag_1_ks_cattleonfeed_jan1 : lag_2_ks_cattleonfeed_jan1)	State	NASS Annual Survey
ks_cattleonfeed_jan1_avgpre5	Average (ks_cattleonfeed_jan1, lag_1_ks_cattleonfeed_jan1 : lag_4_ks_cattleonfeed_jan1)	State	NASS Annual Survey
ks_cattleonfeed_jan1_avg3	Average (lag_1_ks_cattleonfeed_jan1 : lag_3_ks_cattleonfeed_jan1)	State	NASS Annual Survey

VARIABLES	MEANING	GEOGRAPHIC LEVEL	SOURCE
ks_cattleonfeed_jan1_avg5	Average (lag_1_ks_cattleonfeed_jan1 : lag_5_ks_cattleonfeed_jan1)	State	NASS Annual Survey
decade_1985_1993	Binary variable for "decade", 1 = (1984 <Year <1994)		
decade_1994_2002	Binary variable for "decade", 1 = (1993 <Year <2003)		
decade_2003_2011	Binary variable for "decade", 1 = (2002 <Year <2012)		
decade_2012_2020	Binary variable for "decade", 1 = (2011 <Year <2021)		
ops_under_35	ops_under_25 + ops_25_34	County	Agricultural Census
share_ops_occupation_farming	ops_occupation_farming / (ops_occupation_farming + ops_occupation_other)	County	Agricultural Census
share_ops_occupation_other	ops_occupation_other / (ops_occupation_farming + ops_occupation_other)	County	Agricultural Census
share_pastureland	pastureland / total_acres	County	Agricultural Census
share_cropland	cropland / total_acres	County	Agricultural Census
share_irr_acres	irr_acres / total_acres	County	Agricultural Census
share_female_acres	female_acres / total_acres	County	Agricultural Census
share_full_owner_acres	full_owner_acres / total_acres	County	Agricultural Census
share_part_owner_owned_acres	part_owner_owned_acres / total_acres	County	Agricultural Census
share_part_owner_rented_acres	part_owner_rented_acres / total_acres	County	Agricultural Census
share_part_owner_total_acres	part_owner_total_acres / total_acres	County	Agricultural Census
share_tenants_acres	tenants_acres / total_acres	County	Agricultural Census

Table A.2: Summary Statistics

VARIABLES	N	Mean	SD	Min	Max
year	3,500	2,003	10.10	1,986	2,020
fips	3,500	20,104	61.31	20,001	20,209
total_farms	3,500	582.1	280.4	154.4	1,604
full_owner_acres	3,500	93,626	35,817	0	268,923
full_owner_farms	3,500	301.0	186.6	43	1,146
irr_acres	3,500	25,974	39,783	0	230,339
total_acres	3,500	446,730	133,692	12,009	816,563
part_owner_owned_acres	3,500	118,895	40,100	494	290,106
part_owner_rented_acres	3,500	183,687	62,504	3,553	431,766
part_owner_total_acres	3,500	302,582	97,435	5,064	589,926
part_owner_total_farms	3,500	219.3	101.9	26	715.4
pastureland	3,500	165,908	89,650	2,032	586,370
tenants_acres	3,500	50,536	32,986	0	218,330
tenants_farms	3,500	61.73	33.27	0	247
cropland	3,500	285,244	117,940	7,328	684,908
woodland	3,500	6,168	6,374	0	32,814
avg_farm_size_acres	3,500	934.2	473.9	73	2,537
equine_inventory_farms	3,500	100.4	75.71	0	589
ops_25_34	3,500	0.0841	0.0365	0.00475	0.215
ops_35_44	3,500	0.155	0.0564	0	0.332
ops_45_54	3,500	0.209	0.0475	0.0268	0.352
ops_55_64	3,500	0.233	0.0468	0.107	0.418
ops_over_65	3,500	0.306	0.0737	0.114	0.564
ops_under_25	3,500	0.0138	0.0116	0	0.0757
ops_avg_age	3,500	56.13	3.115	47.36	65.16
ops_over200days_off_farm	3,500	227.3	155.3	23	1,043
ops_anydays_off_farm	3,500	339.3	208.6	60	1,437
ops_occupation_farming	3,500	338.6	138.2	52	832.4
ops_occupation_other	3,500	277.5	195.1	28	1,469
female_acres	3,500	33,292	41,509	581	420,214
female_farms	3,500	71.19	75.04	5	749.8
yrs_on_present_farm_ge_10	3,500	0.771	0.0454	0.525	0.914
yrs_on_present_farm_0_2	3,500	0.0406	0.0185	0	0.134
yrs_on_present_farm_3_4	3,500	0.0558	0.0185	0	0.150
yrs_on_present_farm_5_9	3,500	0.133	0.0272	0	0.269
yrs_on_present_farm_avg	3,500	24.17	2.122	16.70	30.70

VARIABLES	N	Mean	SD	Min	Max
equine_inventory	3,500	550.4	572.5	0	5,542
weightedareaspi	3,500	-0.465	1.490	-4.823	4.265
lag_1_weightedareaspi	3,500	-0.481	1.490	-4.823	4.265
lag_2_weightedareaspi	3,500	-0.404	1.416	-4.823	4.265
lag_3_weightedareaspi	3,500	-0.419	1.404	-4.823	4.265
lag_4_weightedareaspi	3,500	-0.406	1.398	-4.823	4.265
lag_5_weightedareaspi	3,500	-0.351	1.397	-4.823	4.265
lag_6_weightedareaspi	3,500	-0.304	1.408	-4.823	4.265
lag_7_weightedareaspi	3,500	-0.321	1.403	-4.823	4.265
lag_8_weightedareaspi	3,500	-0.347	1.384	-4.823	4.265
lag_9_weightedareaspi	3,500	-0.376	1.365	-4.823	4.265
lag_10_weightedareaspi	3,500	-0.385	1.340	-4.823	3.586
weightedareaspi_avgpre3	3,500	-0.434	0.918	-2.939	2.560
weightedareaspi_avgpre5	3,500	-0.412	0.670	-2.245	1.749
weightedareaspi_avgpre10	3,500	-0.379	0.373	-1.503	0.862
weightedareaspi_avg3	3,500	-0.450	0.923	-2.939	2.560
weightedareaspi_avg5	3,500	-0.435	0.681	-2.245	1.749
weightedareaspi_avg10	3,500	-0.387	0.369	-1.503	0.862
ks_calfcrop	3,500	1.426e+06	69,535	1.260e+06	1.550e+06
ks_cattleonfeed_jan1	3,500	2.182e+06	353,139	1.395e+06	2.630e+06
per_capita_prsnl_income	3,500	29,904	12,950	10,537	90,601
population	3,500	19,733	49,959	1,210	524,246
total_employment	3,500	11,891	32,260	1,087	341,085
cpi2015	3,500	78.72	18.77	46.24	109.2
agdistrict_grouped	3,500	5.110	2.565	1	9
nonarms_ag_dry	3,464	1,317	1,140	0	10,193
nonarms_ag_irr	3,464	156.8	335.4	0	3,836
nonarms_ag_native	3,464	987.3	1,111	0	15,024
nonarms_ag_tame	3,464	136.9	301.0	0	4,074
nonarms_ag_acres	3,464	2,599	1,883	5.600	18,088
nonarms_total_mkt	3,464	8.617	16.94	0	256.3
nonarms_total_acres	3,464	2,607	1,886	6.300	18,093
arms_ag_dry	3,491	3,416	2,441	0	22,021
arms_ag_irr	3,491	524.4	1,072	0	12,705
arms_ag_native	3,491	3,569	4,108	0	63,459
arms_ag_tame	3,491	371.2	742.2	0	5,910
arms_ag_acres	3,491	7,881	5,176	38.57	68,986
arms_total_mkt	3,491	23.23	41.41	0	695.8
arms_total_acres	3,491	7,904	5,181	44.28	68,989

VARIABLES	N	Mean	SD	Min	Max
total_ag_dry	3,495	4,843	3,064	0	23,445
total_ag_irr	3,495	692.1	1,293	0	15,555
total_ag_native	3,495	4,663	4,656	0	64,297
total_ag_tame	3,495	525.5	1,003	0	9,019
total_ag_acres	3,495	10,724	5,847	92.89	72,487
total_total_mkt	3,495	33.15	52.86	0	749.2
total_total_acres	3,495	10,758	5,853	94.61	72,492
total_ag_turnover	3,495	2.446	1.138	0.0221	13.25
nonarms_ag_turnover	3,464	0.596	0.423	0.00114	7.582
arms_ag_turnover	3,491	1.792	1.032	0.0185	12.27
treasury_yld_7yr	3,500	4.625	2.348	0.720	8.710
s_tx_steers_r	3,500	114.6	17.98	88.75	153.5
s_ks_steers_r	3,500	114.6	18.12	88.71	154.5
s_ks_heifers_r	3,500	114.4	17.83	88.88	154.5
f_steers_400500_r	3,500	166.5	35.38	95.43	276.4
f_steers_500600_r	3,500	151.6	31.32	91.54	248.6
f_steers_600700_r	3,500	140.3	27.37	90.71	221.8
f_steers_700800_r	3,500	134.8	25.11	91.95	207.3
f_steers_8001000_r	3,500	128.4	23.64	90.20	193.4
f_heifers_400500_r	3,500	147.7	32.71	81.51	251.3
f_heifers_500600_r	3,500	137.3	28.66	81.00	225.8
f_heifers_600700_r	3,500	130.8	25.13	85.00	204.3
f_heifers_700800_r	3,500	126.6	23.63	86.48	193.6
ks_corn_price_r	3,500	3.924	1.044	2.512	7.268
ks_wheat_price_r	3,500	5.206	1.364	3.160	7.722
farm_inc_1000000_r	3,500	20.57	20.99	-14.33	220.9
farm_proprtors_inc_1000000_r	3,500	16.44	18.89	-16.92	204.4
nonfarm_proprtors_inc_1000000_r	3,500	62.85	241.6	2.219	4,600
nonfarm_prsnl_inc_1000000_r	3,500	702.4	2,110	35.33	26,436
per_capita_prsnl_income_r	3,500	36,643	8,642	21,786	92,180
prsnl_inc_1000000_r	3,500	723.0	2,109	40.15	26,464
lag_1_s_tx_steers_r	3,500	115.6	18.05	88.75	153.5
lag_2_s_tx_steers_r	3,500	116.9	18.99	88.75	153.5
lag_3_s_tx_steers_r	3,500	118.1	19.89	88.75	153.5
lag_4_s_tx_steers_r	3,500	119.4	21.18	88.75	161.9
lag_5_s_tx_steers_r	3,500	120.9	22.90	88.75	171.6
s_tx_steers_r_avgpre3	3,500	116.9	17.68	93.22	146.4
s_tx_steers_r_avgpre5	3,500	118.2	17.95	92.95	154.5
s_tx_steers_r_avg3	3,500	115.7	17.03	93.22	142.9

VARIABLES	N	Mean	SD	Min	Max
s_tx_steers_r_avg5	3,500	116.9	16.86	92.95	145.9
lag_1_s_ks_steers_r	3,500	115.6	18.20	88.71	154.5
lag_2_s_ks_steers_r	3,500	116.9	19.10	88.71	154.5
lag_3_s_ks_steers_r	3,500	118.1	19.99	88.71	154.5
lag_4_s_ks_steers_r	3,500	119.3	21.24	88.71	161.3
lag_5_s_ks_steers_r	3,500	120.8	22.84	88.71	169.7
s_ks_steers_r_avgpre3	3,500	116.8	17.78	93.10	146.1
s_ks_steers_r_avgpre5	3,500	118.1	17.98	92.94	153.9
s_ks_steers_r_avg3	3,500	115.7	17.14	93.10	143.3
s_ks_steers_r_avg5	3,500	116.9	16.94	92.94	145.7
lag_1_s_ks_heifers_r	3,500	115.3	17.84	88.88	154.5
lag_2_s_ks_heifers_r	3,500	116.4	18.57	88.88	154.5
lag_3_s_ks_heifers_r	3,500	117.5	19.25	88.88	154.5
lag_4_s_ks_heifers_r	3,500	118.6	20.25	88.88	155.3
lag_5_s_ks_heifers_r	3,500	119.9	21.67	88.88	164.8
s_ks_heifers_r_avgpre3	3,500	116.4	17.21	93.20	143.3
s_ks_heifers_r_avgpre5	3,500	117.6	17.13	93.00	149.2
s_ks_heifers_r_avg3	3,500	115.4	16.73	93.20	143.3
s_ks_heifers_r_avg5	3,500	116.5	16.28	93.00	141.4
lag_1_f_steers_400500_r	3,500	166.4	35.38	95.43	276.4
lag_2_f_steers_400500_r	3,500	166.3	35.40	95.43	276.4
lag_3_f_steers_400500_r	3,500	166.1	35.36	95.43	276.4
lag_4_f_steers_400500_r	3,500	165.9	35.32	95.43	276.4
lag_5_f_steers_400500_r	3,500	166.4	35.62	95.43	276.4
f_steers_400500_r_avgpre3	3,500	166.3	30.59	117.8	246.7
f_steers_400500_r_avgpre5	3,500	166.2	26.82	123.7	223.4
f_steers_400500_r_avg3	3,500	166.4	30.59	117.8	246.7
f_steers_400500_r_avg5	3,500	166.3	26.82	123.7	223.4
lag_1_f_steers_500600_r	3,500	151.7	31.30	91.54	248.6
lag_2_f_steers_500600_r	3,500	151.8	31.30	91.54	248.6
lag_3_f_steers_500600_r	3,500	151.7	31.27	91.54	248.6
lag_4_f_steers_500600_r	3,500	151.8	31.30	91.54	248.6
lag_5_f_steers_500600_r	3,500	152.2	31.56	91.54	248.6
f_steers_500600_r_avgpre3	3,500	151.7	27.05	109.8	221.4
f_steers_500600_r_avgpre5	3,500	151.8	23.95	114.4	200.9
f_steers_500600_r_avg3	3,500	151.7	27.05	109.8	221.4
f_steers_500600_r_avg5	3,500	151.7	23.91	114.4	200.9
lag_1_f_steers_600700_r	3,500	140.6	27.33	90.71	221.8
lag_2_f_steers_600700_r	3,500	140.8	27.37	90.71	221.8

VARIABLES	N	Mean	SD	Min	Max
lag_3_f_steers_600700_r	3,500	140.9	27.39	90.71	221.8
lag_4_f_steers_600700_r	3,500	141.2	27.53	90.71	221.8
lag_5_f_steers_600700_r	3,500	141.8	27.96	90.71	221.8
f_steers_600700_r_avgpre3	3,500	140.8	23.77	104.6	200.0
f_steers_600700_r_avgpre5	3,500	141.1	21.30	107.4	182.1
f_steers_600700_r_avg3	3,500	140.6	23.74	104.6	200.0
f_steers_600700_r_avg5	3,500	140.8	21.18	107.4	182.1
lag_1_f_steers_700800_r	3,500	135.2	25.06	91.95	207.3
lag_2_f_steers_700800_r	3,500	135.6	25.14	91.95	207.3
lag_3_f_steers_700800_r	3,500	135.9	25.25	91.95	207.3
lag_4_f_steers_700800_r	3,500	136.4	25.51	91.95	207.3
lag_5_f_steers_700800_r	3,500	137.1	26.07	91.95	207.3
f_steers_700800_r_avgpre3	3,500	135.6	22.08	102.8	187.9
f_steers_700800_r_avgpre5	3,500	136.1	20.03	104.6	172.5
f_steers_700800_r_avg3	3,500	135.2	22.01	102.8	187.9
f_steers_700800_r_avg5	3,500	135.6	19.82	104.6	172.5
lag_1_f_steers_8001000_r	3,500	128.9	23.59	90.20	193.4
lag_2_f_steers_8001000_r	3,500	129.4	23.75	90.20	193.4
lag_3_f_steers_8001000_r	3,500	129.7	23.85	90.20	193.4
lag_4_f_steers_8001000_r	3,500	130.3	24.26	90.20	193.4
lag_5_f_steers_8001000_r	3,500	131.2	25.09	90.20	193.4
f_steers_8001000_r_avgpre3	3,500	129.3	20.97	98.65	176.4
f_steers_8001000_r_avgpre5	3,500	129.9	19.29	99.98	162.5
f_steers_8001000_r_avg3	3,500	128.9	20.88	98.65	176.4
f_steers_8001000_r_avg5	3,500	129.3	18.98	99.98	162.5
lag_1_f_heifers_400500_r	3,500	147.7	32.73	81.51	251.3
lag_2_f_heifers_400500_r	3,500	147.3	32.81	81.51	251.3
lag_3_f_heifers_400500_r	3,500	146.9	32.76	81.51	251.3
lag_4_f_heifers_400500_r	3,500	146.7	32.74	81.51	251.3
lag_5_f_heifers_400500_r	3,500	146.8	32.78	81.51	251.3
f_heifers_400500_r_avgpre3	3,500	147.3	28.13	102.0	221.2
f_heifers_400500_r_avgpre5	3,500	147.1	24.42	107.7	199.6
f_heifers_400500_r_avg3	3,500	147.6	28.08	102.0	221.2
f_heifers_400500_r_avg5	3,500	147.3	24.42	107.7	199.6
lag_1_f_heifers_500600_r	3,500	137.4	28.64	81.00	225.8
lag_2_f_heifers_500600_r	3,500	137.3	28.65	81.00	225.8
lag_3_f_heifers_500600_r	3,500	137.0	28.60	81.00	225.8
lag_4_f_heifers_500600_r	3,500	137.0	28.60	81.00	225.8
lag_5_f_heifers_500600_r	3,500	137.3	28.72	81.00	225.8

VARIABLES	N	Mean	SD	Min	Max
f_heifers_500600_r_avgpre3	3,500	137.3	24.58	98.51	200.8
f_heifers_500600_r_avgpre5	3,500	137.2	21.47	102.8	181.7
f_heifers_500600_r_avg3	3,500	137.4	24.57	98.51	200.8
f_heifers_500600_r_avg5	3,500	137.2	21.48	102.8	181.7
lag_1_f_heifers_600700_r	3,500	131.1	25.07	85.00	204.3
lag_2_f_heifers_600700_r	3,500	131.3	25.07	85.00	204.3
lag_3_f_heifers_600700_r	3,500	131.3	25.07	85.00	204.3
lag_4_f_heifers_600700_r	3,500	131.5	25.16	85.00	204.3
lag_5_f_heifers_600700_r	3,500	131.6	25.23	85.00	204.3
f_heifers_600700_r_avgpre3	3,500	131.2	22.18	98.10	185.8
f_heifers_600700_r_avgpre5	3,500	131.3	19.73	100.4	170.4
f_heifers_600700_r_avg3	3,500	131.0	22.18	98.10	185.8
f_heifers_600700_r_avg5	3,500	131.2	19.68	100.4	170.4
lag_1_f_heifers_700800_r	3,500	127.0	23.55	86.48	193.6
lag_2_f_heifers_700800_r	3,500	127.3	23.57	86.48	193.6
lag_3_f_heifers_700800_r	3,500	127.4	23.59	86.48	193.6
lag_4_f_heifers_700800_r	3,500	127.8	23.76	86.48	193.6
lag_5_f_heifers_700800_r	3,500	128.4	24.19	86.48	193.6
f_heifers_700800_r_avgpre3	3,500	127.3	20.66	97.03	176.2
f_heifers_700800_r_avgpre5	3,500	127.6	18.51	98.90	161.5
f_heifers_700800_r_avg3	3,500	127.0	20.65	97.03	176.2
f_heifers_700800_r_avg5	3,500	127.2	18.40	98.90	161.5
lag_1_ks_corn_price_r	3,500	3.960	1.067	2.512	7.268
lag_2_ks_corn_price_r	3,500	4.046	1.130	2.512	7.268
lag_3_ks_corn_price_r	3,500	4.170	1.280	2.512	7.734
lag_4_ks_corn_price_r	3,500	4.270	1.332	2.512	7.734
lag_5_ks_corn_price_r	3,500	4.372	1.379	2.512	7.734
ks_corn_price_r_avgpre3	3,500	4.059	0.983	2.682	6.425
ks_corn_price_r_avgpre5	3,500	4.164	0.942	2.833	6.532
ks_corn_price_r_avg3	3,500	3.977	0.898	2.682	6.422
ks_corn_price_r_avg5	3,500	4.074	0.858	2.833	5.878
lag_1_ks_wheat_price_r	3,500	5.267	1.364	3.160	7.722
lag_2_ks_wheat_price_r	3,500	5.375	1.392	3.160	7.722
lag_3_ks_wheat_price_r	3,500	5.474	1.457	3.160	8.091
lag_4_ks_wheat_price_r	3,500	5.601	1.510	3.160	8.375
lag_5_ks_wheat_price_r	3,500	5.790	1.606	3.201	9.801
ks_wheat_price_r_avgpre3	3,500	5.372	1.150	3.483	7.414
ks_wheat_price_r_avgpre5	3,500	5.501	1.045	3.724	8.029
ks_wheat_price_r_avg3	3,500	5.283	1.116	3.483	7.414

VARIABLES	N	Mean	SD	Min	Max
ks_wheat_price_r_avg5	3,500	5.384	0.983	3.724	7.042
lag_1_ks_calfcrop	3,500	1.427e+06	69,815	1.260e+06	1.550e+06
lag_2_ks_calfcrop	3,500	1.431e+06	74,062	1.260e+06	1.575e+06
lag_3_ks_calfcrop	3,500	1.434e+06	79,094	1.260e+06	1.610e+06
lag_4_ks_calfcrop	3,500	1.437e+06	81,220	1.260e+06	1.610e+06
lag_5_ks_calfcrop	3,500	1.446e+06	98,181	1.260e+06	1.770e+06
ks_calfcrop_avgpre3	3,500	1.431e+06	65,738	1.273e+06	1.562e+06
ks_calfcrop_avgpre5	3,500	1.435e+06	64,664	1.316e+06	1.600e+06
ks_calfcrop_avg3	3,500	1.428e+06	62,257	1.273e+06	1.527e+06
ks_calfcrop_avg5	3,500	1.431e+06	58,440	1.316e+06	1.547e+06
lag_1_ks_cattleonfeed_jan1	3,500	2.152e+06	362,532	1.395e+06	2.630e+06
lag_2_ks_cattleonfeed_jan1	3,500	2.120e+06	384,705	1.320e+06	2.630e+06
lag_3_ks_cattleonfeed_jan1	3,500	2.088e+06	402,681	1.320e+06	2.630e+06
lag_4_ks_cattleonfeed_jan1	3,500	2.054e+06	432,490	1.110e+06	2.630e+06
lag_5_ks_cattleonfeed_jan1	3,500	2.022e+06	459,489	1.100e+06	2.630e+06
ks_cattleonfeed_jan1_avgpre3	3,500	2.120e+06	375,181	1.390e+06	2.600e+06
ks_cattleonfeed_jan1_avgpre5	3,500	2.087e+06	396,383	1.276e+06	2.548e+06
ks_cattleonfeed_jan1_avg3	3,500	2.151e+06	358,309	1.422e+06	2.600e+06
ks_cattleonfeed_jan1_avg5	3,500	2.119e+06	374,227	1.342e+06	2.548e+06
decade_1985_1993	3,500	0.229	0.420	0	1
decade_1994_2002	3,500	0.257	0.437	0	1
decade_2003_2011	3,500	0.257	0.437	0	1
decade_2012_2020	3,500	0.257	0.437	0	1
ops_under_35	3,500	0.0979	0.0446	0.00475	0.256
share_ops_occupation_farming	3,500	0.576	0.113	0.275	0.882
share_ops_occupation_other	3,500	0.424	0.113	0.118	0.725
share_pastureland	3,500	0.374	0.166	0.0214	0.883
share_cropland	3,500	0.634	0.161	0.128	0.984
share_irr_acres	3,500	0.0541	0.0819	0	0.527
share_female_acres	3,500	0.0761	0.0896	0.00406	0.859
share_full_owner_acres	3,500	0.218	0.0729	0	0.562
share_part_owner_owned_acres	3,500	0.265	0.0456	0.0411	0.556
share_part_owner_rented_acres	3,500	0.408	0.0569	0.233	0.630
share_part_owner_total_acres	3,500	0.673	0.0748	0.363	0.923
share_tenants_acres	3,500	0.109	0.0577	0	0.416

Appendix B

Transfer Validity Codes

Table B.1: Transfer Validity Codes

Code	Meaning	Classification	Reason for Drop/Unclassified	N	Mean	Min	Max
0	Valid sale	Arm's length		60,480	116.15	5.00	850.10
0.0	Valid sale	Arm's length		677	56.38	5.00	639.00
1	Involved multiple parcels	Arm's length		91,240	150.07	5.00	1634.73
1-3	Unknown	Dropped	Unknown	13	9.22	5.10	22.47
1-I	Unknown	Dropped	Unknown	653	48.75	5.00	163.77
1-V	Unknown	Dropped	Unknown	301	44.24	5.00	635.27

Code	Meaning	Classification	Reason for Drop/Unclassified	N	Mean	Min	Max
1.0	Involved multiple parcels	Arm's length		685	73.93	5.00	639.00
10	Unknown	Dropped	Unknown	529	148.49	5.12	644.34
10.0	Unknown	Dropped	Unknown	5	37.12	6.40	79.00
11	SVQ exempt (void)	Dropped	Void	74	101.53	6.84	307.30
12	Refinance	Arm's length		9	83.90	9.03	308.37
13	Partial interest	Arm's length		2,688	150.51	5.10	756.00
13.0	Partial interest	Arm's length		17	68.01	5.60	316.60
14	Other see comments	Dropped	Unclear due to comments	2,257	106.96	5.00	791.50
14.0	Other see comments	Dropped	Unclear due to comments	46	66.12	5.20	599.10
15	Immediate family sale	Non-arm's length		9,520	111.08	5.00	1258.70
15.0	Immediate family sale	Non-arm's length		68	64.25	6.10	233.10
15V	Unknown	Dropped	Unknown	3	79.43	39.50	158.60
16	Foreclosure or repossession	Non-arm's length		401	48.12	5.00	654.90
16.0	Foreclosure or repossession	Non-arm's length		27	25.45	5.60	88.20
16M	Unknown	Dropped	Unknown	5	19.62	8.03	58.83
18	Absolute auction (Few people there)	Non-arm's length		1,663	134.81	5.10	656.20
18.0	Absolute auction (Few people there)	Non-arm's length		1	39.00	39.00	39.00

Code	Meaning	Classification	Reason for Drop/Unclassified	N	Mean	Min	Max
18V	Unknown	Dropped	Unknown	2	123.15	84.30	162.00
19	Judicial order	Unclassified	Unclear sale situation	340	100.00	5.24	618.15
1N	Unknown	Dropped	Unknown	144	28.91	5.25	150.76
1V	Unknown	Dropped	Unknown	105	32.39	5.01	236.50
2	Not open market	Non-arm's length		45,255	113.37	5.00	1473.42
2.0	Not open market	Non-arm's length		346	54.35	5.00	265.00
20	Owns adjacent property	Unclassified	Unclear sale situation	1,094	96.69	5.00	720.60
20V	Unknown	Dropped	Unknown	1	79.90	79.90	79.90
21	Not open multiple parcels	Non-arm's length		106	110.55	5.00	399.15
21.0	Not open multiple parcels	Non-arm's length		1	14.40	14.40	14.40
22	Unknown	Dropped	Unknown	51	114.50	5.30	496.70
23	Unknown	Dropped	Unknown	11	48.07	12.35	161.10
24	Not open corporate	Non-arm's length		18	22.60	5.24	42.28
25	Unknown	Dropped	Unknown	22	77.99	9.32	318.38
26	Not open corporate	Non-arm's length		18	30.55	5.05	157.94
27	Not open construction	Unclassified	Unclear sale situation	45	51.13	5.16	158.19
28	Unknown	Dropped	Unknown	4	43.48	19.01	75.83

Code	Meaning	Classification	Reason for Drop/Unclassified	N	Mean	Min	Max
2V	Unknown	Dropped	Unknown	2	118.50	79.30	157.70
3	Change after sale	Arm's length		41,658	92.06	5.00	886.86
3.0	Change after sale	Arm's length		1,655	43.27	5.00	479.60
30	Unknown	Dropped	Unknown	45	182.55	6.77	220.42
31	Unknown	Dropped	Unknown	8	193.71	6.77	220.42
4	Corporate affiliates	Arm's length		26,389	127.67	5.00	685.00
4.0	Corporate affiliates	Arm's length		294	55.35	5.00	316.80
42007	Unknown	Dropped	Unknown	7	27.30	7.70	63.65
5	Liquidation or forced sale (repo)	Non-arm's length		5,222	133.04	5.00	663.40
5.0	Liquidation or forced sale (repo)	Non-arm's length		331	57.48	5.60	320.00
5A	Unknown	Dropped	Unknown	2	14.63	5.73	23.53
6	Financing/land contract	Unclassified	Unclear sale situation	7,465	113.75	5.00	673.73
6.0	Financing/land contract	Unclassified	Unclear sale situation	120	65.06	5.50	320.00
7	Construction cost only	Unclassified	Unclear sale situation	535	72.38	5.05	631.50
7.0	Construction cost only	Unclassified	Unclear sale situation	8	28.88	5.20	78.00
8	Excessive personal property	Non-arm's length		16,069	132.38	5.00	791.50
8.0	Excessive personal property	Non-arm's length		249	66.14	5.50	586.30

Code	Meaning	Classification	Reason for Drop/Unclassified	N	Mean	Min	Max
9	Not verified	Dropped	Unverified sale	3,283	112.50	5.00	675.80
9.0	Not verified	Dropped	Unverified sale	164	62.37	5.00	318.00
A	Unknown	Dropped	Unknown	492	86.56	5.06	381.89
AS	Unknown	Dropped	Unknown	1	7.75	7.75	7.75
BS	Unknown	Dropped	Unknown	6	18.18	7.00	33.60
C	Unknown	Dropped	Unknown	11	183.85	8.88	658.40
E	Unknown	Dropped	Unknown	2	239.80	159.30	320.30
F	Unknown	Dropped	Unknown	758	23.67	5.06	552.00
F3	Unknown	Dropped	Unknown	14	46.71	5.38	154.16
FM	Unknown	Dropped	Unknown	2	7.44	6.90	7.97
FM2	Unknown	Dropped	Unknown	1	15.56	15.56	15.56
H	Unknown	Dropped	Unknown	86	35.53	5.08	170.24
M	Unknown	Dropped	Unknown	117	109.27	6.02	478.18
MM	Unknown	Dropped	Unknown	3	36.90	9.70	61.60
N	Unknown	Dropped	Unknown	4	26.15	9.09	62.26
NA	Unknown	Dropped	Unknown	804	116.47	5.00	645.40
NC	Unknown	Dropped	Unknown	2	234.30	234.30	234.30

Code	Meaning	Classification	Reason for Drop/Unclassified	N	Mean	Min	Max
P	Unknown	Dropped	Unknown	2	119.99	81.38	158.60
S	Unknown	Dropped	Unknown	347	117.93	5.15	643.70
SP	Unknown	Dropped	Unknown	1	80.70	80.70	80.70
V	Unknown	Dropped	Unknown	53	57.79	6.08	327.00
V2	Unknown	Dropped	Unknown	22	63.15	8.54	152.19
V3	Unknown	Dropped	Unknown	3	30.05	6.93	74.51
VM	Unknown	Dropped	Unknown	18	60.78	5.66	156.66
X3	Unknown	Dropped	Unknown	163	58.51	5.15	640.67

Appendix C

Variable Selection Penalty Terms

Table C.1: *Selected Penalty Terms by Specification*

Dependent variable	Model	Selection method	Selection criterion	alpha	lambda	No. of selected variables	MSE	R-squared	rseed()
total_ag_turnover	linear (1)	cv	CV min.		0.005	68	0.907	0.299	1863
total_ag_turnover	linear (2)	adaptive	CV min.		0.010	49	0.907	0.299	1863
total_ag_turnover	sq linear (3)	cv	CV min.		0.517	68	0.905	0.301	1863
total_ag_turnover	linear (4)	cv	CV min.	0.750	0.007	69	0.908	0.299	1863

Appendix D

OLS Regression Results

Table D.1: Full OLS Primary Model Results

VARIABLES	(1) total_ag_turnover	(2) arms_ag_turnover	(3) nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00126	0.00272*	-0.00122*
	(0.00140)	(0.00142)	(0.000624)
ks_corn_price_r	0.0880**	0.00935	0.0723***
	(0.0343)	(0.0305)	(0.0123)
s_ks_steers_r	-0.00261	-0.00159	-0.000950
	(0.00303)	(0.00253)	(0.00107)
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	-0.000184	-3.21e-05	-0.000176*
	(0.000146)	(7.76e-05)	(8.88e-05)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
treasury_yld_7yr	0.331***	0.272***	0.0533***
	(0.0314)	(0.0299)	(0.0115)
Demographics			
population	4.28e-06	5.99e-07	4.82e-06
	(5.12e-06)	(2.81e-06)	(3.08e-06)
ops_avg_age	0.165***	0.128***	0.0242
	(0.0383)	(0.0420)	(0.0153)
ops_over_65	-2.763*	-2.731**	0.225
	(1.396)	(1.325)	(0.654)
yrs_on_present_farm_avg	-0.100***	-0.0485*	-0.0475***
	(0.0270)	(0.0246)	(0.0143)
Controls			
full_owner_farms	-0.00106**	-0.000655	-0.000537*
	(0.000527)	(0.000471)	(0.000298)
part_owner_owned_acres	-4.11e-06***	-2.51e-06**	-1.42e-06
	(1.37e-06)	(1.19e-06)	(8.58e-07)
part_owner_total_farms	0.00348***	0.00249***	0.000995**
	(0.000859)	(0.000840)	(0.000413)
tenants_farms	-0.00256	-0.00294	0.000165
	(0.00200)	(0.00195)	(0.000969)
woodland	2.21e-05***	1.93e-05***	4.53e-06
	(8.09e-06)	(7.10e-06)	(4.79e-06)
ops_25_34	1.602	1.467	-0.0793

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(1.488)	(1.470)	(0.629)
ops_55_64	-2.428**	-1.675**	-0.346
	(0.990)	(0.759)	(0.414)
ops_occupation_other	-0.000737*	-0.000702*	2.40e-05
	(0.000417)	(0.000376)	(0.000228)
yrs_on_present_farm_0_2	2.199	0.151	1.900**
	(1.484)	(1.503)	(0.933)
yrs_on_present_farm_3_4	1.743	2.180	-0.0958
	(1.777)	(1.932)	(0.632)
equine_inventory	-8.87e-05	-0.000112*	3.20e-05
	(5.68e-05)	(6.42e-05)	(2.42e-05)
ks_calfcrop	-2.36e-06***	-1.34e-06***	-8.91e-07***
	(4.40e-07)	(3.83e-07)	(2.21e-07)
ks_cattleonfeed_jan1	1.22e-06***	1.07e-06***	1.76e-07**
	(2.22e-07)	(1.93e-07)	(6.80e-08)
ks_wheat_price_r	-0.0669**	-0.0149	-0.0487***
	(0.0260)	(0.0220)	(0.00976)
nonfarm_proprtors_inc_1000000_r	0.000644*	8.59e-05	0.000571***
	(0.000332)	(0.000174)	(0.000205)
lag_5_f_steers_400500_r	-0.00123	-0.000443	-0.000760*
	(0.000853)	(0.000784)	(0.000407)
lag_2_f_steers_500600_r	-0.00634***	-0.00458***	-0.00138***
	(0.00149)	(0.00137)	(0.000411)
lag_3_f_steers_600700_r	-0.00797***	-0.00717***	-0.000713
	(0.00166)	(0.00154)	(0.000611)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
lag_4_f_heifers_600700_r	-0.00562***	-0.00439***	-0.000992
	(0.00193)	(0.00161)	(0.000729)
lag_1_ks_corn_price_r	0.0866***	0.0621**	0.0238**
	(0.0303)	(0.0281)	(0.0105)
lag_3_ks_corn_price_r	-0.0269	-0.0117	-0.0155*
	(0.0224)	(0.0209)	(0.00862)
lag_1_ks_calfcrop	1.63e-06***	1.36e-06***	2.77e-07
	(5.35e-07)	(4.88e-07)	(2.24e-07)
lag_3_ks_calfcrop	-1.88e-06***	-1.74e-06***	-1.01e-07
	(4.78e-07)	(3.90e-07)	(2.02e-07)
lag_4_ks_calfcrop	-4.65e-06***	-3.40e-06***	-1.09e-06***
	(5.92e-07)	(4.94e-07)	(2.48e-07)
share_pastureland	1.398***	1.597***	-0.246*
	(0.193)	(0.181)	(0.137)
share_full_owner_acres	1.343**	1.667**	-0.120
	(0.648)	(0.708)	(0.348)
share_part_owner_owned_acres	1.284	0.599	0.791
	(1.347)	(1.071)	(0.753)
share_tenants_acres	-0.0446	1.098	-0.800**
	(1.070)	(1.121)	(0.336)
decade_1994_2002	-0.611***	-0.534***	-0.0871*
	(0.116)	(0.109)	(0.0518)
decade_2003_2011	0.221*	0.142	0.0671
	(0.127)	(0.137)	(0.0547)
decade_2012_2020	0.900***	0.572***	0.296***

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.186)	(0.194)	(0.0844)
i.agdistrict_grouped			
2.agdistrict_grouped	0.100	0.0723	-0.00530
	(0.137)	(0.133)	(0.0696)
3.agdistrict_grouped	0.216**	0.0839	0.0983
	(0.104)	(0.0978)	(0.0626)
4.agdistrict_grouped	0.0582	-0.0639	0.0616
	(0.124)	(0.125)	(0.0807)
5.agdistrict_grouped	0.554***	0.452***	0.0871
	(0.130)	(0.113)	(0.0768)
6.agdistrict_grouped	0.128	0.165*	-0.0360
	(0.101)	(0.0934)	(0.0629)
7.agdistrict_grouped	0.335***	0.332***	-0.00586
	(0.125)	(0.126)	(0.0706)
8.agdistrict_grouped	0.327**	0.350***	-0.0231
	(0.137)	(0.133)	(0.0685)
9.agdistrict_grouped	0.305**	0.104	0.202**
	(0.139)	(0.129)	(0.0808)
Constant	4.854*	1.687	2.860***
	(2.661)	(2.773)	(1.015)
Observations	3,495	3,491	3,464
R-squared	0.302	0.280	0.189

Robust standard errors, clustered by county, in parentheses.

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover

*** p<0.01, ** p<0.05, * p<0.1

Table D.2: Full OLS Year FE Model Results

	(1)	(2)	(3)
VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00158	0.00314**	-0.00126*
	(0.00145)	(0.00146)	(0.000671)
ks_corn_price_r			
s_ks_steers_r			
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	-0.000185	-2.97e-05	-0.000182*
	(0.000145)	(7.61e-05)	(9.21e-05)
treasury_yld_7yr			
Demographics			
population	4.38e-06	5.69e-07	5.07e-06
	(5.11e-06)	(2.78e-06)	(3.21e-06)
ops_avg_age	0.147***	0.114**	0.0187
	(0.0416)	(0.0451)	(0.0161)
ops_over_65	-1.655	-1.713	0.357
	(1.493)	(1.372)	(0.737)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
yrs_on_present_farm_avg	-0.102***	-0.0507**	-0.0459***
	(0.0281)	(0.0249)	(0.0148)
Controls			
full_owner_farms	-0.00125**	-0.000803*	-0.000588*
	(0.000538)	(0.000480)	(0.000305)
part_owner_owned_acres	-3.87e-06***	-2.28e-06*	-1.43e-06*
	(1.38e-06)	(1.21e-06)	(8.55e-07)
part_owner_total_farms	0.00335***	0.00237***	0.000975**
	(0.000871)	(0.000860)	(0.000415)
tenants_farms	-0.00284	-0.00327*	0.000214
	(0.00202)	(0.00196)	(0.000971)
woodland	2.29e-05***	1.99e-05***	4.79e-06
	(8.22e-06)	(7.19e-06)	(4.89e-06)
ops_25_34	1.703	1.681	-0.213
	(1.534)	(1.522)	(0.655)
ops_55_64	-1.632	-0.834	-0.382
	(1.056)	(0.827)	(0.489)
ops_occupation_other	-0.000431	-0.000435	8.45e-05
	(0.000437)	(0.000400)	(0.000238)
yrs_on_present_farm_0_2	2.317	0.210	1.974**
	(1.460)	(1.466)	(0.944)
yrs_on_present_farm_3_4	1.845	2.251	-0.0819
	(1.784)	(1.944)	(0.635)
equine_inventory	-0.000102*	-0.000124*	3.04e-05

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(5.56e-05)	(6.28e-05)	(2.46e-05)
nonfarm_proprtors_inc_1000000_r	0.000633*	7.43e-05	0.000576***
	(0.000329)	(0.000167)	(0.000209)
share_pastureland	1.348***	1.546***	-0.241*
	(0.198)	(0.182)	(0.140)
share_full_owner_acres	1.270*	1.604**	-0.137
	(0.656)	(0.720)	(0.356)
share_part_owner_owned_acres	1.223	0.537	0.795
	(1.344)	(1.079)	(0.753)
share_tenants_acres	-0.0123	1.125	-0.794**
	(1.073)	(1.122)	(0.336)
i.agdistrict_grouped			
i.year			
2.agdistrict_grouped	0.105	0.0767	-0.00566
	(0.137)	(0.133)	(0.0702)
3.agdistrict_grouped	0.227**	0.0969	0.0963
	(0.104)	(0.0971)	(0.0626)
4.agdistrict_grouped	0.0762	-0.0454	0.0603
	(0.125)	(0.124)	(0.0816)
5.agdistrict_grouped	0.549***	0.447***	0.0885
	(0.131)	(0.111)	(0.0772)
6.agdistrict_grouped	0.118	0.155*	-0.0362
	(0.101)	(0.0918)	(0.0634)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
7.agdistrict_grouped	0.342***	0.338***	-0.00431
	(0.125)	(0.124)	(0.0712)
8.agdistrict_grouped	0.311**	0.332**	-0.0209
	(0.137)	(0.132)	(0.0689)
9.agdistrict_grouped	0.295**	0.0938	0.203**
	(0.139)	(0.129)	(0.0809)
1987.year	0.328***	0.179***	0.125***
	(0.0744)	(0.0641)	(0.0332)
1988.year	0.788***	0.545***	0.197***
	(0.0873)	(0.0757)	(0.0385)
1989.year	1.252***	0.920***	0.295***
	(0.113)	(0.102)	(0.0516)
1990.year	1.262***	0.821***	0.404***
	(0.124)	(0.114)	(0.0616)
1991.year	1.346***	0.928***	0.382***
	(0.138)	(0.115)	(0.0742)
1992.year	1.430***	1.027***	0.366***
	(0.188)	(0.165)	(0.0807)
1993.year	1.284***	0.949***	0.306***
	(0.177)	(0.143)	(0.0859)
1994.year	1.453***	1.079***	0.324***
	(0.156)	(0.112)	(0.0867)
1995.year	1.397***	1.038***	0.319***
	(0.169)	(0.133)	(0.0839)
1996.year	1.704***	1.281***	0.368***

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.188)	(0.147)	(0.0903)
1997.year	1.788***	1.337***	0.379***
	(0.185)	(0.137)	(0.0943)
1998.year	1.812***	1.359***	0.395***
	(0.185)	(0.137)	(0.0938)
1999.year	1.524***	1.121***	0.355***
	(0.198)	(0.154)	(0.0944)
2000.year	1.624***	1.201***	0.391***
	(0.185)	(0.143)	(0.0929)
2001.year	1.471***	1.091***	0.346***
	(0.189)	(0.154)	(0.0969)
2002.year	1.374***	1.003***	0.359***
	(0.208)	(0.158)	(0.114)
2003.year	1.355***	1.023***	0.314***
	(0.199)	(0.155)	(0.103)
2004.year	1.731***	1.345***	0.379***
	(0.227)	(0.183)	(0.0978)
2005.year	1.595***	1.216***	0.367***
	(0.223)	(0.183)	(0.104)
2006.year	1.635***	1.276***	0.349***
	(0.229)	(0.191)	(0.0961)
2007.year	1.473***	1.124***	0.355***
	(0.232)	(0.197)	(0.101)
2008.year	1.367***	1.012***	0.348***
	(0.209)	(0.190)	(0.0966)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
2009.year	0.883***	0.546***	0.330***
	(0.186)	(0.165)	(0.0927)
2010.year	1.286***	0.819***	0.434***
	(0.188)	(0.170)	(0.0895)
2011.year	1.047***	0.569***	0.449***
	(0.186)	(0.181)	(0.0867)
2012.year	2.624***	1.657***	0.890***
	(0.256)	(0.225)	(0.111)
2013.year	1.843***	1.099***	0.673***
	(0.223)	(0.233)	(0.0999)
2014.year	1.027***	0.542**	0.439***
	(0.226)	(0.210)	(0.0941)
2015.year	0.990***	0.525***	0.421***
	(0.198)	(0.199)	(0.0911)
2016.year	1.089***	0.613***	0.450***
	(0.233)	(0.231)	(0.0927)
2017.year	0.990***	0.498**	0.472***
	(0.247)	(0.202)	(0.136)
2018.year	1.207***	0.688***	0.500***
	(0.234)	(0.226)	(0.118)
2019.year	1.279***	0.716***	0.542***
	(0.242)	(0.245)	(0.112)
2020.year	0.394*	0.148	0.248**
	(0.215)	(0.217)	(0.108)
Constant	-5.158**	-5.015**	0.228

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(2.023)	(2.190)	(0.778)
Observations	3,495	3,491	3,464
R-squared	0.311	0.288	0.195

Robust standard errors, clustered by county, in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table D.3: Full OLS County FE Model Results

	(1)	(2)	(3)
VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00140	0.00240**	-0.000939*
	(0.000982)	(0.00104)	(0.000554)
ks_corn_price_r	0.0887***	0.0139	0.0684***
	(0.0336)	(0.0307)	(0.0124)
s_ks_steers_r	-0.00248	-0.00161	-0.000717
	(0.00311)	(0.00258)	(0.00110)
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	2.51e-05	1.80e-05	-2.08e-05
	(0.000171)	(0.000142)	(0.000103)
treasury_yld_7yr	0.311***	0.248***	0.0576***
	(0.0321)	(0.0311)	(0.0126)
Demographics			
population	-6.12e-06	-2.55e-06	-3.09e-06
	(1.54e-05)	(1.23e-05)	(8.16e-06)
ops_avg_age	0.152***	0.116**	0.0270
	(0.0440)	(0.0458)	(0.0213)
ops_over_65	-3.888***	-3.690***	0.0259
	(1.389)	(1.380)	(0.640)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
yrs_on_present_farm_avg	-0.0231	0.0193	-0.0451***
	(0.0278)	(0.0289)	(0.0108)
Controls			
full_owner_farms	0.000478	0.00101	-0.000718
	(0.000761)	(0.000752)	(0.000457)
part_owner_owned_acres	-1.56e-05***	-9.95e-06***	-5.96e-06***
	(2.49e-06)	(2.81e-06)	(1.77e-06)
part_owner_total_farms	0.00392***	0.00356***	0.000818
	(0.00143)	(0.00123)	(0.000650)
tenants_farms	0.000307	-5.16e-05	-0.000124
	(0.00191)	(0.00180)	(0.00117)
woodland	6.38e-06	-9.89e-07	7.33e-06
	(1.21e-05)	(1.33e-05)	(6.40e-06)
ops_25_34	1.596	1.080	-0.0745
	(1.300)	(1.327)	(0.613)
ops_55_64	-3.287***	-2.429***	-0.394
	(0.979)	(0.806)	(0.396)
ops_occupation_other	-0.000771*	-0.000896**	0.000271
	(0.000427)	(0.000437)	(0.000267)
yrs_on_present_farm_0_2	0.890	-0.120	0.908
	(1.609)	(1.742)	(0.776)
yrs_on_present_farm_3_4	2.156	2.537	-0.0918
	(1.680)	(1.723)	(0.691)
equine_inventory	-0.000159**	-0.000195***	4.84e-05

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(6.94e-05)	(5.39e-05)	(2.94e-05)
ks_calfcrop	-2.12e-06***	-1.13e-06***	-8.67e-07***
	(4.48e-07)	(3.88e-07)	(2.33e-07)
ks_cattleonfeed_jan1	1.14e-06***	1.00e-06***	1.57e-07**
	(2.19e-07)	(1.90e-07)	(6.87e-08)
ks_wheat_price_r	-0.0659**	-0.0153	-0.0478***
	(0.0264)	(0.0226)	(0.0102)
nonfarm_proprtors_inc_1000000_r	0.000441	8.86e-05	0.000381*
	(0.000282)	(0.000138)	(0.000213)
lag_5_f_steers_400500_r	-0.00156*	-0.000733	-0.000767*
	(0.000918)	(0.000878)	(0.000423)
lag_2_f_steers_500600_r	-0.00618***	-0.00438***	-0.00150***
	(0.00153)	(0.00144)	(0.000435)
lag_3_f_steers_600700_r	-0.00762***	-0.00669***	-0.000862
	(0.00168)	(0.00156)	(0.000645)
lag_4_f_heifers_600700_r	-0.00529***	-0.00399**	-0.00120*
	(0.00185)	(0.00162)	(0.000714)
lag_1_ks_corn_price_r	0.0751**	0.0497*	0.0249**
	(0.0318)	(0.0292)	(0.0118)
lag_3_ks_corn_price_r	-0.0380	-0.0243	-0.0155
	(0.0233)	(0.0224)	(0.00949)
lag_1_ks_calfcrop	1.61e-06***	1.24e-06**	3.72e-07*
	(5.11e-07)	(4.83e-07)	(2.22e-07)
lag_3_ks_calfcrop	-1.69e-06***	-1.49e-06***	-1.76e-07
	(4.97e-07)	(4.11e-07)	(2.09e-07)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
lag_4_ks_calfcrop	-4.41e-06***	-3.09e-06***	-1.17e-06***
	(5.72e-07)	(5.09e-07)	(2.26e-07)
share_pastureland	0.395	1.147	-0.799**
	(0.894)	(0.785)	(0.352)
share_full_owner_acres	1.312	1.321	0.0615
	(0.860)	(0.855)	(0.463)
share_part_owner_owned_acres	6.838***	4.334***	2.790***
	(1.351)	(1.325)	(1.021)
share_tenants_acres	0.166	0.767	-0.442
	(0.979)	(0.907)	(0.397)
decade_1994_2002	-0.642***	-0.536***	-0.121**
	(0.118)	(0.114)	(0.0558)
decade_2003_2011	0.186	0.149	0.0165
	(0.138)	(0.149)	(0.0626)
decade_2012_2020	0.941***	0.672***	0.223***
	(0.204)	(0.218)	(0.0830)
i.fips			
20003.fips	0.416**	0.388**	0.0492
	(0.165)	(0.173)	(0.0892)
20005.fips	-0.733***	-0.467**	-0.198**
	(0.189)	(0.181)	(0.0872)
20007.fips	1.864***	1.312***	0.689***
	(0.305)	(0.343)	(0.207)
20009.fips	0.430	0.179	0.308

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.367)	(0.360)	(0.195)
20011.fips	1.182***	1.363***	-0.0891
	(0.273)	(0.265)	(0.115)
20013.fips	-0.0857	-0.138	0.101
	(0.299)	(0.272)	(0.0969)
20015.fips	1.926***	1.287**	0.678*
	(0.591)	(0.512)	(0.391)
20017.fips	1.446***	1.441***	0.126
	(0.363)	(0.342)	(0.185)
20019.fips	2.116***	1.836***	0.398**
	(0.426)	(0.374)	(0.193)
20021.fips	0.218	0.324*	-0.0463
	(0.210)	(0.189)	(0.0948)
20023.fips	1.223***	0.964**	0.355**
	(0.348)	(0.380)	(0.168)
20025.fips	1.641***	1.458***	0.166
	(0.325)	(0.351)	(0.205)
20027.fips	0.281	0.0765	0.252***
	(0.199)	(0.200)	(0.0688)
20029.fips	0.543***	0.328*	0.281***
	(0.201)	(0.196)	(0.0737)
20031.fips	0.00150	0.0715	-0.141**
	(0.0904)	(0.107)	(0.0564)
20033.fips	0.964***	0.871***	0.249
	(0.315)	(0.324)	(0.186)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20035.fips	1.273***	0.769**	0.558**
	(0.350)	(0.331)	(0.258)
20037.fips	0.313	0.505**	-0.141
	(0.263)	(0.212)	(0.152)
20039.fips	1.161***	1.081***	0.219
	(0.303)	(0.321)	(0.138)
20041.fips	0.186	-0.225	0.421***
	(0.273)	(0.279)	(0.134)
20043.fips	-0.464	-0.116	-0.277**
	(0.312)	(0.296)	(0.126)
20045.fips	0.0151	0.0271	0.0454
	(0.907)	(0.680)	(0.460)
20047.fips	0.662**	0.798**	0.000200
	(0.329)	(0.325)	(0.127)
20049.fips	1.348***	1.334***	0.143
	(0.361)	(0.318)	(0.164)
20051.fips	0.270	0.221	0.183
	(0.247)	(0.263)	(0.181)
20053.fips	0.247	0.418*	-0.0702
	(0.201)	(0.220)	(0.103)
20055.fips	1.622***	1.378***	0.411
	(0.526)	(0.483)	(0.301)
20057.fips	1.108**	0.825**	0.385
	(0.429)	(0.394)	(0.240)
20061.fips	0.299	0.580**	-0.250**

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.305)	(0.276)	(0.121)
20063.fips	1.591***	1.086**	0.654***
	(0.405)	(0.436)	(0.190)
20065.fips	1.257***	1.233***	0.186
	(0.271)	(0.292)	(0.133)
20067.fips	0.764*	1.241***	-0.333**
	(0.386)	(0.370)	(0.149)
20069.fips	1.019**	1.053**	0.0700
	(0.441)	(0.433)	(0.152)
20071.fips	0.916*	0.759	0.333*
	(0.481)	(0.463)	(0.182)
20073.fips	2.193***	1.641***	0.600**
	(0.404)	(0.405)	(0.256)
20075.fips	1.767***	1.372***	0.600***
	(0.392)	(0.399)	(0.171)
20077.fips	0.665**	0.810***	-0.113
	(0.254)	(0.271)	(0.112)
20079.fips	-0.210	-0.231	0.0159
	(0.335)	(0.278)	(0.150)
20081.fips	0.800*	1.133**	-0.185
	(0.450)	(0.434)	(0.162)
20083.fips	0.839**	0.768**	0.186
	(0.334)	(0.347)	(0.145)
20085.fips	0.106	-0.142	0.155
	(0.283)	(0.264)	(0.112)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20087.fips	0.103	0.174	-0.212*
	(0.266)	(0.272)	(0.126)
20089.fips	0.802***	0.464	0.178*
	(0.277)	(0.280)	(0.105)
20093.fips	1.446***	1.349***	0.258
	(0.383)	(0.400)	(0.175)
20095.fips	0.477*	0.200	0.332**
	(0.246)	(0.277)	(0.128)
20097.fips	0.834***	0.828***	0.134
	(0.248)	(0.280)	(0.137)
20099.fips	0.124	-0.121	0.220**
	(0.191)	(0.180)	(0.102)
20101.fips	0.702**	0.439	0.380***
	(0.346)	(0.347)	(0.140)
20103.fips	-0.298	-0.133	-0.101
	(0.663)	(0.551)	(0.327)
20105.fips	0.924***	0.789***	0.167
	(0.229)	(0.237)	(0.105)
20109.fips	1.899***	1.600***	0.406**
	(0.385)	(0.422)	(0.204)
20111.fips	0.795***	0.471*	0.406*
	(0.284)	(0.255)	(0.206)
20113.fips	-0.0429	-0.256	0.188
	(0.430)	(0.426)	(0.228)
20115.fips	0.463	0.0876	0.320*

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.336)	(0.359)	(0.170)
20117.fips	0.231	-0.0373	0.368***
	(0.322)	(0.324)	(0.132)
20119.fips	1.028***	0.889**	0.248
	(0.331)	(0.365)	(0.168)
20121.fips	0.170	0.174	0.00140
	(0.463)	(0.457)	(0.218)
20123.fips	0.401	0.511	-0.0249
	(0.319)	(0.316)	(0.113)
20125.fips	0.679**	0.635**	0.103
	(0.338)	(0.291)	(0.177)
20127.fips	0.335*	0.178	0.255**
	(0.195)	(0.197)	(0.111)
20129.fips	0.0306	0.196	-0.0132
	(0.338)	(0.362)	(0.164)
20131.fips	-0.245	-0.529*	0.346***
	(0.333)	(0.297)	(0.123)
20133.fips	0.116	0.322***	-0.113*
	(0.110)	(0.111)	(0.0616)
20135.fips	1.423***	0.748*	0.735***
	(0.374)	(0.416)	(0.191)
20137.fips	1.224***	0.889***	0.333**
	(0.302)	(0.322)	(0.143)
20139.fips	0.208	0.0217	0.0648
	(0.194)	(0.211)	(0.108)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20141.fips	0.731***	0.640**	0.150
	(0.264)	(0.284)	(0.131)
20143.fips	0.665***	0.274	0.384***
	(0.194)	(0.216)	(0.0966)
20145.fips	0.781**	0.875**	0.0157
	(0.354)	(0.354)	(0.138)
20147.fips	0.690**	0.374	0.443***
	(0.289)	(0.318)	(0.146)
20149.fips	0.580**	0.482**	0.0626
	(0.223)	(0.234)	(0.135)
20151.fips	0.446	0.433	0.106
	(0.303)	(0.304)	(0.127)
20153.fips	1.371***	1.080**	0.447**
	(0.375)	(0.413)	(0.187)
20157.fips	0.0225	-0.0469	0.156*
	(0.288)	(0.271)	(0.0856)
20159.fips	0.602*	0.565*	0.0555
	(0.311)	(0.304)	(0.124)
20161.fips	0.171	0.154	0.151
	(0.535)	(0.424)	(0.282)
20163.fips	1.248***	0.858**	0.532***
	(0.311)	(0.347)	(0.169)
20165.fips	0.200	0.373	-0.112
	(0.296)	(0.298)	(0.106)
20167.fips	0.974***	0.703***	0.382***

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.198)	(0.228)	(0.120)
20169.fips	0.0155	-0.213	0.291
	(0.380)	(0.283)	(0.229)
20171.fips	0.221	0.135	0.193
	(0.409)	(0.405)	(0.159)
20173.fips	0.649	0.0418	0.892
	(3.765)	(2.877)	(1.987)
20175.fips	0.292	0.533*	-0.0790
	(0.326)	(0.304)	(0.168)
20179.fips	1.491***	0.983**	0.560***
	(0.373)	(0.382)	(0.147)
20181.fips	1.718***	1.498***	0.358*
	(0.439)	(0.451)	(0.182)
20183.fips	1.024***	0.865**	0.239*
	(0.332)	(0.342)	(0.129)
20185.fips	0.545*	0.822**	-0.211*
	(0.317)	(0.316)	(0.115)
20187.fips	0.939**	1.389***	-0.284
	(0.467)	(0.453)	(0.175)
20189.fips	1.078***	1.303***	-0.0796
	(0.379)	(0.377)	(0.155)
20191.fips	0.796*	0.571	0.243
	(0.451)	(0.449)	(0.233)
20193.fips	1.452***	1.338***	0.230
	(0.491)	(0.496)	(0.208)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20195.fips	1.045***	0.606**	0.531***
	(0.266)	(0.288)	(0.131)
20197.fips	0.986***	0.712***	0.350**
	(0.252)	(0.245)	(0.136)
20199.fips	1.278***	1.321***	0.0935
	(0.313)	(0.342)	(0.147)
20201.fips	0.321	0.146	0.269**
	(0.266)	(0.280)	(0.111)
20203.fips	0.395	0.617	-0.0788
	(0.417)	(0.411)	(0.157)
20205.fips	0.159	0.233**	-0.0320
	(0.0964)	(0.0979)	(0.0479)
20207.fips	0.725***	0.941***	-0.190*
	(0.175)	(0.157)	(0.0965)
20209.fips	1.665	1.163	0.588
	(1.617)	(1.248)	(0.841)
Constant	2.794	-0.443	2.983**
	(2.922)	(2.915)	(1.169)
Observations	3,495	3,491	3,464
R-squared	0.363	0.348	0.301

Robust standard errors, clustered by county, in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table D.4: Full OLS Year and County FE Model Results

	(1)	(2)	(3)
VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
Farm_Economy			
farm_inc_1000000_r	0.00157	0.00266**	-0.000953
	(0.000986)	(0.00105)	(0.000617)
ks_corn_price_r			
s_ks_steers_r			
Nonfarm_Economy			
nonfarm_prsnl_inc_1000000_r	4.29e-05	3.55e-05	-2.27e-05
	(0.000171)	(0.000143)	(0.000108)
treasury_yld_7yr			
Demographics			
population	-7.87e-06	-4.33e-06	-3.02e-06
	(1.54e-05)	(1.23e-05)	(8.41e-06)
ops_avg_age	0.135***	0.107**	0.0171
	(0.0464)	(0.0486)	(0.0225)
ops_over_65	-2.213	-2.295	0.363
	(1.500)	(1.450)	(0.749)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
yrs_on_present_farm_avg	-0.0286	0.0118	-0.0424***
	(0.0290)	(0.0295)	(0.0113)
Controls			
full_owner_farms	-3.83e-05	0.000610	-0.000841*
	(0.000775)	(0.000772)	(0.000465)
part_owner_owned_acres	-1.53e-05***	-9.73e-06***	-5.92e-06***
	(2.50e-06)	(2.83e-06)	(1.76e-06)
part_owner_total_farms	0.00328**	0.00294**	0.000808
	(0.00150)	(0.00134)	(0.000643)
tenants_farms	-0.000316	-0.000704	-7.66e-05
	(0.00193)	(0.00184)	(0.00118)
woodland	4.76e-06	-2.43e-06	7.19e-06
	(1.23e-05)	(1.36e-05)	(6.39e-06)
ops_25_34	1.716	1.327	-0.219
	(1.319)	(1.358)	(0.642)
ops_55_64	-2.274**	-1.472*	-0.313
	(1.021)	(0.875)	(0.486)
ops_occupation_other	-0.000326	-0.000544	0.000385
	(0.000457)	(0.000484)	(0.000283)
yrs_on_present_farm_0_2	0.972	-0.133	1.010
	(1.612)	(1.712)	(0.789)
yrs_on_present_farm_3_4	2.278	2.639	-0.105
	(1.678)	(1.729)	(0.700)
equine_inventory	-0.000156**	-0.000189***	4.41e-05

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(6.78e-05)	(5.28e-05)	(3.05e-05)
nonfarm_proprtors_inc_1000000_r	0.000404	5.74e-05	0.000378*
	(0.000276)	(0.000132)	(0.000218)
share_pastureland	0.204	0.917	-0.756**
	(0.920)	(0.811)	(0.350)
share_full_owner_acres	1.017	1.084	-0.0129
	(0.897)	(0.897)	(0.481)
share_part_owner_owned_acres	6.618***	4.142***	2.758***
	(1.344)	(1.348)	(1.006)
share_tenants_acres	0.147	0.774	-0.472
	(0.992)	(0.919)	(0.403)
i.year			
i.fips			
1987.year	0.325***	0.188***	0.117***
	(0.0739)	(0.0633)	(0.0315)
1988.year	0.773***	0.541***	0.198***
	(0.0885)	(0.0756)	(0.0413)
1989.year	1.224***	0.901***	0.296***
	(0.116)	(0.104)	(0.0549)
1990.year	1.223***	0.794***	0.403***
	(0.124)	(0.118)	(0.0693)
1991.year	1.294***	0.885***	0.382***
	(0.135)	(0.113)	(0.0819)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
1992.year	1.364***	0.975***	0.364***
	(0.181)	(0.164)	(0.0877)
1993.year	1.193***	0.878***	0.296***
	(0.165)	(0.137)	(0.0889)
1994.year	1.337***	0.991***	0.303***
	(0.142)	(0.108)	(0.0879)
1995.year	1.253***	0.926***	0.294***
	(0.156)	(0.130)	(0.0826)
1996.year	1.532***	1.155***	0.330***
	(0.166)	(0.141)	(0.0833)
1997.year	1.586***	1.190***	0.331***
	(0.165)	(0.134)	(0.0882)
1998.year	1.641***	1.240***	0.349***
	(0.160)	(0.128)	(0.0896)
1999.year	1.386***	1.032***	0.314***
	(0.185)	(0.156)	(0.0898)
2000.year	1.515***	1.136***	0.354***
	(0.173)	(0.140)	(0.0911)
2001.year	1.391***	1.054***	0.312***
	(0.189)	(0.164)	(0.0984)
2002.year	1.326***	0.990***	0.331***
	(0.220)	(0.179)	(0.116)
2003.year	1.296***	1.011***	0.275**
	(0.214)	(0.179)	(0.109)
2004.year	1.659***	1.326***	0.331***

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.257)	(0.219)	(0.105)
2005.year	1.509***	1.193***	0.304***
	(0.254)	(0.213)	(0.115)
2006.year	1.531***	1.240***	0.280**
	(0.277)	(0.240)	(0.111)
2007.year	1.351***	1.084***	0.270**
	(0.283)	(0.253)	(0.118)
2008.year	1.239***	0.972***	0.256**
	(0.268)	(0.251)	(0.114)
2009.year	0.758***	0.509**	0.239**
	(0.239)	(0.219)	(0.112)
2010.year	1.162***	0.786***	0.343***
	(0.245)	(0.226)	(0.109)
2011.year	0.918***	0.539**	0.350***
	(0.239)	(0.232)	(0.102)
2012.year	2.491***	1.623***	0.790***
	(0.311)	(0.283)	(0.123)
2013.year	1.714***	1.079***	0.563***
	(0.282)	(0.288)	(0.104)
2014.year	0.894***	0.516*	0.329***
	(0.288)	(0.271)	(0.119)
2015.year	0.858***	0.500*	0.307***
	(0.277)	(0.273)	(0.117)
2016.year	0.959***	0.595*	0.332***
	(0.329)	(0.317)	(0.125)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
2017.year	0.860**	0.480	0.351**
	(0.343)	(0.297)	(0.172)
2018.year	1.076***	0.675**	0.369**
	(0.328)	(0.315)	(0.154)
2019.year	1.146***	0.707**	0.408**
	(0.349)	(0.351)	(0.162)
2020.year	0.257	0.155	0.0978
	(0.312)	(0.326)	(0.152)
20003.fips	0.459***	0.432**	0.0473
	(0.167)	(0.178)	(0.0893)
20005.fips	-0.643***	-0.391**	-0.183**
	(0.189)	(0.179)	(0.0912)
20007.fips	1.820***	1.290***	0.670***
	(0.300)	(0.338)	(0.208)
20009.fips	0.433	0.186	0.302
	(0.366)	(0.359)	(0.195)
20011.fips	1.316***	1.480***	-0.0688
	(0.287)	(0.278)	(0.116)
20013.fips	-0.0815	-0.140	0.105
	(0.305)	(0.276)	(0.0978)
20015.fips	2.179***	1.529***	0.688*
	(0.592)	(0.511)	(0.398)
20017.fips	1.354***	1.375***	0.0992
	(0.362)	(0.344)	(0.188)
20019.fips	2.072***	1.803***	0.391**

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.421)	(0.373)	(0.193)
20021.fips	0.274	0.365*	-0.0317
	(0.206)	(0.188)	(0.0972)
20023.fips	1.105***	0.855**	0.349**
	(0.364)	(0.390)	(0.168)
20025.fips	1.443***	1.282***	0.149
	(0.334)	(0.357)	(0.208)
20027.fips	0.260	0.0649	0.241***
	(0.202)	(0.200)	(0.0693)
20029.fips	0.529**	0.323	0.271***
	(0.205)	(0.197)	(0.0744)
20031.fips	-0.00772	0.0640	-0.143**
	(0.0910)	(0.108)	(0.0577)
20033.fips	0.813**	0.750**	0.220
	(0.319)	(0.327)	(0.188)
20035.fips	1.415***	0.915***	0.554**
	(0.350)	(0.328)	(0.260)
20037.fips	0.431	0.611***	-0.130
	(0.263)	(0.212)	(0.158)
20039.fips	1.031***	0.969***	0.201
	(0.320)	(0.329)	(0.139)
20041.fips	0.267	-0.148	0.421***
	(0.267)	(0.277)	(0.135)
20043.fips	-0.507	-0.171	-0.266**
	(0.321)	(0.301)	(0.126)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20045.fips	0.148	0.137	0.0705
	(0.905)	(0.680)	(0.469)
20047.fips	0.464	0.607*	-0.00687
	(0.358)	(0.346)	(0.129)
20049.fips	1.278***	1.276***	0.134
	(0.357)	(0.317)	(0.166)
20051.fips	0.314	0.274	0.172
	(0.243)	(0.258)	(0.183)
20053.fips	0.154	0.343	-0.0880
	(0.207)	(0.221)	(0.105)
20055.fips	1.577***	1.325***	0.419
	(0.531)	(0.490)	(0.301)
20057.fips	1.073**	0.788*	0.385
	(0.432)	(0.399)	(0.239)
20061.fips	0.201	0.498*	-0.264**
	(0.306)	(0.282)	(0.122)
20063.fips	1.508***	1.019**	0.639***
	(0.414)	(0.439)	(0.190)
20065.fips	1.105***	1.098***	0.171
	(0.292)	(0.305)	(0.135)
20067.fips	0.554	1.034***	-0.335**
	(0.416)	(0.393)	(0.146)
20069.fips	0.928**	0.958**	0.0719
	(0.459)	(0.444)	(0.152)
20071.fips	0.648	0.491	0.333*

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.524)	(0.499)	(0.181)
20073.fips	2.130***	1.594***	0.586**
	(0.393)	(0.394)	(0.259)
20075.fips	1.569***	1.173***	0.601***
	(0.425)	(0.425)	(0.169)
20077.fips	0.558**	0.710**	-0.123
	(0.269)	(0.279)	(0.113)
20079.fips	-0.196	-0.221	0.0172
	(0.329)	(0.276)	(0.151)
20081.fips	0.625	0.956**	-0.186
	(0.479)	(0.454)	(0.161)
20083.fips	0.723**	0.669*	0.168
	(0.347)	(0.355)	(0.145)
20085.fips	0.272	0.0113	0.167
	(0.296)	(0.276)	(0.114)
20087.fips	0.250	0.296	-0.188
	(0.276)	(0.280)	(0.129)
20089.fips	0.797***	0.466*	0.170
	(0.279)	(0.280)	(0.107)
20093.fips	1.285***	1.191***	0.257
	(0.405)	(0.416)	(0.173)
20095.fips	0.491**	0.222	0.321**
	(0.241)	(0.273)	(0.128)
20097.fips	0.631**	0.640**	0.121
	(0.272)	(0.294)	(0.141)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20099.fips	0.255	-0.000691	0.230**
	(0.198)	(0.186)	(0.106)
20101.fips	0.511	0.256	0.372***
	(0.374)	(0.368)	(0.139)
20103.fips	-0.0814	0.0469	-0.0624
	(0.670)	(0.553)	(0.338)
20105.fips	0.866***	0.747***	0.150
	(0.235)	(0.238)	(0.107)
20109.fips	1.790***	1.507***	0.393*
	(0.395)	(0.427)	(0.203)
20111.fips	0.899***	0.581**	0.399*
	(0.284)	(0.253)	(0.207)
20113.fips	0.121	-0.0849	0.175
	(0.427)	(0.428)	(0.231)
20115.fips	0.588*	0.227	0.301*
	(0.332)	(0.356)	(0.172)
20117.fips	0.392	0.120	0.368***
	(0.319)	(0.327)	(0.137)
20119.fips	0.909***	0.781**	0.236
	(0.346)	(0.373)	(0.167)
20121.fips	0.393	0.364	0.0358
	(0.476)	(0.466)	(0.224)
20123.fips	0.334	0.454	-0.0360
	(0.330)	(0.322)	(0.113)
20125.fips	0.809**	0.746**	0.123

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.345)	(0.295)	(0.183)
20127.fips	0.284	0.143	0.239**
	(0.191)	(0.192)	(0.113)
20129.fips	-0.208	-0.0413	-0.0129
	(0.375)	(0.389)	(0.164)
20131.fips	-0.0177	-0.318	0.360***
	(0.337)	(0.307)	(0.132)
20133.fips	0.197*	0.391***	-0.0989
	(0.114)	(0.114)	(0.0663)
20135.fips	1.299***	0.645	0.713***
	(0.387)	(0.421)	(0.191)
20137.fips	1.112***	0.797**	0.313**
	(0.313)	(0.326)	(0.143)
20139.fips	0.305	0.110	0.0726
	(0.199)	(0.216)	(0.110)
20141.fips	0.680**	0.608**	0.133
	(0.266)	(0.283)	(0.132)
20143.fips	0.607***	0.229	0.368***
	(0.200)	(0.217)	(0.0977)
20145.fips	0.633*	0.731*	0.0114
	(0.375)	(0.370)	(0.136)
20147.fips	0.659**	0.364	0.421***
	(0.288)	(0.313)	(0.147)
20149.fips	0.711***	0.617**	0.0586
	(0.228)	(0.238)	(0.137)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20151.fips	0.303	0.291	0.104
	(0.323)	(0.321)	(0.125)
20153.fips	1.296***	1.021**	0.431**
	(0.382)	(0.415)	(0.186)
20157.fips	0.0613	-0.00595	0.150*
	(0.290)	(0.271)	(0.0883)
20159.fips	0.509	0.479	0.0461
	(0.322)	(0.313)	(0.122)
20161.fips	0.229	0.221	0.143
	(0.538)	(0.427)	(0.288)
20163.fips	1.151***	0.784**	0.509***
	(0.319)	(0.349)	(0.169)
20165.fips	0.0471	0.229	-0.120
	(0.318)	(0.312)	(0.108)
20167.fips	0.859***	0.596**	0.375***
	(0.210)	(0.234)	(0.121)
20169.fips	0.0674	-0.158	0.289
	(0.375)	(0.281)	(0.232)
20171.fips	0.0679	-0.0170	0.190
	(0.433)	(0.422)	(0.156)
20173.fips	1.324	0.706	0.915
	(3.772)	(2.889)	(2.029)
20175.fips	0.134	0.368	-0.0705
	(0.345)	(0.324)	(0.163)
20179.fips	1.444***	0.944**	0.552***

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
	(0.380)	(0.385)	(0.148)
20181.fips	1.589***	1.368***	0.360**
	(0.461)	(0.467)	(0.180)
20183.fips	0.985***	0.840**	0.222*
	(0.338)	(0.341)	(0.130)
20185.fips	0.429	0.709**	-0.213*
	(0.336)	(0.329)	(0.115)
20187.fips	0.691	1.136**	-0.279
	(0.507)	(0.483)	(0.172)
20189.fips	0.865**	1.094***	-0.0849
	(0.412)	(0.403)	(0.151)
20191.fips	0.939**	0.709	0.243
	(0.441)	(0.449)	(0.236)
20193.fips	1.379***	1.261**	0.235
	(0.506)	(0.507)	(0.207)
20195.fips	0.927***	0.507*	0.510***
	(0.280)	(0.294)	(0.132)
20197.fips	1.009***	0.747***	0.336**
	(0.251)	(0.244)	(0.137)
20199.fips	1.122***	1.170***	0.0922
	(0.336)	(0.357)	(0.147)
20201.fips	0.413	0.236	0.268**
	(0.262)	(0.279)	(0.113)
20203.fips	0.252	0.473	-0.0762
	(0.439)	(0.427)	(0.155)

VARIABLES	total_ag_turnover	arms_ag_turnover	nonarms_ag_turnover
20205.fips	0.128	0.207**	-0.0379
	(0.101)	(0.101)	(0.0484)
20207.fips	0.589***	0.824***	-0.210**
	(0.187)	(0.168)	(0.104)
20209.fips	1.678	1.154	0.622
	(1.612)	(1.252)	(0.859)
Constant	-6.183***	-6.250***	0.391
	(2.229)	(2.349)	(0.991)
Observations	3,495	3,491	3,464
R-squared	0.372	0.355	0.307

Robust standard errors, clustered by county, in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendix E

County FIPS and Ag Districts

Table E.1: County FIPS and Ag Districts

County	Ag District	FIPS
Allen	Southeast	20001
Anderson	East Central	20003
Atchison	Northeast	20005
Barber	South Central	20007
Barton	Central	20009
Bourbon	Southeast	20011
Brown	Northeast	20013
Butler	Southeast	20015
Chase	East Central	20017
Chautauqua	Southeast	20019
Cherokee	Southeast	20021
Cheyenne	Northwest	20023
Clark	Southwest	20025
Clay	North Central	20027

County	Ag District	FIPS
Cloud	North Central	20029
Coffey	East Central	20031
Comanche	South Central	20033
Cowley	Southeast	20035
Crawford	Southeast	20037
Decatur	Northwest	20039
Dickinson	Central	20041
Doniphan	Northeast	20043
Douglas	East Central	20045
Edwards	South Central	20047
Elk	Southeast	20049
Ellis	Central	20051
Ellsworth	Central	20053
Finney	Southwest	20055
Ford	Southwest	20057
Franklin	East Central	20059
Geary	East Central	20061
Gove	West Central	20063
Graham	Northwest	20065
Grant	Southwest	20067
Gray	Southwest	20069
Greeley	West Central	20071
Greenwood	Southeast	20073
Hamilton	Southwest	20075
Harper	South Central	20077

County	Ag District	FIPS
Harvey	South Central	20079
Haskell	Southwest	20081
Hodgeman	Southwest	20083
Jackson	Northeast	20085
Jefferson	Northeast	20087
Jewell	North Central	20089
Johnson	East Central	20091
Kearny	Southwest	20093
Kingman	South Central	20095
Kiowa	South Central	20097
Labette	Southeast	20099
Lane	West Central	20101
Leavenworth	Northeast	20103
Lincoln	Central	20105
Linn	East Central	20107
Logan	West Central	20109
Lyon	East Central	20111
McPherson	Central	20113
Marion	Northeast	20115
Marshall	Central	20117
Meade	Southwest	20119
Miami	East Central	20121
Mitchell	North Central	20123
Montgomery	Southeast	20125
Morris	East Central	20127

County	Ag District	FIPS
Morton	Southwest	20129
Nemaha	Northeast	20131
Neosho	Southeast	20133
Ness	West Central	20135
Norton	Northwest	20137
Osage	East Central	20139
Osborne	North Central	20141
Ottawa	North Central	20143
Pawnee	South Central	20145
Phillips	North Central	20147
Pottawatomie	Northeast	20149
Pratt	South Central	20151
Rawlins	Northwest	20153
Reno	South Central	20155
Republic	North Central	20157
Rice	Central	20159
Riley	Northeast	20161
Rooks	North Central	20163
Rush	Central	20165
Russell	Central	20167
Saline	Central	20169
Scott	West Central	20171
Sedgwick	South Central	20173
Seward	Southwest	20175
Shawnee	East Central	20177

County	Ag District	FIPS
Sheridan	Northwest	20179
Sherman	Northwest	20181
Smith	North Central	20183
Stafford	South Central	20185
Stanton	Southwest	20187
Stevens	Southwest	20189
Sumner	South Central	20191
Thomas	Northwest	20193
Trego	West Central	20195
Wabaunsee	East Central	20197
Wallace	West Central	20199
Washington	North Central	20201
Wichita	West Central	20203
Wilson	Southeast	20205
Woodson	Southeast	20207
Wyandotte	Northeast	20209

Table E.2: *Ag Districts and Codes*

Ag District	Code
Central	1
East Central	2
North Central	3
Northeast	4
Northwest	5
South Central	6
Southeast	7
Southwest	8
West Central	9

Appendix F

Measured Turnover Maps

Figure F.1: *Mean Yearly Agricultural Land Turnover by County, 1986-2020*

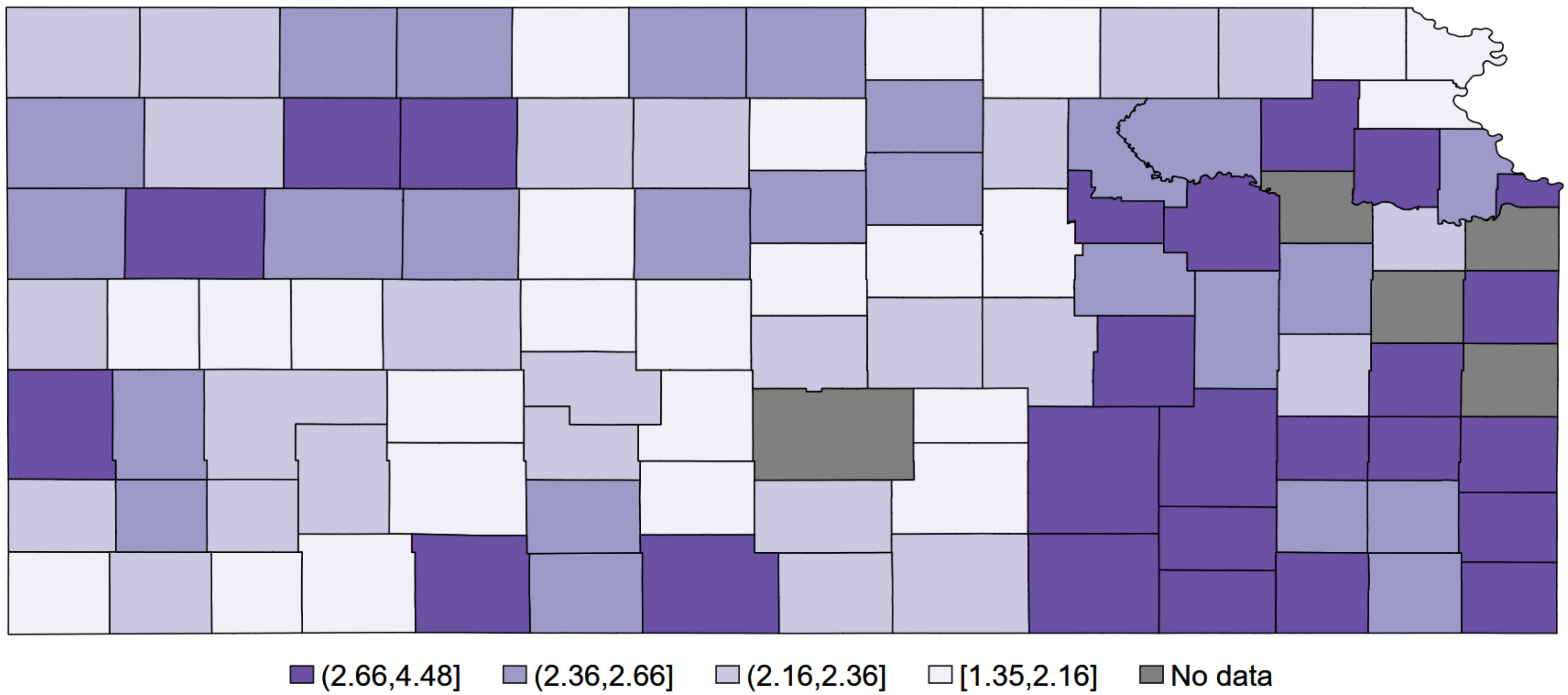


Figure F.2: *Mean Yearly Arm's Length Agricultural Land Turnover by County, 1986-2020*

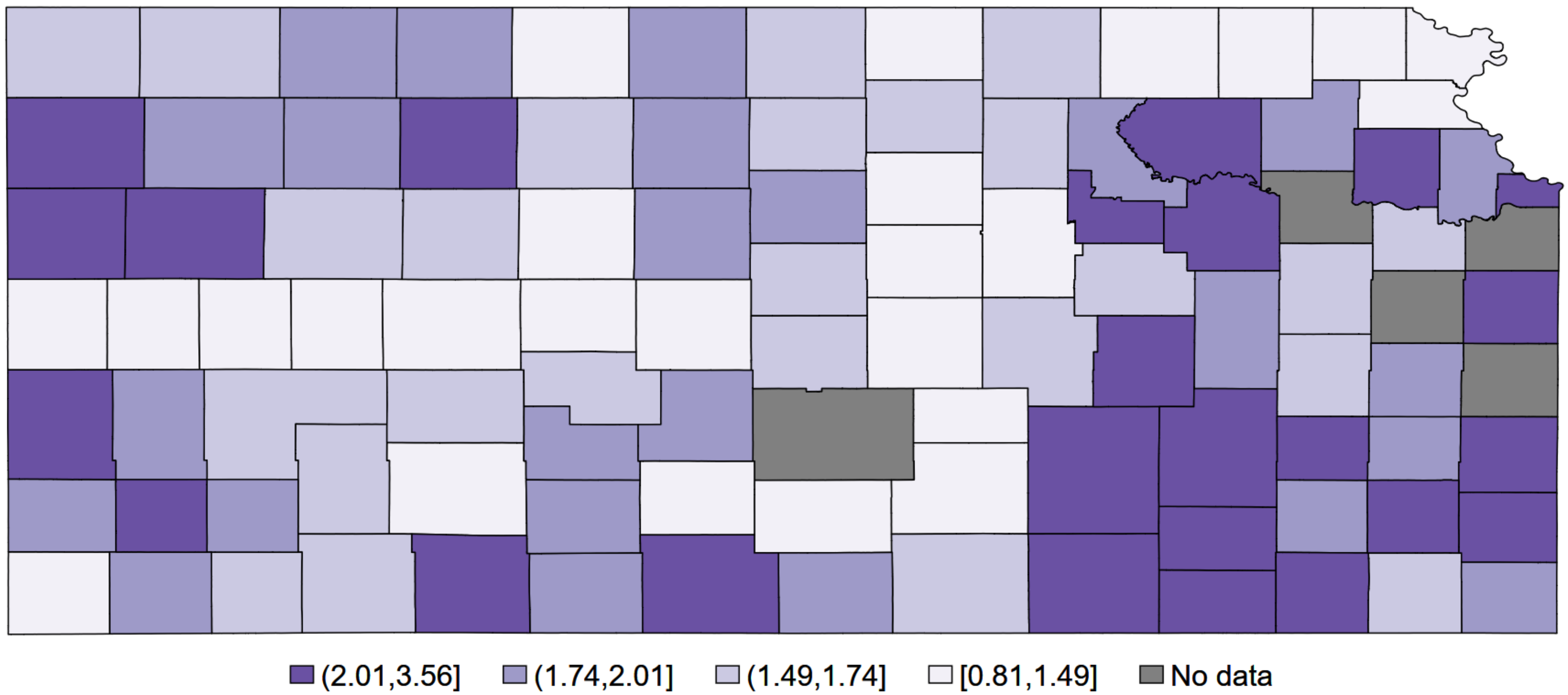


Figure F.3: *Mean Yearly Non-arm's Length Agricultural Land Turnover by County, 1986-2020*

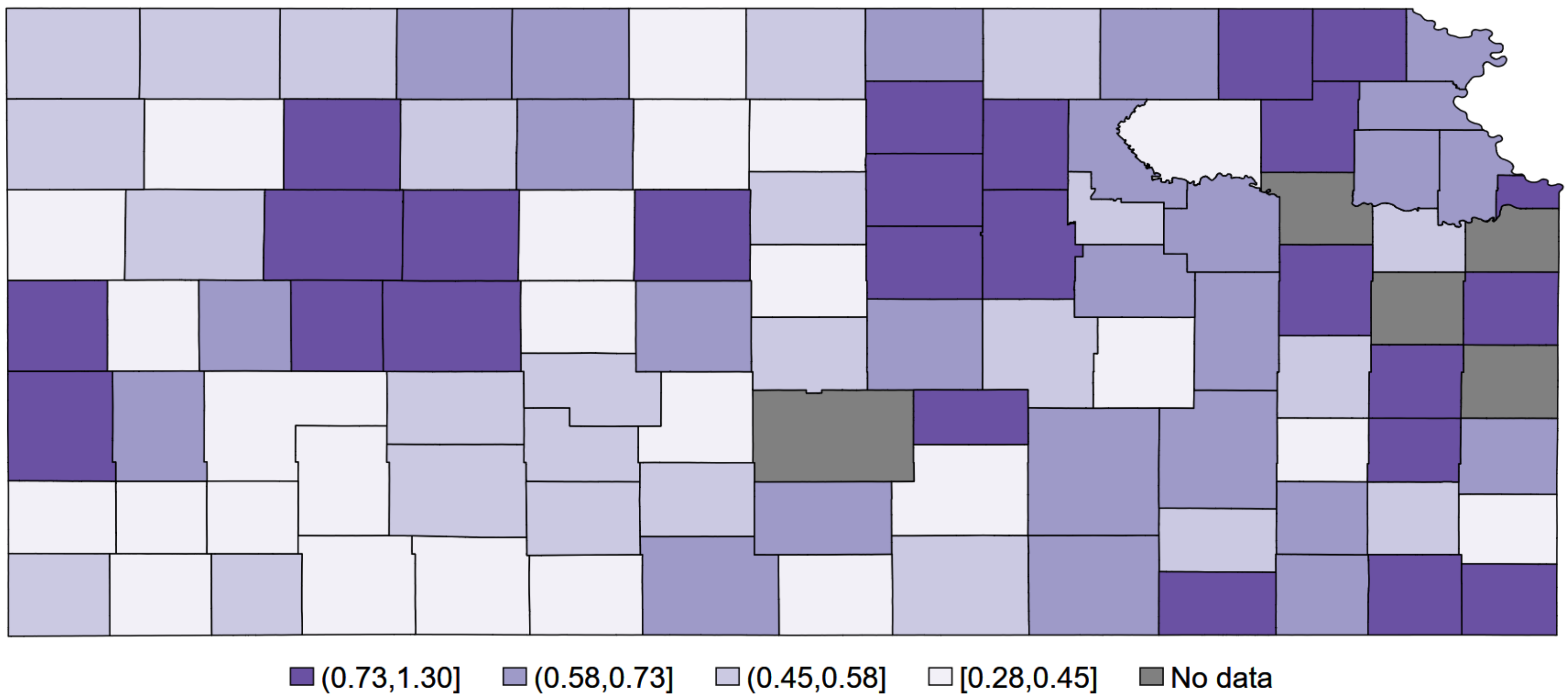


Figure F.4: *Standard Deviation of Yearly Agricultural Land Turnover by County, 1986-2020*

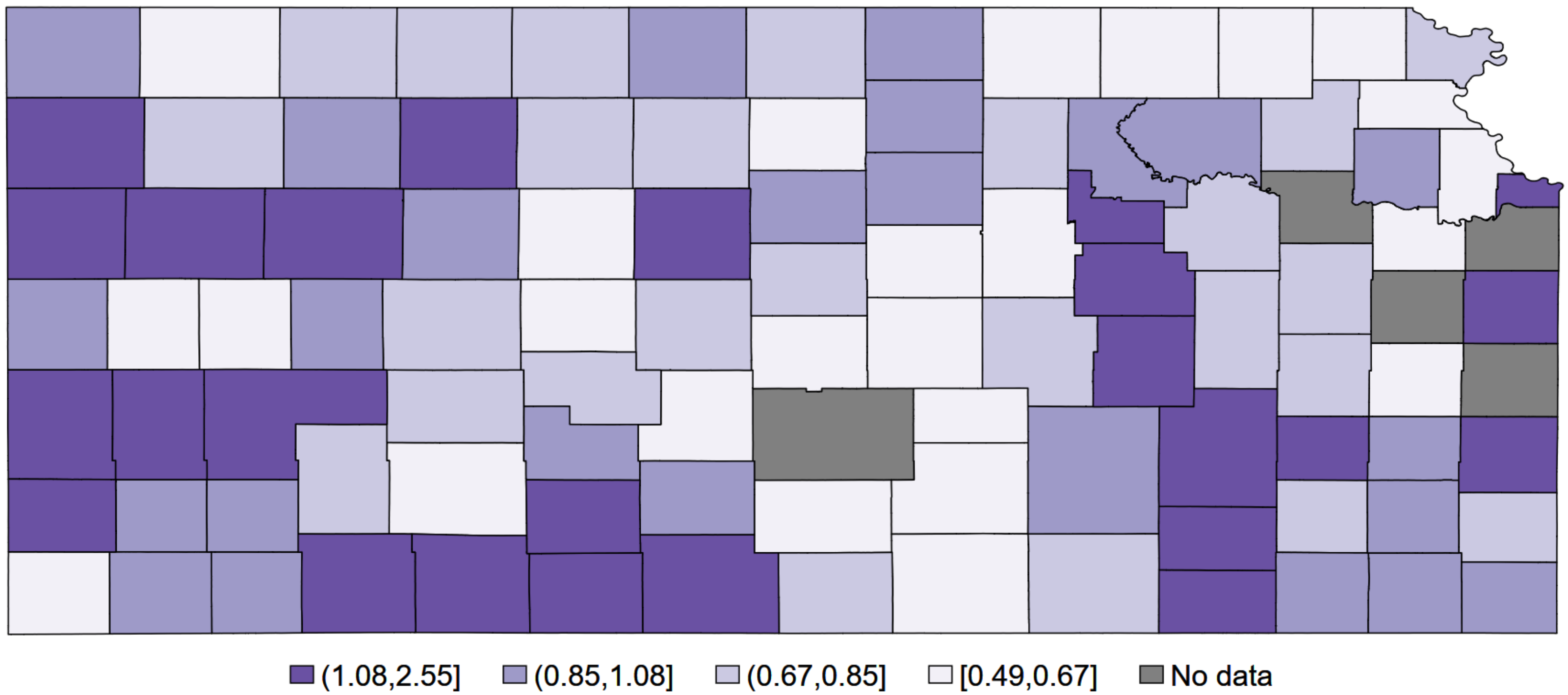


Figure F.5: *Standard Deviation of Yearly Arm's Length Agricultural Land Turnover by County, 1986-2020*

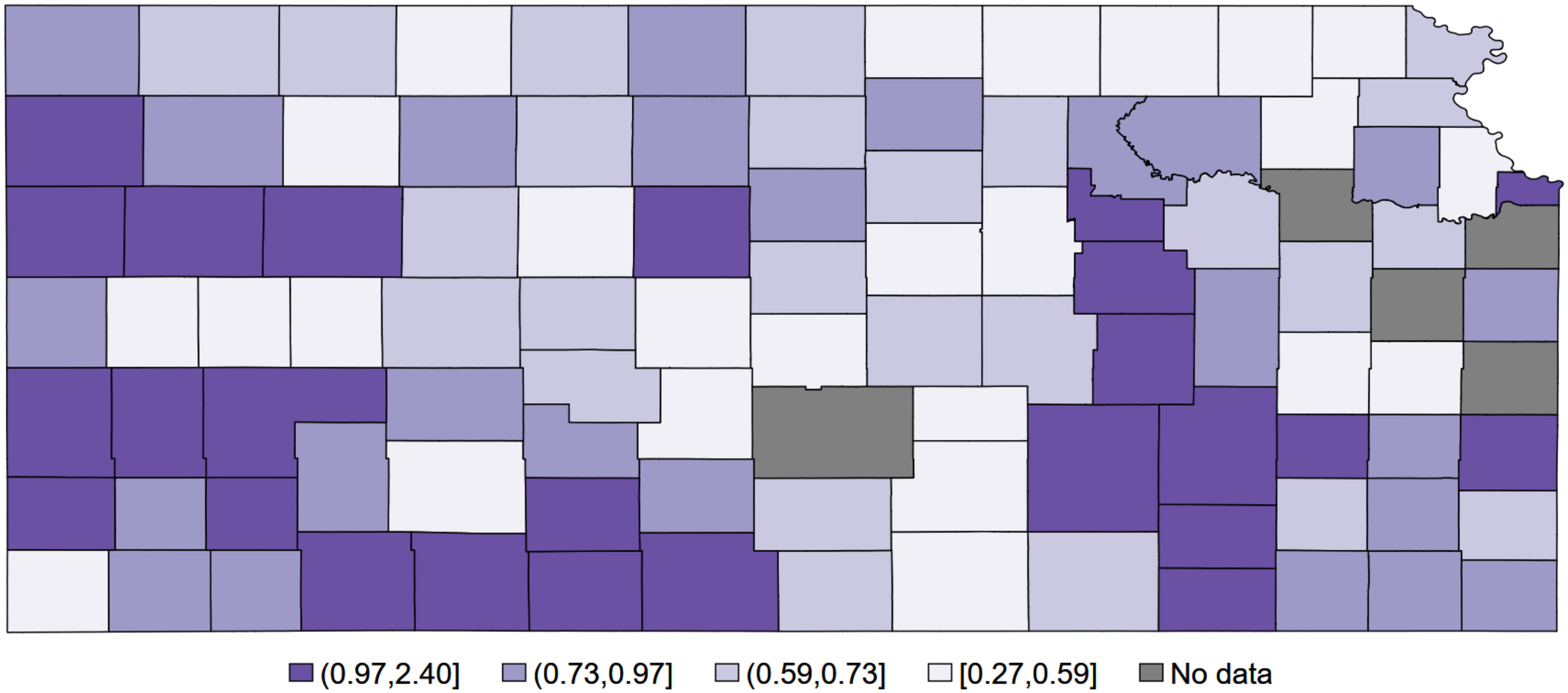
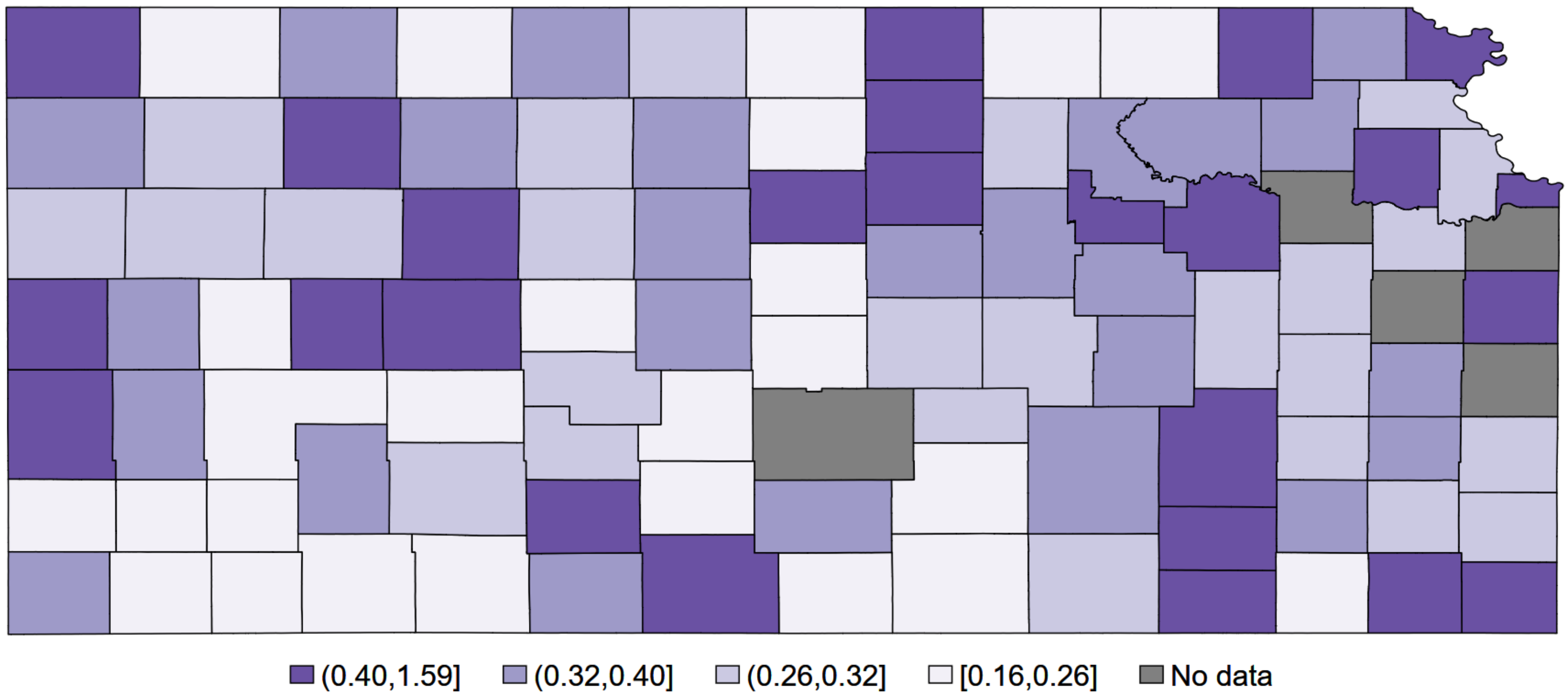


Figure F.6: *Standard Deviation of Yearly Non-arm's Length Agricultural Land Turnover by County, 1986-2020*



Appendix G

Income Maps

Figure G.1: *Mean Yearly Farm Income by County ($1,000,000), 1986-2020*

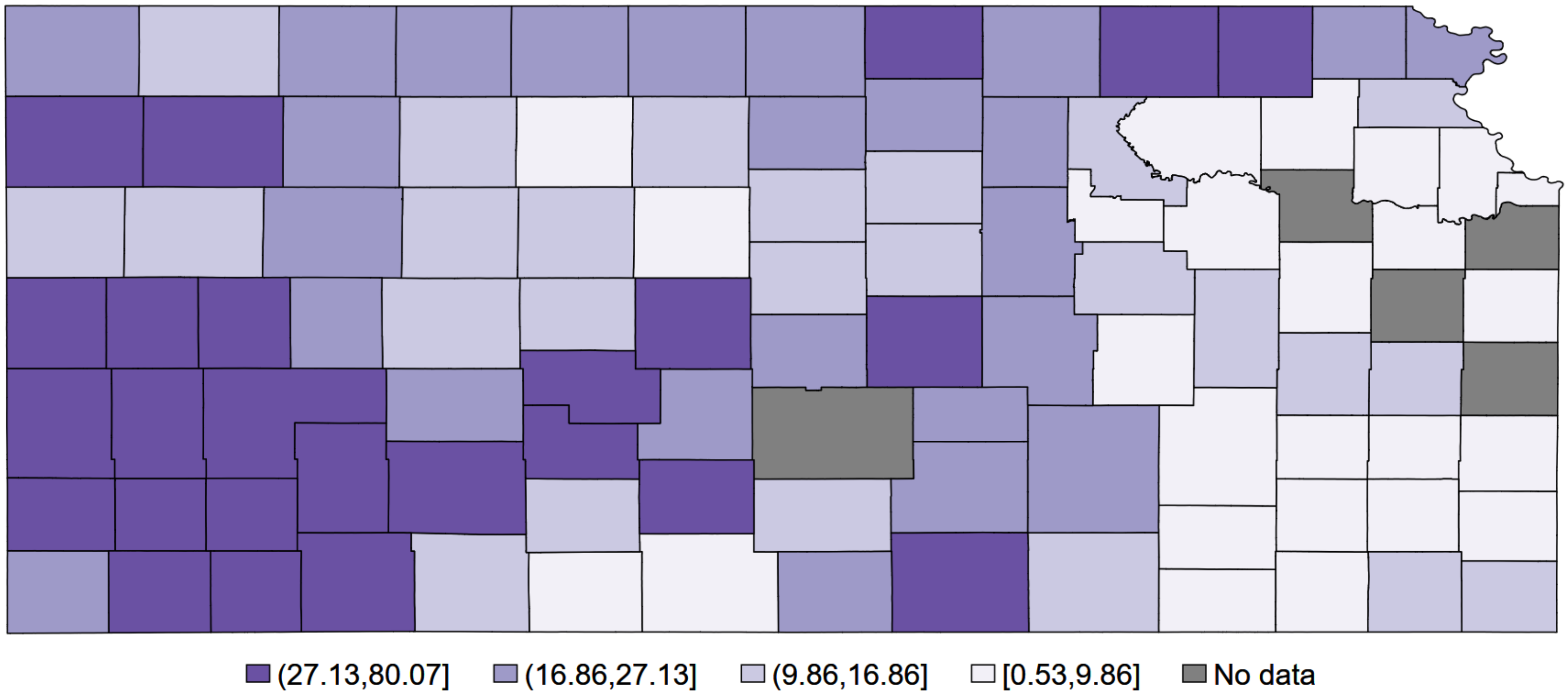


Figure G.2: *Mean Yearly Nonfarm Personal Income by County ($1,000,000), 1986-2020*

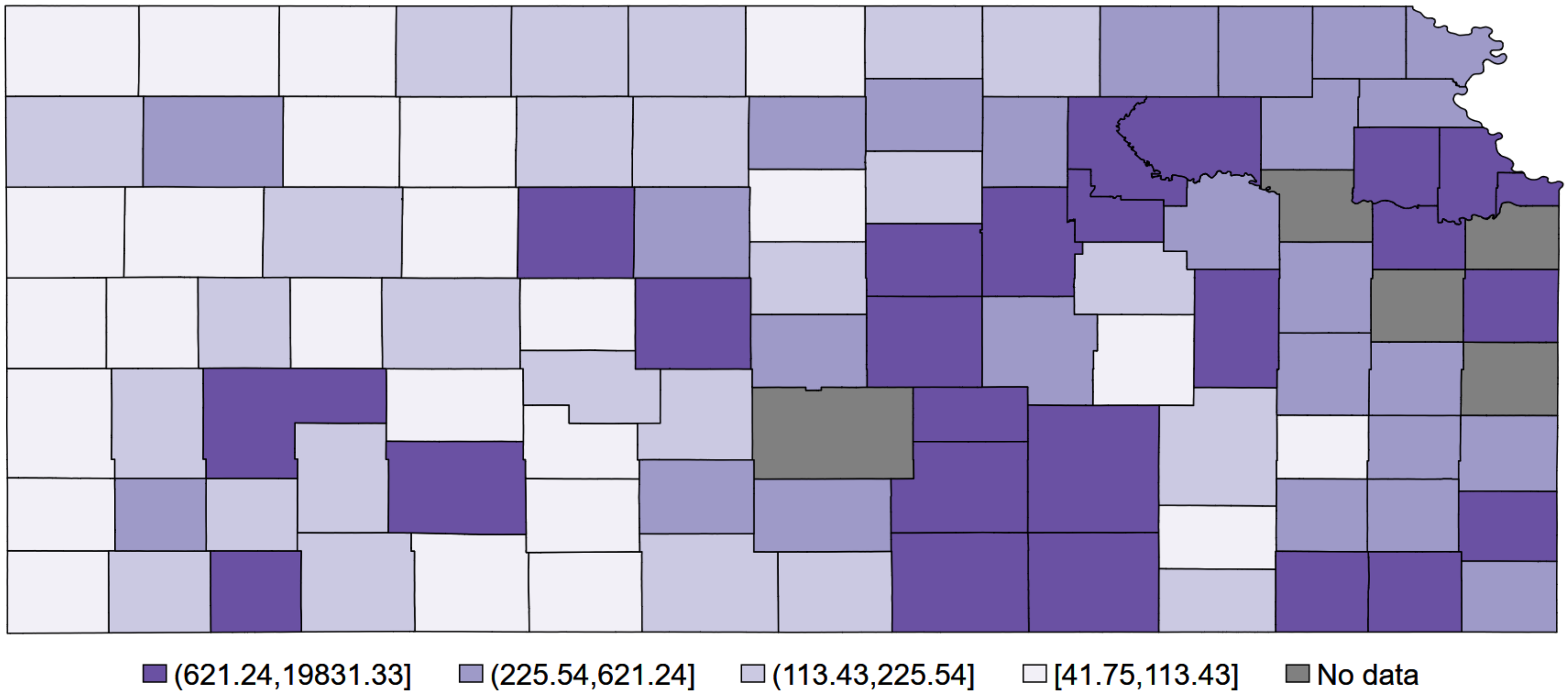


Figure G.3: *Standard Deviation of Yearly Farm Income by County ($1,000,000), 1986-2020*

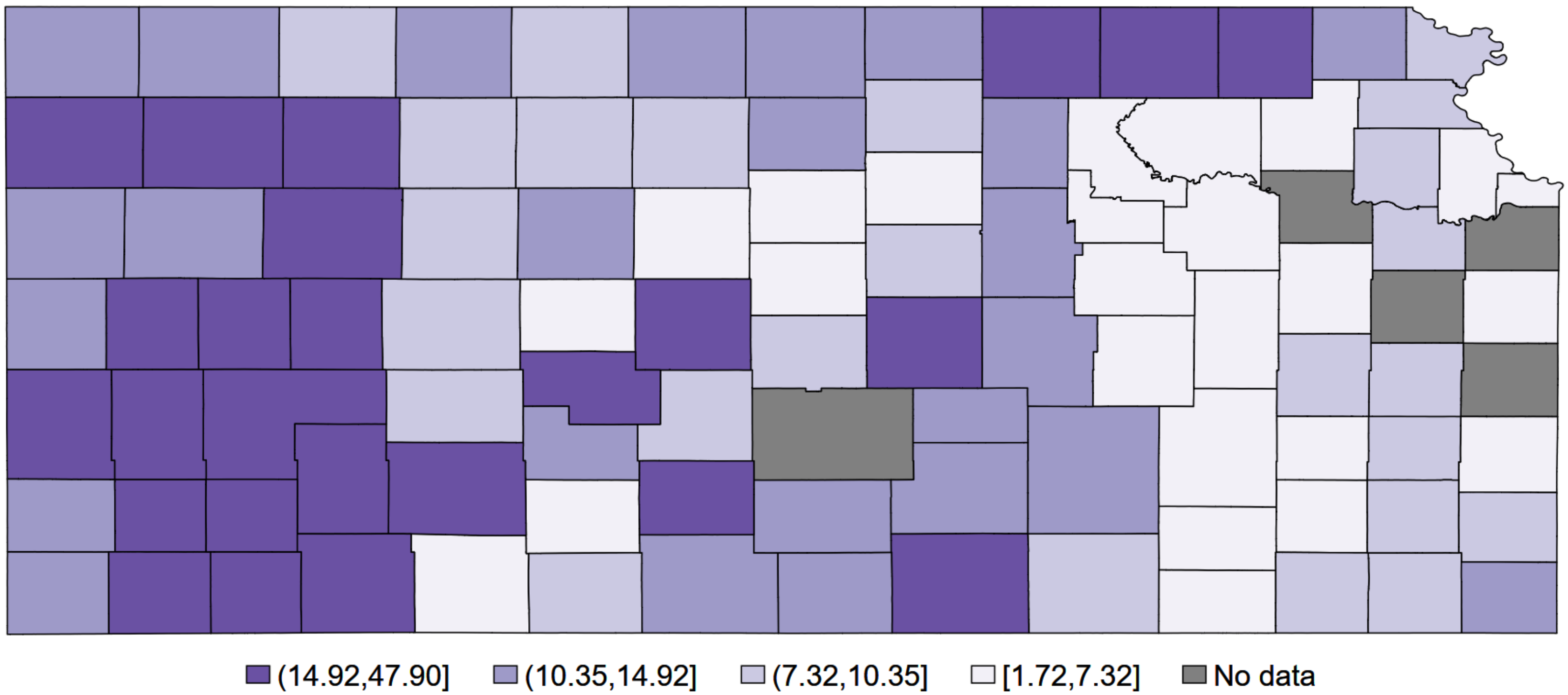
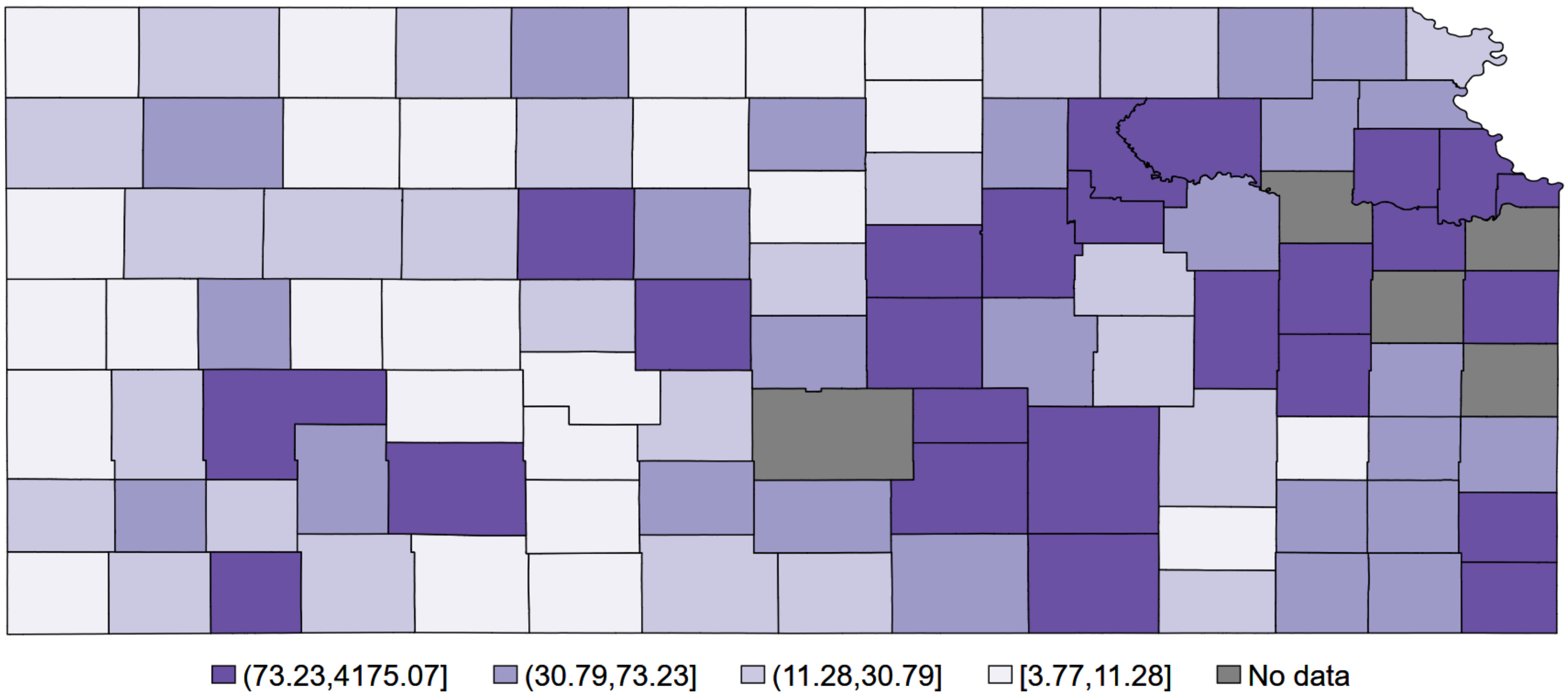


Figure G.4: *Standard Deviation of Yearly Nonfarm Personal Income by County ($1,000,000), 1986-2020*



Appendix H

Other Graphs and Charts

Figure H.1: *Mean of Average Yearly Operator Age, 1986-2020*

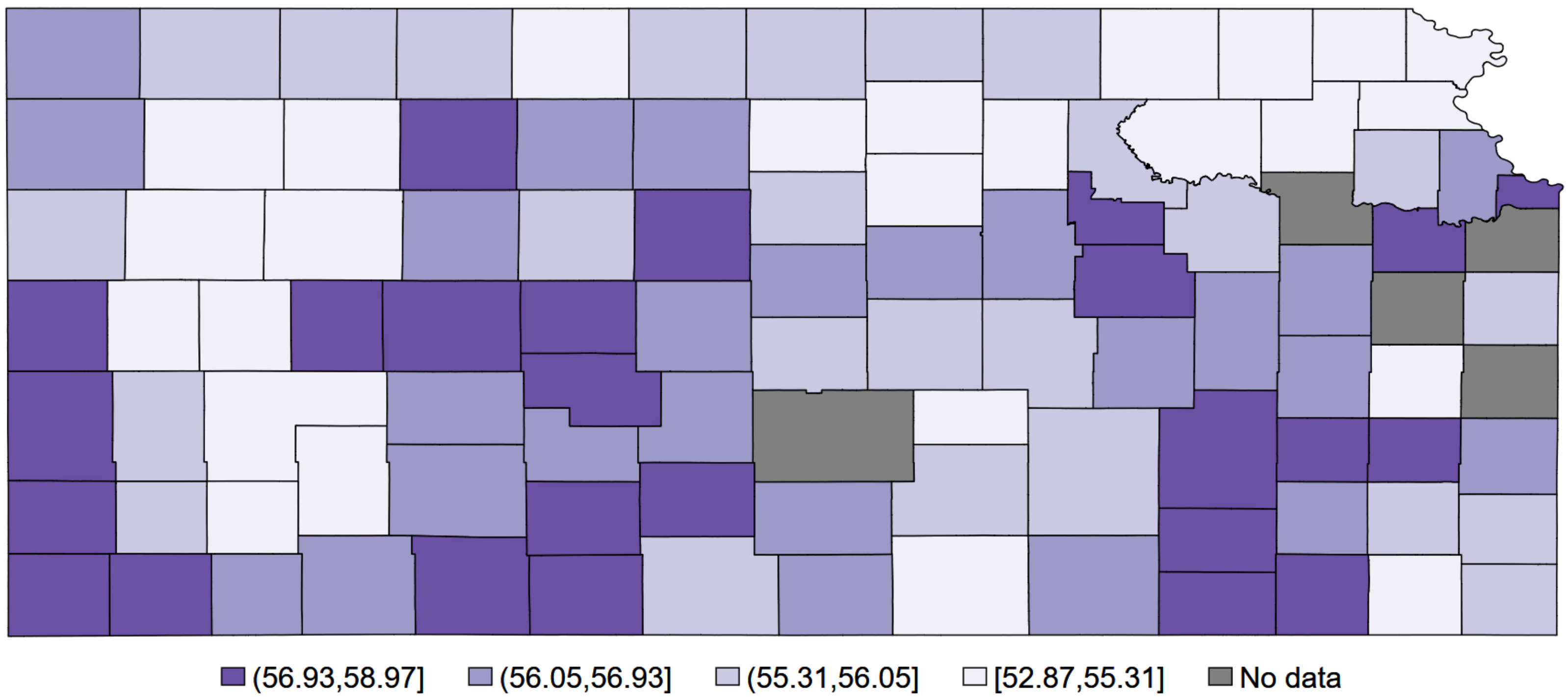


Figure H.2: *Mean Share of Operators Over 65, 1986-2020*

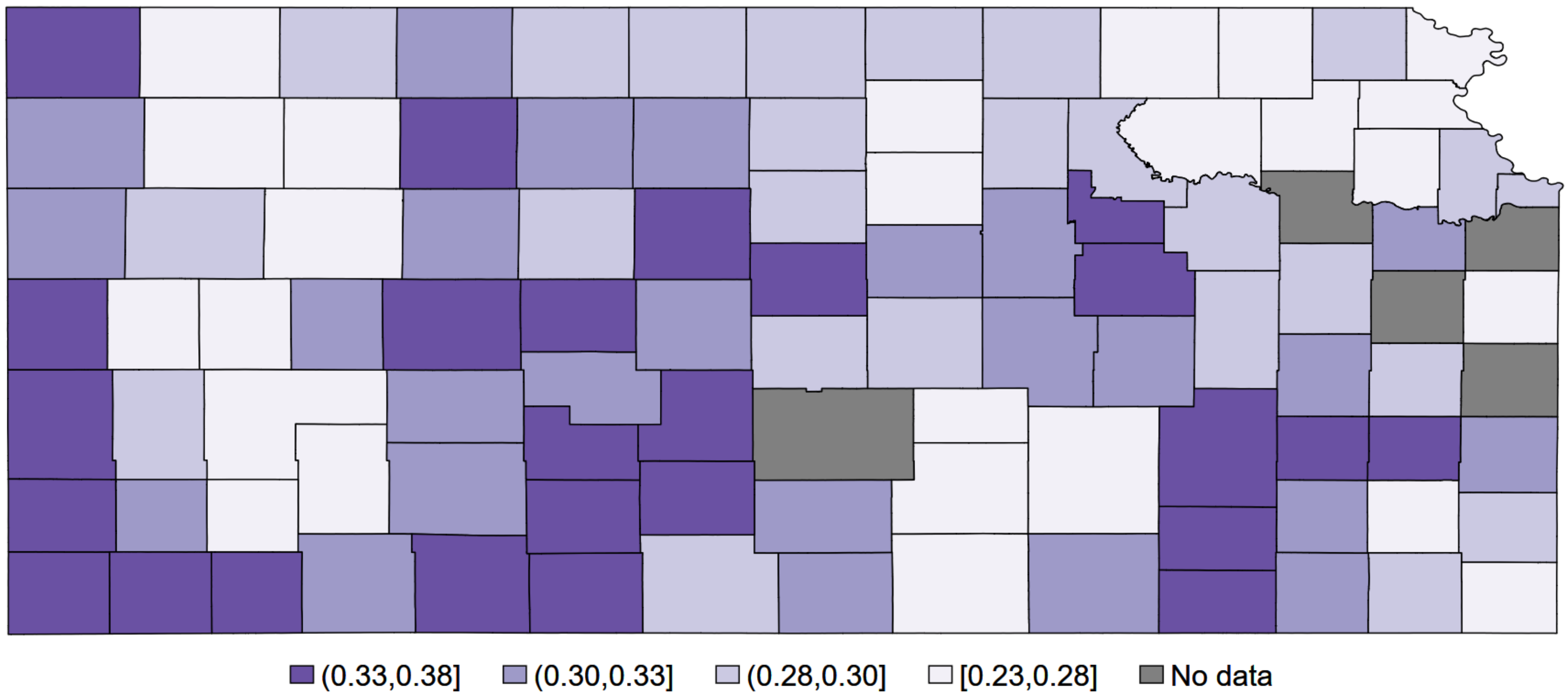


Figure H.3: *Mean of Average Years on Present Farm, 1986-2020*

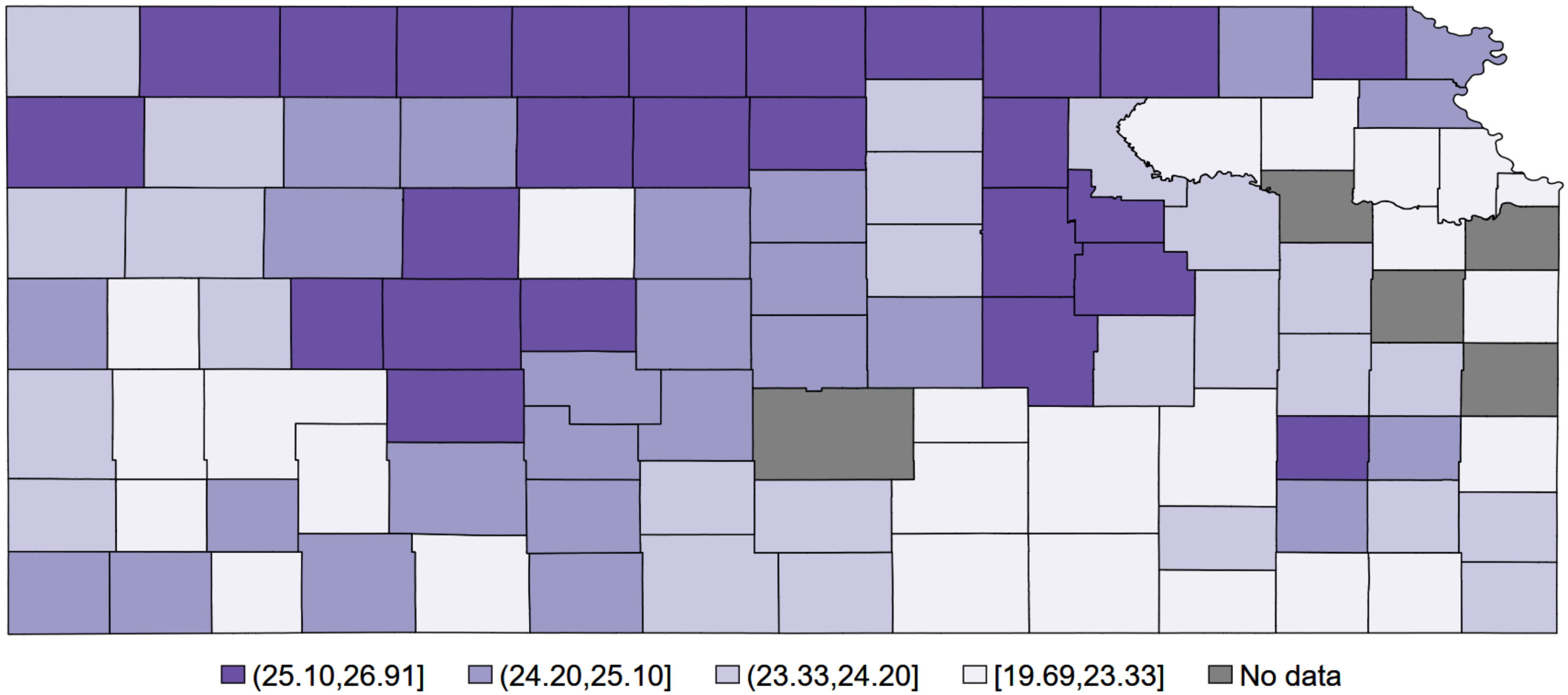
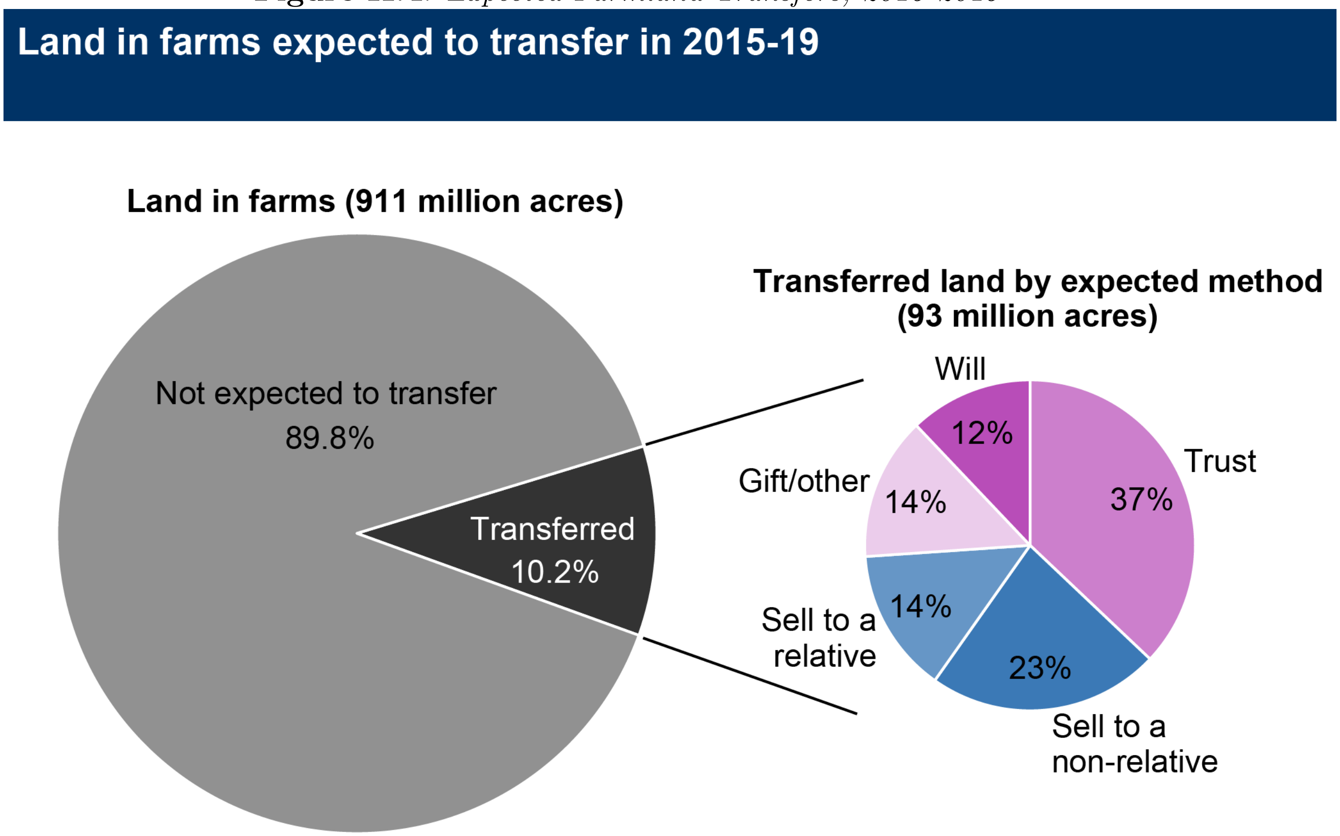


Figure H.4: *Expected Farmland Transfers, 2015-2019*



Note: Data exclude Alaska and Hawaii.
Source: USDA, Economic Research Service and National Agricultural Statistics Service, 2014 Tenure, Ownership, and Transition of Agricultural Land (TOTAL) survey.

Figure H.5: *Yearly Seven Year Treasury Yield, 1986-2020*

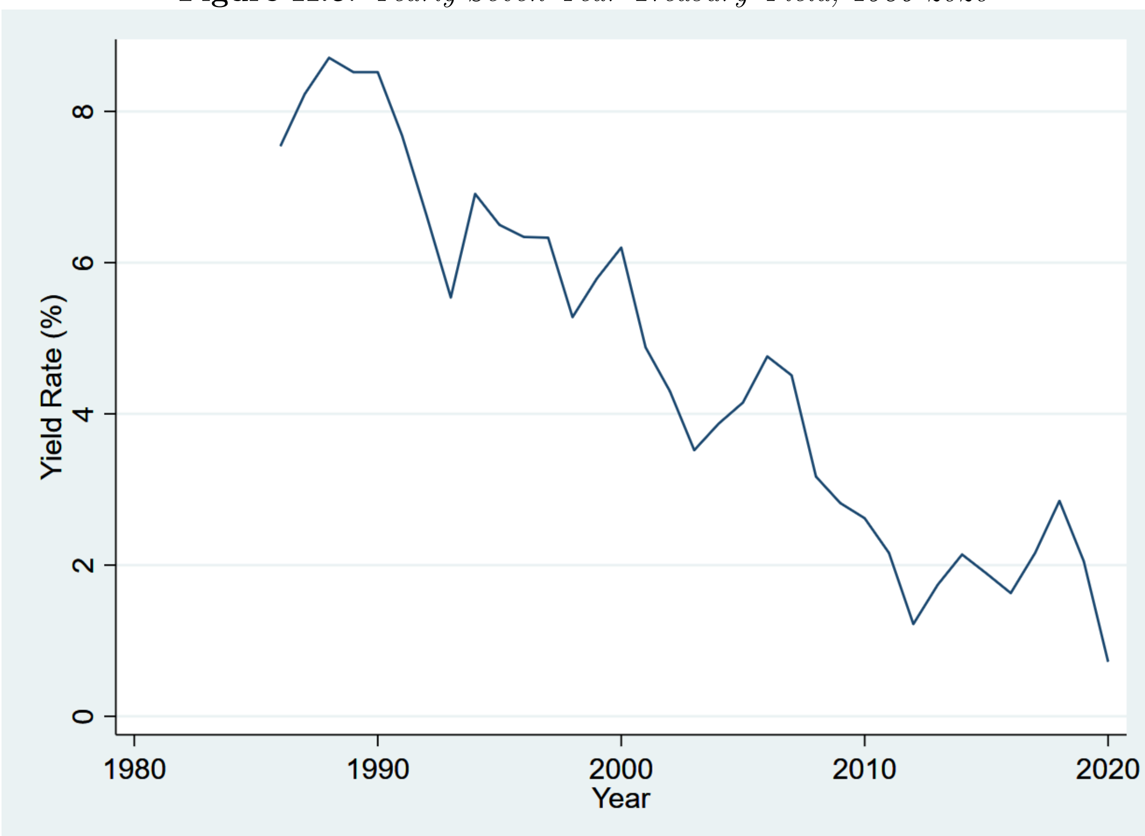


Figure H.6: *Real Price of Kansas Corn, 1986-2020*