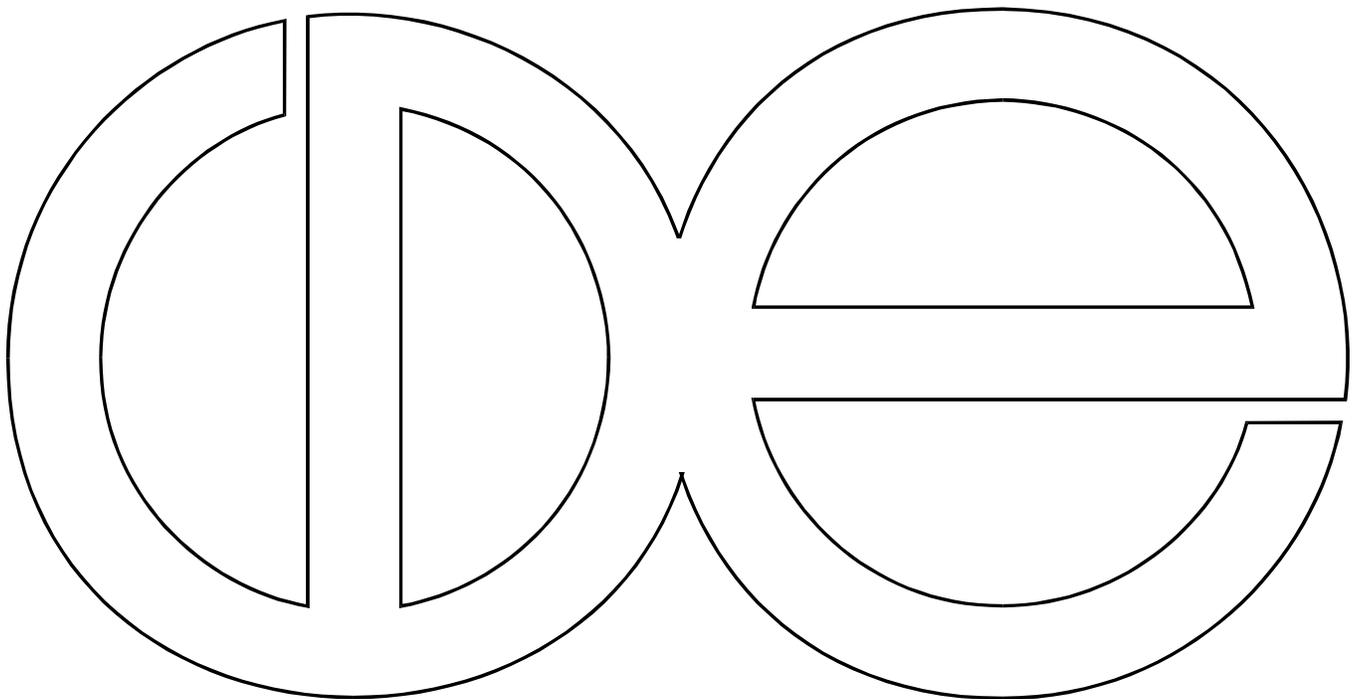


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**Temporal and Spatial Variation
in 20th Century U.S. Great Plains
Population Change**

Katherine J. Curtis White

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ABSTRACT

Although the Great Plains region typically connotes population loss, there are periods in its history more accurately associated with growth. And while the Plains might be considered homogeneous, there is reason to suspect variation in patterns of population growth across the vast region. Using census data, I employ growth curve modeling and GIS techniques to assess the nature and extent of temporal and spatial variation in county population change throughout the 20th century. The region experienced overall growth during the Settlement Period (1900-1930), negative growth during the Crisis and Post-War Periods (1930-1950 and 1950-1970), and a return to positive growth in the Agricultural Bust Period (1970-2000). However, results also suggest that there is considerable variation in growth between these time periods as well as variation across geography within the eras corresponding with important historical events. These findings motivate further analysis of potential correlates driving temporal and spatial patterns of variation.

INTRODUCTION

Most U.S. residents have heard of the Great Plains and thousands of people aboard transnational flights pass over this vast region daily. From the window, passengers inspect the seemingly endless green and brown checked plains, finding scant evidence of inhabitation, let alone urban development. Yet at points in its history, this region has been the intended and desired destination for thousands of individuals, families, and sometimes entire communities looking to achieve the American Dream. While the United States witnessed considerable population growth over the 20th century, certain subregions did not share in the nation's general expansion. As populations multiplied on the east and west coasts, some periods have found the center of the U.S. struggling to ward off decline.

In the present paper, I estimate the nature and extent of temporal and spatial variation in patterns of county population change in the U.S. Great Plains throughout the 20th century. While residents of New York or Philadelphia may not easily distinguish North Dakota from Nebraska, there is significant diversity within the Great Plains region, including patterns of population change. Although the Great Plains is commonly associated with population loss, especially in recent decades (Rathge and Highman 1998), certain periods within the region's history are associated with growth rather than decline. Further, there are variations in patterns of growth within the region throughout its history. Using decennial census data from 1900 through 2000, I employ growth curve modeling and GIS techniques to address whether the region always suffered population loss, and whether all places shared the same population trajectory. In doing so, I quantify and illustrate the degree of variation in growth patterns across time and space.

There are three main aspects of the Great Plains that make it particularly relevant to understanding general processes of population change and distribution. First, it is unique in its extent, concentration, and nature of “rural-ness.” While rural or non-metropolitan places are scattered throughout the nation’s landscape, the Great Plains as an entire region remains predominantly rural. For example, today approximately 8% of the Great Plains counties are considered metropolitan (Cromartie 1998) leaving the remaining 92% classified as nonmetropolitan. In contrast, 77% of all U.S. counties are metropolitan while only 23% are nonmetropolitan (Rain and Perry 1998). Yet within this sparsely populated area exists industrial complexity. The region relies not only on farming, but also ranching, mining and other extractive industries in addition to government employment and, more recently, manufacturing. Each industry, as it has waxed and waned over time, influences the region’s population composition and organization.

Second, the Great Plains region is unique in its general pattern of population change. Nowhere is population static, but most areas within the U.S. have experienced continued positive growth while the Great Plains ebbs and flows or, more appropriately, flows and ebbs. This region is not the first or only to experience a remarkable loss. A dramatic population change was observed in the South during what has become known as the Great Migration, covering the years between 1910 and 1970. The main difference is that the South suffered a general exodus followed by a general repopulation while the Great Plains has presumably experienced an extended period of exodus.

Third, the Great Plains region is unique in its extent of government involvement. This region possesses a fascinating history of direct government intervention to settle, manage, and

sometimes repossess the land through homestead acts, wildlife preserves, and agricultural subsidies. Presently, multiple chunks of the Great Plains are divided between national and state parks, preserves and refuges, and tribal reservations. Each division marks a distinction in agency mission and management, and each division impacts population growth.

THE HISTORICAL CONTEXT

I have divided the 20th century into four main epochs based on historical events relevant to population change. They include the Settlement Period, 1900-1930; the Crisis Period, 1930-1950; the Post-War Period, 1950-1970; and the Agricultural Bust Period, 1970-2000. During the Settlement Period, the Great Plains experienced an agricultural expansion aided by World War I and innovations in agricultural technology impacting seed, soil, and equipment. The agricultural industry boomed in the earlier years, fueled by favorable environmental conditions and an expanding need for agricultural goods stimulated by the war and increased industrial wages among consumers on the eastern seaboard. Following WWI, young soldiers returned to the farm equipped with a renewed desire for the American Dream and low land prices and a demanding global market to assist their enthusiasm. However, this surge was followed by severe drought and an agricultural, and more general economic, downturn during the 1920s.

While most of America identified 1929 as the turning point, those reliant upon the agricultural industry realized the economic climate had gone sour earlier. Low levels of rain and high quantities of grasshoppers and wind gusts offered many plains folk early admission to the Depression Era. Those on the Texas and Oklahoma panhandle were spared from the ravages of the grasshoppers and still prospered in the mid-1920s. But while they entered the depression somewhat later, they did so under the grand introduction of the Dust Bowl (Gregory 1989).

It was not until the 1930s that the government responded with federal aid. And until these programs were in place, farmers and their community dependents relied upon family and local organizations for support (Grant 2002). Those with substantial capital preceding the depression were able to take advantage of the government programs, usually consisting of seed loans and temporary off-farm employment through the Civil Works Administration (CWA) and then the Works Progress Administration (WPA). Other, less fortunate and less capially endowed farmers most often ended up selling their property—including land, machinery, and stock—to pay their debts. They were ill equipped to enter the new agricultural industry, more accurately characterized as a business rather than a way of life.

During the Crisis Period, from 1930 to 1950, mechanization, economic pressures, and political maneuverings transformed farming and ranching from family run operations to corporate enterprises. This shift demanded expansion of land and equipment, and diversification of crops and livestock. Farm sizes began to increase while the number of farms declined, especially after 1940 (National Agricultural Statistics Service 2003). Tractors began replacing the mule and horse and by 1940, 55% of plains farmers had tractors compared to 23% among all other U.S. farmers (Grant 2002:15). Those squeezed out of farming often looked to the newly established industrial market. Here, no financial capital was necessary to gain entrance and larger paychecks were generally brought home.

Not only did this new model of agricultural production weed out smaller operations without the financial backing to expand, but it also required fewer farms in general. Rather than calling for a multitude of small farms, the mechanized industry demanded fewer but larger operations (Lobao and Meyer 2001). Therefore, unlike the veterans of WWI, young soldiers

returning from WWII headed to town for better-paying industrial jobs rather than back to the farm, if there was even a farm to which to return.

The U.S. experienced a great deal of change during the Post-War period, covering the years between 1950 and 1970. The nation was coming off of WWII and entering the Cold War. Urbanization, suburbanization, industrialization, and trade expansion rapidly took hold, dramatically altering the country's landscape. The agricultural industry continued to adapt to the demands of a large-scale operation while manufacturing and other industries flourished. In fact, much of the U.S. economic boom was centered in the expansion of the non-agricultural sector (Johansen and Fugitt 1984). During this twenty-year stretch, the U.S. was immersed in technology and technological innovations, ranging from humankind's first walk on the moon to the advent of the interstate highway system to the first commercial computer to the birth control pill. Importantly, these innovations required a labor force. And most of the labor force was found in or called to locations outside of the Great Plains. Geographically, much of the computer industry was centered in the west coast and the auto industry flourished in the Northeast, while the Great Plains remained agriculturally centered.

The demand for U.S. goods, agricultural and otherwise, reached beyond the U.S. borders. During this era, the U.S. government passed legislation directly influencing agriculture, namely the Agricultural Trade Development and Assistance Act of 1954 and the Trade Expansion Act of 1962. By reducing trade tariffs these acts expanded the market for U.S. goods and, presumably, the opportunity for U.S. profit. But while trade expanded, the proportional value of agricultural exports actually declined between 1930 and 1950 from 32% to 22%, and then remained stable until contracting further in 1970 to 19% of all U.S. exports (U.S. Department of Agriculture

2003). In contrast, agricultural products accounted for 58% of the value of all U.S. exports in 1900. Further, the prices farmers received for their products continued to decline relative to the costs of production (National Agricultural Statistics Service 2003).

Beyond tariffs, the government passed additional legislation that impacted the agricultural sector, especially the Great Plains region. Motivated by the resurrection of drought and dust storms, the Great Plains Conservation Program (GPCP) was initiated in 1956, with the following purpose:

To conserve and develop the Great Plains soil and water resources by providing technical and financial assistance to farmers, ranchers, and others in planning and implementing conservation practices (Public Law 84-1021).

This conservation program was an amended version of the Soil Conservation and Domestic Allotment Act of 1936, with a similar purpose to address wind and soil erosion extending beyond the Great Plains region. Conservation practices generally included seeding, reseeding, mulching, fencing, and irrigating. In essence, farmland was taken out of production and returned to grassland to repair the damage of previous erosion and prevent future destruction. Public Law 84-1021 was extended in 1969 and again in 1980, and remains operated through the Natural Resources Conservation Services (NRCS) of the U.S. Department of Agriculture.

While the proportional economic significance of the agricultural industry declined, between 1970 and 2000, rural places began to promote or at least be recognized for alternative features: recreational amenities and quality of life. Perhaps rooted in the country's earlier economic boom, more of the U.S. population looked for recreation and relaxation than before, whether it was in the form of a short-term vacation or a more long-term residential or retirement

move (Berry and Dahmann 1980; Fuguitt and Zuiches 1975; Long 1985; Long and Frey 1982; Zuiches 1981; Zuiches et al. 1978). It was during this era that the “population turnaround” occurred, albeit only for a brief period between 1970 and 1980. During this decade, population researchers noted a reversal in the typical rural-to-urban migration (Fuguitt 1985; Long and DeAre 1988; Wardwell and Gilchrist 1980). Instead of observing this normative pattern, they noticed growth among the rural locations accompanied by some decline within more urban places. Even though it was short-lived, the turnaround remains an important mark in the U.S. urbanization process.

By 1990 the typical pattern of urban centered growth had generally reconvened for the U.S. The extent to which the Great Plains region was affected by this population turnaround remains in question. Clearly, there are rural locations within the region and, therefore, we might expect that these rural places followed the national trend. However, given that much of the movement was to places within commuting distances to an urban center, the degree to which this reversal greatly upset the normative trend within the Great Plains is potentially low. Studies of the population turnaround by region have suggested that the turnaround was less dramatic in the Great Plains than other areas of the U.S. (Richter 1985). Still, there are at least a handful of urban places within the region and it is likely that these places and their neighbors were influenced, although perhaps to a lesser degree than other regions. Beyond retirement and recreation, the later part of the 20th century witnessed a movement of small manufacturing companies and energy developments in the Great Plains. With the companies came jobs and, some have argued, population stability if not growth (McGranahan 1998; Murdock, Leistriz, and Schriener 1980).

During the Agricultural Bust Period, between 1970 and 2000, more agricultural legislation occurred. While there was not a return of the Dust Bowl during this era, “green” politics in agriculture had taken hold and continued to influence agricultural policy. And, given declining agricultural prices, farmers and ranchers were willing if not relieved participants of the Conservation Reserve Program. Similar to the GPCP, this program...

...provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner (Farm Service Agency 2003).

CRP was established in 1985 under the Food Security Act and is operated through the Farm Service Agency, an agency within the NRCS. It is available to farmers and ranchers within and beyond the Great Plains region. Like the GPCP, CRP addresses soil erosion by taking land out of production through, in essence, renting the land from the farmer and rancher. More crudely stated, farmers and ranchers are paid to not farm or graze a certain amount of their land. As though the legislators had some foresight, by 1988 the parts of the Great Plains experienced one of the U.S.’s most severe droughts. These harsh environmental conditions were accompanied by plummeting land values and increasing competition with foreign exports.

DATA AND METHODS

Defining the Great Plains

There is no consistent geographical definition of the Great Plains among historians, geographers, demographers, and sociologists. Inclusion ranges from six U.S. states in their entirety to counties within 13 states plus Canadian and Mexican territories. The eastern border is

sometimes drawn at the 98th meridian, the 100th meridian, or the line following 20 inches or less of rainfall, while the western boundary is typically demarcated at the base of the Rocky Mountains. Yet, scholars agree that the Great Plains is distinct from its surrounding areas by its semi-arid quality.

The Great Plains region is semi-arid, meaning that some years it is dry and even arid, or desert-like, while other years it is very wet. Still, in other years it is wet or dry at the wrong time from the viewpoint of agricultural production (Kraenzel 1955:12). It is this unpredictability, or annual variation that separates the Plains from its more predictable eastern and western neighbors. The Great Plains are not the only area considered semi-arid. In fact, nearly 15% of the world's surface is similarly classified. Yet it is the only semi-arid region within the U.S.

The sample for this study follows the U.S. Geological Survey definition and, therefore, includes approximately 876 counties within 13 states (aggregated into 745 county clusters, as described in greater detail below), illustrated in Figure 1.¹ Data are drawn from the *Historical, Demographic, Economic, and Social Data: The United States, 1790-1970*, made available by the Inter-University Consortium for Political and Social Research (ICPSR 1976), and supplemented with U.S. Census data to gain county level data for all decades between 1900 and 2000.

[Figure 1 About Here]

Counties are the selected unit of analysis given that they are governmental units functioning to unify the population within its boundaries. Government taxes and programs involving agriculture, social welfare, education, and transportation construction and maintenance operate at the county-level. Because few large metropolitan centers are found within the Great

Plains, concerns regarding metropolitan overflow incessantly bothersome in studies of more urban locations do not apply to the present study.

However, county borders change over time. And county borders tend to change for political reasons mainly associated with population size. Using a template developed by Horan Hargis, and Killian (1989), each county is converted into its 1900 form and given a unique county cluster code, producing 745 county clusters for analysis according to the 1900 boundaries.² Some counties do not change their shape while others are dramatically different. For example, most of the counties in Iowa have not changed their boundaries since 1900, yet almost every county in Oklahoma has. In fact, in 1900, Oklahoma had not yet become a state and was largely considered “Indian Territory.” The southern and northeastern parts of the state were divided between two large areas, while smaller county divisions were made in the northwestern part of the state. This division is reflected in Figure 1, resulting in a few relatively huge county clusters.

Assessing and Estimating Population Change

I begin the exploration of variation in population change with an assessment of average growth rates, or percent population change,³ across the century. Here, emphasis is placed on the temporal aspect of variation in patterns of population change. The county averages are compared to state and national figures in order to situate the Great Plains’ level of change in a meaningful context. I then place varying patterns of growth within a geographic environment. Using GIS tools, notable spatial patterns of population change are revealed when mapping the patterns of growth for the Great Plains counties across the century.

Mean growth curve modeling techniques are employed to characterize the average growth rate and population trajectory in addition to the extent of county-specific variation around the mean trend. This analysis provides statistical estimates of the observed variation in temporal and spatial distributions. Estimation is conducted through use of growth modeling techniques (Byrk and Raudenbush 1992). There are two levels and, therefore, two equations that are estimated through this method. The first level model is sometimes referred to as the repeated observation model while the second level model is often known as the personal- or individual-level model. In the current analysis, level 1 contains 11 repeated observations of counties, one for each census year between 1900 and 2000, and level 2 is the county-level model.

In the linear growth model, level 1 is denoted as

$$Y_{ti} = \pi_{0i} + \pi_{1i} T_{ti} + e_{ti}$$

where π_{0i} indicates the initial status of county i when time is zero or 1900, π_{1i} indicates the expected change in the population between census years or the growth rate for county i , T_{ti} is the value of time for county i , and e_{ti} is the error for county i . Here, time is represented as a linear function. However, it can take on various forms including quadratic, spline, or log.

The accompanying level 2 model is denoted as

$$\pi_{0i} = \beta_{00} + \sum_{q=1}^{Q_0} \beta_{0q} X_{0qi} + \Gamma_{0i}$$

$$\pi_{1i} = \beta_{10} + \sum_{q=1}^{Q_0} \beta_{1q} X_{1qi} + \Gamma_{1i} .$$

In essence, this describes the average county-level population change by considering both the average initial status (π_{0i}) and the average growth rate (π_{1i}). Importantly, the purpose of the

analysis is not to fit the average trajectory in order to make claims about the general pattern of population change in the Great Plains. Instead, the average trajectory is estimated in order to quantify the observed variation about this average. The focus lies on whether and to what degree there is variation in county population change, or county population growth curves.

FINDINGS

Temporal Patterns of Population Change

Given the historical circumstances, it is reasonable to expect that patterns of county-level population change within the Great Plains would vary over the course of the 20th century. Further, it is unlikely that patterns of change were consistent across the vast region. I address precisely how these patterns changed, referring to counties as either having declined, grown, or remained stable. A county cluster was considered stable if the difference between two time points neither increased nor decreased by more than 5% of its value in the earliest year. Such classifications, reported in Table 1, are made for both era and decennial differences in order to gain both a broad and a more detailed understanding of population change. In the case of changes within an era, the differences are calculated by comparing population at the first and last points. For example, in the Settlement Period, classification was based on the population difference between 1900 and 1930. For the 1900 to 1910 decennial comparison, classification was based on the difference between 1900 and 1910 only. The corresponding growth rates for the entire U.S. are reported for comparative purposes.

[Table 1 About Here]

When reviewing the growth patterns over the four eras, the Great Plains county clusters generally experienced growth at the beginning and decline through the end of the century with a

slight rebound during the final period. During the Settlement Period, 65% of the 742 county clusters experienced growth while 24% suffered more than a 5% loss. Both the Plains and total U.S. were experiencing a high degree of growth during the early years, yet by the Crisis Period, the distribution practically reversed. Between 1930 and 1950, 60% of the Great Plains counties lost population while 24% grew. The U.S. in general was not experiencing the same degree of high growth relative to the preceding era, moving from a 62% increase to a 23% increase between the Settlement and Crisis Periods. This was a period marked by the Depression, the Dust Bowl, and WWII, the impacts of which were felt across the nation.

This pattern of greater loss in proportion to growth generally held during the Post-War period on the Plains. Despite the slight increase in Great Plains counties growing between 1950 and 1970 (from 24% to 26%), most places continued to decline during the twenty-year stretch. Yet there was a notable increase in the proportion of counties gaining population during the Agricultural Bust Period as fewer suffered loss. Here, 45% lost population while 13% remained stable and 42% actually experienced growth between 1970 and 2000. These patterns are consistent with the continued increase in the U.S. growth rate during this era relative to the preceding two epochs. This modest return to growth is interesting in light of media outcries regarding severe population loss within the Great Plains during recent periods. When taking a broader look at growth characterization over the century, improvements were actually made in the most recent era relative to the previous forty years.

Greater detail regarding patterns of population change can be gained from reviewing the decennial growth patterns. When referring back to the decennial differences reported in Table 1, we see that much of the growth characterizing the Settlement Period is concentrated in the first

and last decades, from 1900-1910 and 1920-1930. Between 1910 and 1920, the region experienced more loss than growth, perhaps due to noted drought conditions (Otto et al. 1966). However, by the end of the period, most counties either grew or remained stable while strikingly few declined, and the period in general is marked as an era of settlement and dryland farm expansion (U.S. Department of Agriculture 2003).

Consistent with the era comparisons, counties mainly experienced decline during the Crisis and Post-War Periods. The distribution remained nearly stable over these two epochs. While around half of the region continued to lose population, one-quarter to one-third of the counties remained stable and the remaining 20% grew. This dominant decline occurred while agriculture continued its transformation into a commercial venture and non-agricultural industries located mainly outside of the Great Plains expanded.

Regarding the final era, covering the years between 1970 and 2000, the region experienced growth at the beginning and ending decades, and loss in between. The Great Plains did experience positive growth during the 1970-1980 decade, when researchers observed the “population turnaround,” suggesting that the region may not have been excluded from the national pattern. And like the U.S., the pattern of growth reversed between 1980 and 1990, presumably when the population turnaround had ended and the rural-to-urban migration pattern recommenced. Yet, the pattern reverses again for the Great Plains in the final decade. The years between 1990 and 2000 were marked with growth where 41% of the counties grew and less than one-quarter experienced loss.

Estimates of the epoch-specific mean population growth trajectories are reported in Table 2. Initial status (β_{00} , r_{0i}), or the initial population, and change (β_{10} , r_{1i}), or the growth rate, are

included in the model, where the natural log of the county population for each decade within the epoch is the dependent variable. Figure 2 illustrates the predicted population for each of the epochs spanning the 20th century, calculated by considering both the initial status and the growth rate ($\exp(a + bT)$, where a is the initial status, b is the growth rate, and T is time with the first year in the epoch equal to 0). Whether the average growth rate significantly varies between the epochs is indicated in the figure, and confirms the temporal patterns described above. Overall, the Great Plains experienced considerable growth between 1900 and 1930. The growth trajectory significantly shifted during the next forty years, moving from rapid growth to a slight decline. Yet growth returned to the region during the final era. While not as dramatic as the first epoch, the years between 1970 and 2000 were marked by gradual growth.

[Table 2 About Here]

[Figure 2 About Here]

The Great Plains versus the U.S.

The pattern of population change in the Great Plains can be placed in context by comparing the percent change in population for the Great Plains sample to that of the state totals and the entire U.S. As evidenced in Table 3, the level of growth for the Great Plains sample is less consistent with those observed for the U.S. in the early part of the century, relative to the degree of correspondence observed toward the end of the one-hundred year period. Researchers have suggested that growth patterns for smaller, more rural geographical units become increasingly similar to national levels in later periods or stages of development, as economic structures become more similar to one another (Bender 1980). It is in these later periods that

employment patterns in rural areas became closely linked to national economic activity and, importantly, economic activity is associated with population growth.

[Table 3 About Here]

When reviewing the percent change in population by decade, the Great Plains growth levels exceed the U.S.'s between 1920 and 1930 by 15%. The magnitude of the growth over this ten-year period, following WWI and accompanying continued seed strain advancements, is substantial. For example, 85% of the Great Plains counties grew by more than 10%. More specifically, 24% of the counties increased by between 25% and 50%, and more than 18% grew by 50% or more. In contrast, less than 1% of the counties lost more than 10% of their population. Yet, between 1910 and 1920, during the war, the Great Plains suffered a 6% loss as the U.S. experienced a 15% gain. And between 1940 and 1950, the U.S. experienced an increase larger than the preceding years (15%), yet the Great Plains population remained nearly stable (6%). This was a decade of marked suburban growth for the U.S. in general (Edmonston and Guterbock 1984; Guest 1978; Schnore 1962). The divergence between the Great Plains and U.S. trends suggests that suburbanization was mainly located beyond the Great Plains boundaries. However, by the end of the century, especially after 1970, growth between the two comparison groups became more similar, deviating from one another by only three percent at most. Importantly, these deviations typically favored the Great Plains, such that this region underwent a slightly higher percentage increase in population relative to the entire U.S. For example, between 1990 and 2000, Great Plains counties grew by 16% while the U.S. experienced a 13% increase.

A similar story is revealed when comparing the percent change in population by era. In general, growth in the Great Plains sample slightly exceeds that of the U.S. at the end of the century. Yet there is a sizeable difference in the percent change between these two groups during the middle periods, where the U.S. population increased and the Great Plains population remained virtually stable, especially between 1930 and 1950.

The information in Table 3 also reveals important differences in population change between the states. Iowa remained relatively stable throughout the century, with only a faintly higher percentage increase between 1910 and 1920, and decreases between 1900 and 1910, and 1980 and 1990. In contrast, Oklahoma grew rapidly during the first two decades, before losing population and then returning to growth, but at a much more subdued rate. Still, Texas continued to grow at a relatively high, steady rate throughout the century, whereas North Dakota grew substantially between 1900 and 1910, but fluctuated between a 6% increase and decrease after 1920. Importantly, not all of the counties within these states are included in the Great Plains sample. So, while all of the states in total grew between 1910 and 1920, those counties within the Great Plains sample actually lost 6% of their population. And while no state exceeded a 25% increase, the Great Plains sample grew by almost 32% between 1920 and 1930.

Spatial Patterns of Population Change

Spatial distributions of population change for the respective eras are illustrated in Figure 3. During the Settlement Period, between 1900 and 1930, most of the growth was generally concentrated in the western portion of the Great Plains region while stability and decline were mainly located in the eastern counties, especially in Iowa, Minnesota and eastern Texas. This pattern reflects the extent and location of 20th century homesteading and metropolitan

development, in that most of the eastern counties had been settled long before the turn of the century while many counties and even some states were not yet or only very recently organized in the western Great Plains.⁴ While the region grew in total, expansion was concentrated in the western part of the Great Plains while loss was restricted to eastern counties, mainly in Iowa and Missouri. Further inspection of this period reveals that the negative growth observed for 1910-1920 in Table 1 was limited to the eastern and central counties (results not shown). As mentioned earlier, previous work has suggested that drought conditions in the Eastern and Central Plains during the 1910s may have contributed to population loss (Otto et al. 1966). Results here are suggestive of such a spatial distribution.

[Figure 3 About Here]

Between 1930 and 1950, during the Crisis Period, the spatial distribution of population change dramatically altered. There are two main differences. First, there is considerably less overall growth and strikingly more decline. Second, the distribution is no longer differentiated by east-west demarcations. Instead, noted in Figure 3, much of the loss was found in the center of the Great Plains region with limited stability and growth moving outward. Recall that during this period, the U.S. and the Great Plains witnessed several important historic events, namely the Great Depression, the Dust Bowl, and WWII. No place within the nation was unaffected by these events, including the Great Plains. This is also the era in which the agricultural industry began shifting from a family-based way of life to a larger, more business oriented model of production (Lobao and Meyer 2001). This transition left behind a considerable proportion of farmers with weak ties to the land and much motivation to find an alternative source of income.

In addition, those in the community who provided services to the farmers were also forced to seek alternatives.

This general pattern continued through the Post-War Period, between 1950 and 1970. Again, most of the decline is located in the center of the Great Plains. Yet growth and stability appears to have extended inland, reaching western and central South Dakota, as well as eastern Oklahoma and southern Missouri. In essence, stability and growth were not as concentrated along the boundaries, but interior counties experienced positive growth during this period in addition to border counties. The spatial distribution appears less concentrated and comparatively more evenly dispersed.

Yet during the Agricultural Bust Period, a stronger geographic pattern re-emerges. Rather than seeing both stability and growth relatively evenly distributed around these central counties, the final map in Figure 3 reveals that most of the growth was again restricted to the region's periphery, especially along the western, southeastern, and southwestern boundaries, while the northern counties mainly suffered loss. For example, between 1970 and 2000, nearly all counties within North Dakota declined while most counties within southern Montana, Wyoming, southeast Texas and New Mexico experienced stability and growth. Many of the growing areas correspond to energy developments in the early part of the period, mainly consisting of coal and oil extraction; although researchers claim that such mining based growth is eventually followed by nearly as much loss (Murdock et al. 1980).

Figure 4 shows the observed county-specific growth rates for each of the four eras. The estimated mean growth rates, reported in Table 2, are also noted. The panels reveal that relatively few counties actually share the estimated average growth rate. Instead, there is

considerable county level variation around the average trajectory, such that some counties have higher rates of growth while others are lower. For example, between 1900 and 1930, the average decadal growth rate was 0.16. Only 6 counties (0.8%) actually shared this growth rate, with the first 25% of the counties falling below -0.04, the next quartile break at 0.22 followed by 0.82. During the Crisis Period, 1.2% of the counties shared the average growth rate of -0.03 with inter-quartile breaks at -0.23, -0.11, and 0.06. This distribution is relatively comparable for the Post-War Period but slightly higher values are observed for the Agricultural Bust Period given the positive mean growth rate of 0.02.

[Figure 4 About Here]

Examination of the variance components and chi-square estimates produced in the growth curve analysis, reported in Table 2, provides statistical support for the observed spatial variation. The estimates indicate that significant variation in population growth persists within each epoch throughout the century. The greatest level of divergence is observed during the Settlement Period, with considerable deviation in the Crisis and Agricultural Bust Periods, while the smallest degree of variation in the rate of growth is found for the Post-War Period.

DISCUSSION

These temporal and spatial comparisons have two noteworthy implications for perceptions of the Great Plains and notions regarding long-term patterns in regional population change. First, the analysis indicates that variation in the distribution of growth patterns persisted within and between eras and decades throughout the century. Second, the dominant pattern was either population growth or decline and not stability. This second point is further illustrated in Figure 5. Here, comparisons are made between the population in 1900 and 2000. Much of the

recent attention regarding population change in the Great Plains highlights instances where present-day counties have lower populations than they did at the turn of the century (Rowley 1998). This is not necessarily the norm for all Great Plains counties. Instead, nearly 60% of the counties had comparable or larger populations in 2000 than in 1900. Among those not in the red, more than half of the counties had larger populations in 2000, most of which are found within the western portion of the region.

[Figure 5 About Here]

This statement is not intended to imply that the Great Plains has not suffered population loss or low growth. This, too, is clearly not the case. Yet it does indicate that the region as a whole cannot be accurately characterized as exclusively experiencing growth or decline or stability. Rather, the region is best described as one containing variation in population change across both time and space. Some counties grew, while others remained stable or declined. Further, counties did not experience only one of these statuses, but had varying directions and degrees of growth throughout the century.

Regarding temporal variation, the Great Plains witnessed rapid and extensive growth during the first thirty years of the 20th century. In fact, growth in the Plains exceeded that observed for the U.S. as a whole. Most of the expanding counties were located in the western part while those suffering loss were limited to the east, highlighting the spatial distribution of 20th century settlement patterns. Yet this period of remarkable growth was followed by dramatic loss. Between 1930 and 1950, 60% of the Great Plains counties lost population. Although the U.S.'s growth rate also slowed during this period, it did not decline as severely as that of the Great Plains. The small percentage of growing counties were found along the region's

boundaries while the center, that most affiliated with agriculture, was overridden with loss. Gains were made in the Post-War period, between 1950 and 1970, as a somewhat larger proportion of counties experienced growth, some of which reached the region's center. However, decline dominated.

Growth returned to the Plains during the final period, spanning the years between 1970 and 2000, although it remained mainly concentrated at the region's boundaries. The population turnaround appears to have impacted the Great Plains, as 43% of the counties grew between 1970 and 1980. A similar proportion of growth was also observed for the 1990-2000 decade. Further, the overall growth rates became more similar to the nation's rates. This growth, and its correspondence with the nation's, may be attributable to a shift in the Great Plains' economic structure. Researchers have noted an increase in the number of manufacturing businesses and employees within the region in recent years (Beale 1980; McGranahan 1998), while others have emphasized energy developments (Murdock et al. 1980) and recreational expansion (Heaton, Clifford, and Fuguitt 1981). Such research suggests that the region is economically diversifying and growing increasingly similar to the nation's economic base; therefore, regional growth patterns more similarly approximate the national trends (Bender 1980).

This analysis is intended to motivate additional exploration of growth patterns in the Great Plains. While I have drawn links between county level growth and the historical context in which these patterns are observed, the next step lies in identifying the influence of specific county characteristics that might explain temporal and spatial variation. There are several factors researchers have identified as potential correlates of population growth, including economic development. Yet there are aspects of the Great Plains that may be equally if not more

influential in shaping the population landscape, such as climate and government involvement.

This study provides an important first step in a potentially extensive and worthwhile line of research concerning trends in, and correlates and consequences of population change.

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ENDNOTES

¹ I have selected a broader definition than some studies of the Great Plains in an attempt to remain as inclusive as possible. Minnesota, Iowa, and Missouri are often omitted from studies of this region due to the variation in precipitation, grass length, and altitude. For example, *The Great Plains Population and Environment Project* excludes counties within these three states, thereby creating a sample of 450 counties (Gutmann et al. 1998). Other contemporary Great Plains researchers (Cromartie 1998) restrict their analysis to 478 counties. However, while places within these states may receive more than 20 inches of rainfall, evaporation maintains semi-arid conditions among the western counties within these states (Kraenzel 1955).

² Use of the template has the following implications: if county A and B are not involved in the formation of a new county there would be no change in their county code, and would each be assigned a separate county cluster code. But, if county A split to produce county B, they would share the same county cluster code. Similarly, if county B merged with county A, they would also have the same county cluster code.

³ The percent change is calculated by $[1 - (P_t/P_{t+1})]$ and multiplied by 100, where P_t is the population at time 1 and P_{t+1} is the population at time 2, with values generally ranging from -1 to 1 (Farley 1964). A zero indicates stability, while a value less than zero implies decline and a value greater than zero suggests growth. While I refer to this measure as “percent change” it is different from typical formulas of percent change, although generally comparable to alternative measures of percent change and growth rates. In essence, this equation calculates the relative size of the old to the new population.

⁴ The rectangular county in Colorado along the western border is the Arapahoe/Adams County Cluster. Here, population loss was recorded between 1900 and 1910, as much of the population moved west to its neighbor, Denver.

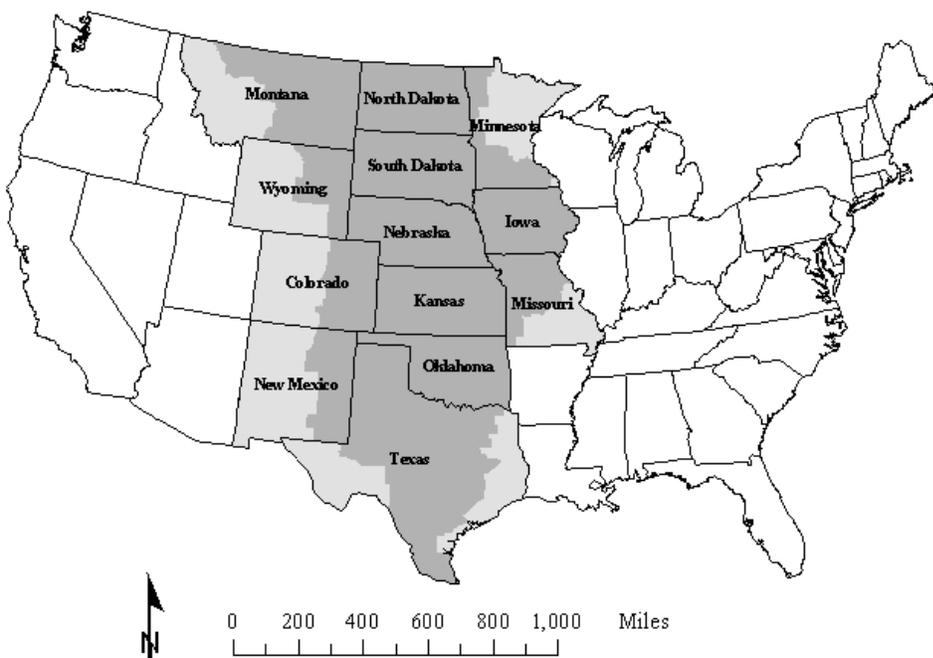


Figure 1. The Great Plains County Clusters within the Study Sample

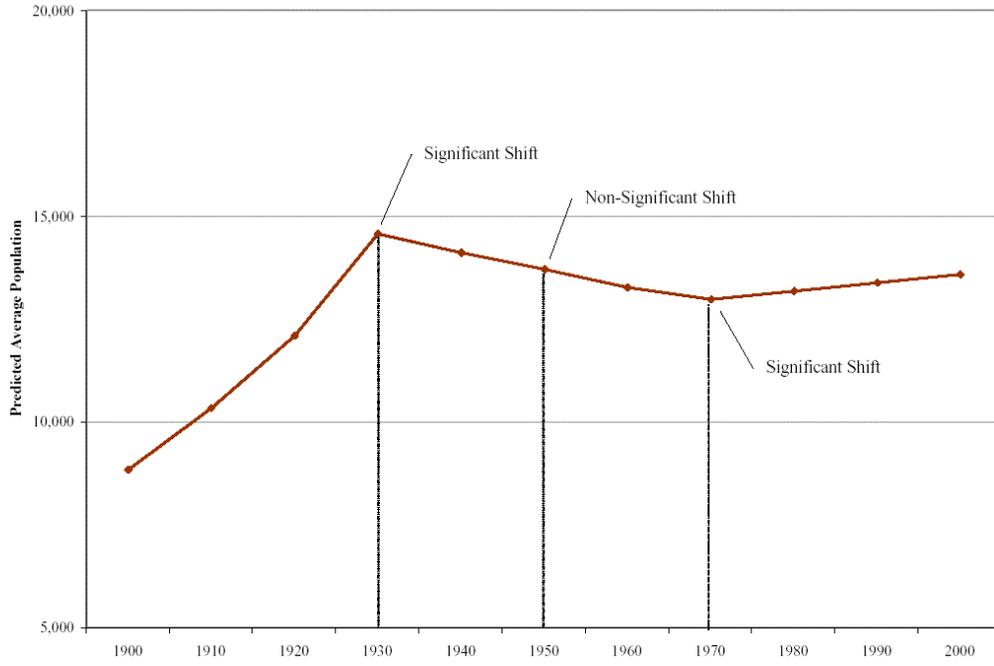


Figure 2. Predicted Average Population by Year according to Epoch-Specific Population Trajectories, 1900 to 2000

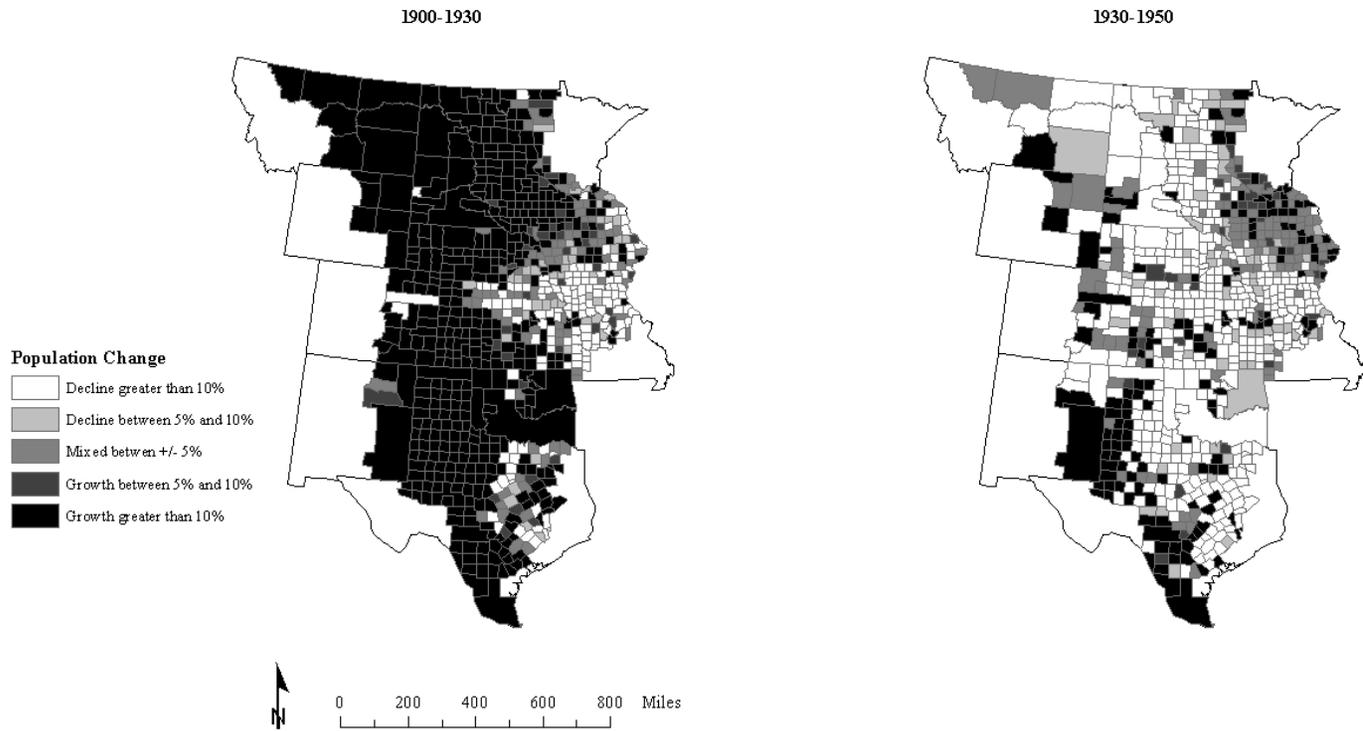


Figure 3. Population Change throughout the 20th Century

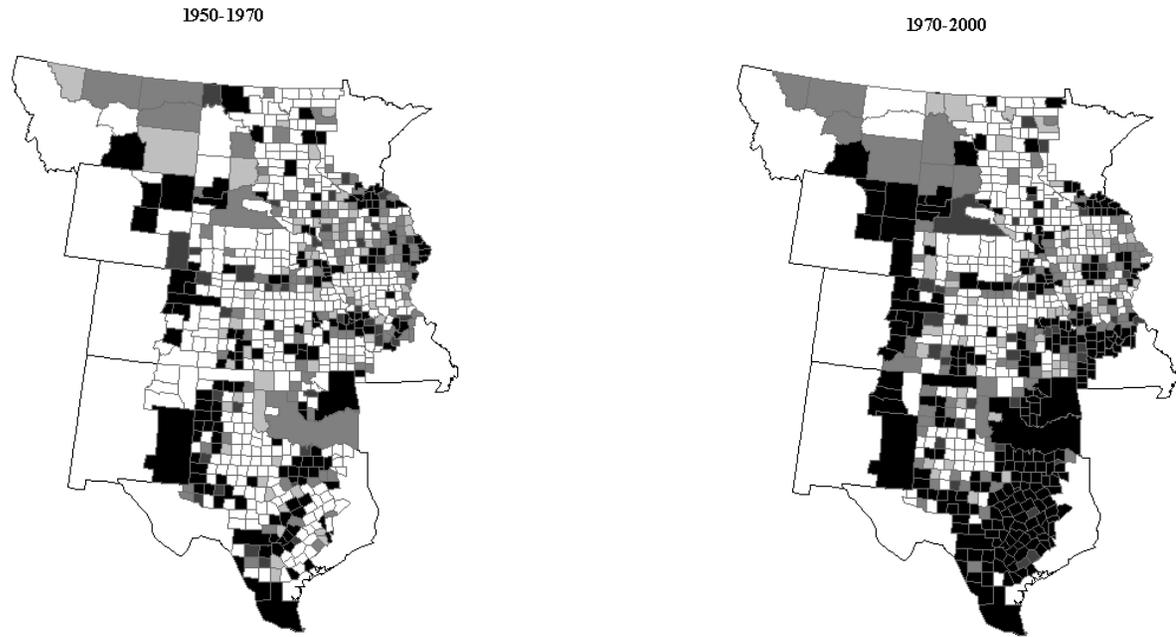


Figure 3. (continued)

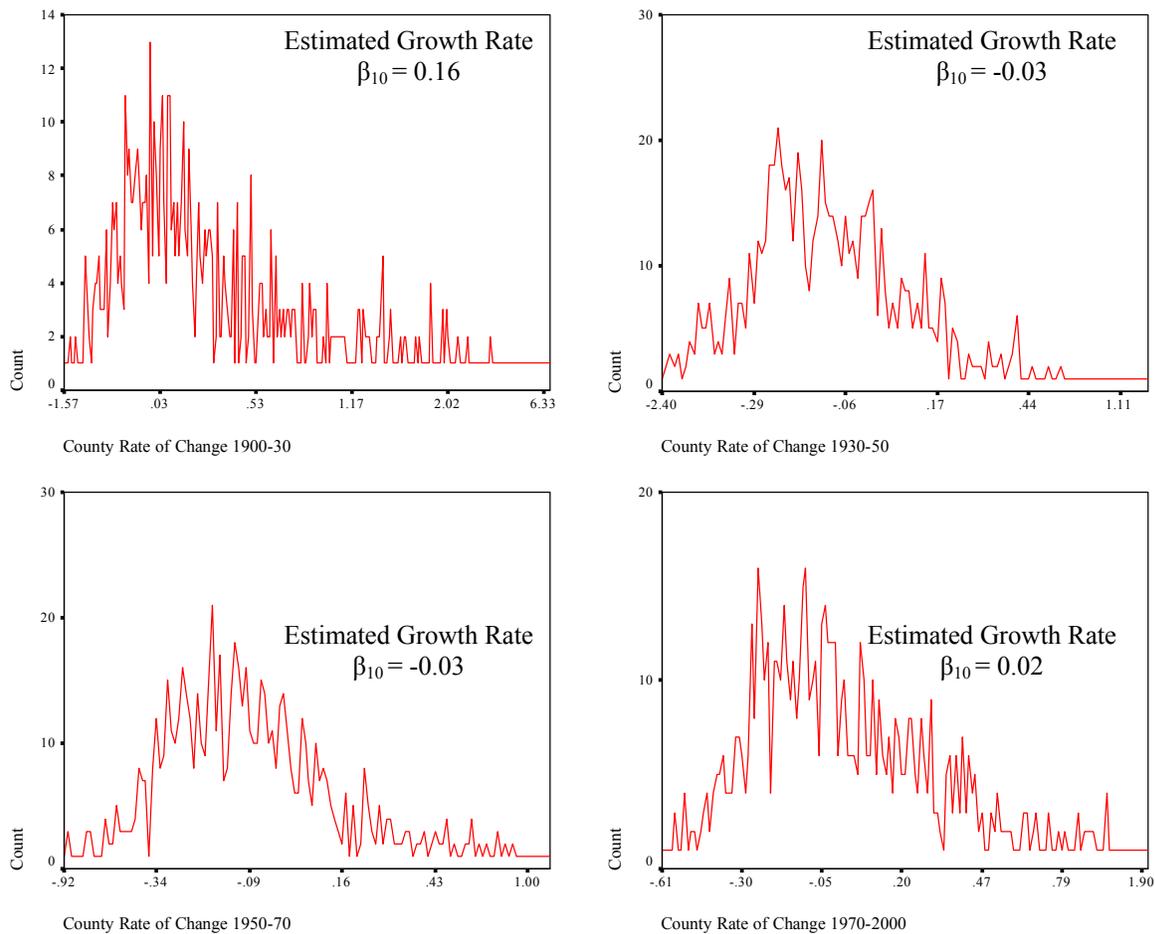


Figure 4. Distribution of County-Specific Growth Rates Relative to the Estimated Mean Growth Rate for Each Era

Note: Estimated mean growth rates (β_{10}) are derived from growth curve modeling techniques, results reported in Table 2.

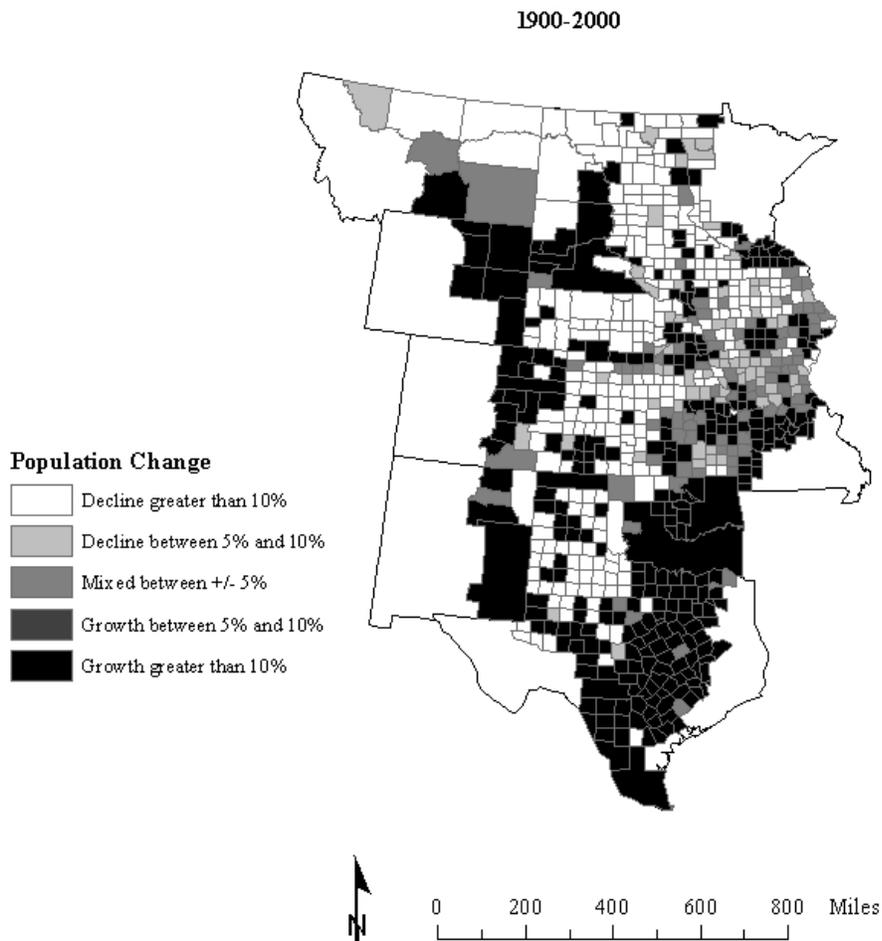


Figure 5. A Century of Population Change in Summary, 1900-2000

Table 1. Growth Characterizations for Great Plains County Clusters by Epoch and Decade (N = 742)

	N	%		N	%
Epoch					
Settlement Period, 1900-1930			Post-War Period, 1950-1970		
Decline	181	24.4	Decline	444	59.8
Stable	80	10.8	Stable	103	13.9
Growth	481	64.8	Growth	195	26.3
<i>U.S. Growth</i> ^a		61.7	<i>U.S. Growth</i>		34.3
Crisis Period, 1930-1950			Agricultural Bust Period, 1970-2000		
Decline	447	60.2	Decline	335	45.1
Stable	115	15.5	Stable	98	13.2
Growth	180	24.3	Growth	309	41.6
<i>U.S. Growth</i>		22.8	<i>U.S. Growth</i>		38.5
Decade					
1900-1910			1950-1960		
Decline	151	20.4	Decline	355	47.8
Stable	154	20.8	Stable	203	27.4
Growth	437	58.9	Growth	184	24.8
<i>U.S. Growth</i>		21.0	<i>U.S. Growth</i>		18.5
1910-1920			1960-1970		
Decline	547	73.7	Decline	400	53.9
Stable	81	10.9	Stable	183	24.7
Growth	114	15.4	Growth	159	21.4
<i>U.S. Growth</i>		15.0	<i>U.S. Growth</i>		13.3
1920-1930			1970-1980		
Decline	13	1.8	Decline	156	21.0
Stable	43	5.8	Stable	269	36.3
Growth	686	92.5	Growth	317	42.7
<i>U.S. Growth</i>		16.2	<i>U.S. Growth</i>		11.5
1930-1940			1980-1990		
Decline	336	45.3	Decline	412	55.5
Stable	264	35.6	Stable	182	24.5
Growth	142	19.1	Growth	148	19.9
<i>U.S. Growth</i>		7.3	<i>U.S. Growth</i>		9.8
1940-1950			1990-2000		
Decline	388	52.3	Decline	159	21.4
Stable	180	24.3	Stable	280	37.7
Growth	174	23.5	Growth	303	40.8
<i>U.S. Growth</i>		14.5	<i>U.S. Growth</i>		13.2

^a Indicates the percent change in the total U.S. population calculated by $(pt+1 - pt)/pt * 100$

Table 2. Linear Model of Growth in County Population by Epoch

	Settlement Period, 1900-1930				Crisis Period, 1930-1950			
<i>Fixed Effect</i>	<i>Coefficient</i>	<i>SE</i>	<i>p-value</i>		<i>Coefficient</i>	<i>SE</i>	<i>p-value</i>	
Mean Initial Status, β_{00}	9.07	0.05	0.000		9.58	0.03	0.000	
Mean Growth Rate, β_{10}	0.16	0.01	0.000		-0.03	0.01	0.032	
	<i>Variance</i>				<i>Variance</i>			
<i>Random Effect</i>	<i>Component</i>	<i>df</i>	<i>X²</i>	<i>p-value</i>	<i>Component</i>	<i>df</i>	<i>X²</i>	<i>p-value</i>
Initial Status, r_{00}	1.76	741	20238.53	0.000	0.74	741	79108.23	0.000
Growth Rate, r_{10}	0.08	741	4032.76	0.000	0.02	741	4330.47	0.000
Level 1 Error, e_{it}	0.10				0.01			
<i>Correlation between Change and Initial Status</i>	-0.78				0.10			
	Post-War Period, 1950-1970				Agricultural Bust Period, 1970-2000			
<i>Fixed Effect</i>	<i>Coefficient</i>	<i>SE</i>	<i>p-value</i>		<i>Coefficient</i>	<i>SE</i>	<i>p-value</i>	
Mean Initial Status, β_{00}	9.53	0.03	0.000		9.47	0.04	0.000	
Mean Growth Rate, β_{10}	-0.03	0.01	0.000		0.02	0.00	0.001	
	<i>Variance</i>				<i>Variance</i>			
<i>Random Effect</i>	<i>Component</i>	<i>df</i>	<i>X²</i>	<i>p-value</i>	<i>Component</i>	<i>df</i>	<i>X²</i>	<i>p-value</i>
Initial Status, r_{00}	0.87	741	29784.96	0.000	1.20	741	352720.90	0.000
Growth Rate, r_{10}	0.01	741	1177.24	0.000	0.02	741	16848.41	0.000
Level 1 Error, e_{it}	0.03				0.00			
<i>Correlation between Change and Initial Status</i>	0.88				0.41			

Table 3. Percent Change in Population for Great Plains States and the Total U.S. compared to the Great Plains Sample by Decade and Epoch

	Percent Change ^a by Decade									
	1900- 1910	1910- 1920	1920- 1930	1930- 1940	1940- 1950	1950- 1960	1960- 1970	1970- 1980	1980- 1990	1990- 2000
Colorado	48.0	17.6	10.2	8.4	18.0	32.4	25.8	30.9	14.0	30.6
Iowa	-0.3	8.1	2.8	2.7	3.3	5.2	2.4	3.2	-4.7	5.4
Kansas	15.0	4.6	6.3	-4.3	5.8	14.3	3.1	5.2	4.8	8.5
Minnesota	18.5	15.0	7.4	8.9	6.8	14.5	11.5	7.1	7.3	12.4
Missouri	6.0	3.4	6.6	4.3	4.5	9.2	8.3	5.1	4.1	9.3
Montana	54.5	46.0	-2.1	4.1	5.6	14.2	2.9	13.3	1.6	12.9
Nebraska	11.8	8.7	6.3	-4.5	0.7	6.5	5.1	5.8	0.5	8.4
New Mexico	67.6	10.1	17.5	25.6	28.1	39.6	6.8	28.2	16.3	20.1
North Dakota	80.8	12.1	5.3	-5.7	-3.5	2.1	-2.3	5.7	-2.1	0.5
Oklahoma	109.7	22.4	18.1	-2.5	-4.4	4.3	9.9	18.2	4.0	9.7
South Dakota	45.4	9.0	8.8	-7.2	1.5	4.3	-2.2	3.8	0.8	8.5
Texas	27.8	19.7	24.9	10.1	20.2	24.2	16.9	27.1	19.4	22.8
Wyoming	57.7	33.2	16.0	11.2	15.9	13.6	0.7	41.3	-3.4	8.9
United States	21.0	15.0	16.2	7.3	14.5	18.5	13.3	11.5	9.8	13.2
Great Plains Sample	17.2	-5.9	31.2	0.4	5.9	12.2	8.1	14.2	9.3	16.1
	Percent Change by Epoch									
	1900- 1930	1930- 1950	1950- 1970	1970- 2000						
Colorado	91.9	27.9	66.6	94.9						
Iowa	10.7	6.1	7.8	3.6						
Kansas	27.9	1.3	17.9	19.7						
Minnesota	46.4	16.3	27.6	29.3						
Missouri	16.8	9.0	18.3	19.6						
Montana	120.9	9.9	17.5	29.9						
Nebraska	29.2	-3.8	11.9	15.4						
New Mexico	116.7	60.9	49.2	79.0						
North Dakota	113.3	-9.0	-0.3	4.0						
Oklahoma	203.1	-6.8	14.6	34.8						
South Dakota	72.5	-5.8	2.0	13.4						
Texas	91.1	32.4	45.2	86.2						
Wyoming	143.8	28.8	14.4	48.5						
United States	61.7	22.8	34.3	38.5						
Great Plains Sample	44.6	6.3	21.2	45.0						

Note: Data from the U.S. Census Bureau

^a Indicates the percent change in the total U.S. population calculated by $(pt+1 - pt)/pt * 100$

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