

# THE DETERMINANTS OF INCOME INEQUALITY IN RURAL WISCONSIN AND POLICY IMPLICATIONS



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## Preface

Enclosed please find our final research report titled “**The Determinants of Income Inequality in Rural Wisconsin and Policy Implications.**” Our project is funded by Tommy G. Thompson Center on Public Leadership under “Challenges Facing Rural Communities in Wisconsin” for 2022-2023.

We have measured income inequality in Wisconsin with an emphasis on rural communities while identifying the main explanatory factors. The American Community Survey data and quantile regression analysis have been used to evaluate the impact of access to broadband, childcare, education, entrepreneurship, gender, and race on rural incomes. Lastly, we have offered recommendations to Wisconsin policymakers on how to use our empirical findings to improve the prospects of rural communities and combat rural poverty.

This project is a collaboration of three faculty members in the Department of Economics at the University of Wisconsin – Eau Claire. I have developed this proposal and worked on the research with my colleagues and co-PIs Dr. Wayne Carroll and Dr. Maria DaCosta. Should you need any additional information, please do not hesitate to contact me at 836-3507 or at [liyan@uwec.edu](mailto:liyan@uwec.edu).

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## **Acknowledgment**

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While we have made every effort to mention everyone, please accept our apologies if any individual or group has been inadvertently overlooked. The completion of this research project would not have been possible without the support and contributions of each and every one of you.

## Introduction

Wisconsin has a disproportionate number of rural communities compared to other states, with 2.2 million Wisconsinites living in 58 rural counties as of 2018. These communities are currently facing many economic challenges, namely high levels of poverty, lack of high-quality services and poor infrastructure. For example, Wisconsin's agricultural sector is declining in importance as many small family farms are going out of business and others struggle to survive. The U.S. Department of Agriculture reports that the average per capita income for Wisconsinites in 2020 was \$55,593, with per capita income at \$49,842 and a poverty rate of 10.6% in rural regions. The income inequality in Wisconsin has been rising since the latter 20th century. It is no wonder the 2020 U.S. census shows a decrease in the population of many rural areas as more and more residents seek better economic opportunities in flourishing metropolitan areas such as Madison and Minneapolis-St. Paul.

Yet, these rural areas are "rich" communities with lots of potential. First, Wisconsin remains a national leader in farming with good prospects for production of organic and local foods. It is also a good location for new sources of renewable energy such as solar and wind, both for homes and businesses. It offers a comparative advantage in such activities as tourism and recreation. These are all sectors where businesses could potentially grow, given the opportunity and support, even in the rural areas. Rural entrepreneurship is key to economic development and poverty reduction. Second, although considerable state funds have been invested to strengthen the broadband across rural Wisconsin, about 25% of rural communities are still left out of this digital boom. The access to broadband will increase the availability of information that could help make those plans a reality. The literature has firmly established that "access to broadband has become a necessary, although not sufficient, condition for economic growth and development" (Deller et al., 2022).

Third, Wisconsin in general, and rural communities in particular, are becoming more ethnically diverse. Wisconsin's white population decreased from 86.2 % in 2010 to 80.4% in 2020, although across the 58 rural counties 94% of the population is white. In addition to the indigenous Tribal Nations that call Wisconsin home (55% of the Native population live in rural areas), 15% of all Wisconsin farmers and foresters are immigrants. "Immigrants are essential to the operation of rural Wisconsin's major industry sectors that provide essential goods and services. Five counties in southwestern Wisconsin dairy country, for example, saw Hispanic population grow by at least 115% in the 2000-2010 Census count; two of those counties exceeded 300% growth." (Wisconsin Economic Development Corporation, 2021)

Our study of Wisconsin's rural economy makes three contributions. First, we use a variety of data sources to study the facts and impacts of income inequality across rural Wisconsin and highlight the factors that contribute to such income gaps. Second, we undertake an econometric analysis to identify significant determinants of rural personal income. Third, we make a broad set of policy recommendations to alleviate rural poverty and promote economic development in rural areas.

## **Data**

In this study we have used several data sources that offer different perspectives on the problem of poverty in rural Wisconsin. Each source has limitations, so no single source tells the whole story; but together they provide a comprehensive view.

### **Integrated Public Use Microdata Series**

Every ten years through 2000, and each year after that in the American Community Survey (ACS), the U.S. Census Bureau asked a large sample of residents to complete the “long form” questionnaire, which includes dozens of questions about demographic and socioeconomic characteristics of American households and all the individuals in those households. After removing information that could be used to identify individuals, the Census Bureau makes a sample of the data available to researchers. The Institute for Social Research and Data Innovation at the University of Minnesota, in its Integrated Public Use Microdata Series (IPUMS) program, edits the Census samples to ensure comparability across years, and then provides the data in a user-friendly form to researchers (Ruggles et al., 2023). We have assembled a database that includes all IPUMS data for the state of Wisconsin from 2000 through 2021. Our data sample includes about 270,000 individuals in the decennial Census year of 2000 and more than 50,000 observations in almost every year after that.

The IPUMS data include a 5% sample of the population in 2000 and 1% samples in most subsequent years, so each observation represents about twenty individuals or households in 2000 and about one hundred in later years, on average; however, the Census Bureau assigns sample weights that differ across observations. In this study, the sample weights are applied in all calculations of summary statistics and in other analyses. In order to enhance comparability of dollar figures across years, wages and incomes are expressed in inflation-adjusted 2021 dollars. These inflation-adjusted dollar amounts were calculated using annual consumer price index (CPI) data.

The IPUMS data provide valuable information about a large sample of Wisconsin residents, but, unfortunately, they offer limited geographic detail. The smallest geographic unit in the data is the Public Use Microdata Area (PUMA), each of which includes a population of about 100,000 or more. PUMA boundaries generally follow county lines, but some PUMAs encompass more than one small-population county, and larger metropolitan areas – Milwaukee, Madison, and Green Bay – are spanned by more than one PUMA. Overall, Wisconsin’s 72 counties are covered by 40 PUMAs. Table 1 lists the counties included in each Wisconsin PUMA in recent years.

### **Wisconsin Poverty Report**

A second important data source is the *Wisconsin Poverty Report*, which was published annually from 2009 through 2020 by the Institute for Research on Poverty (IRP) at the University of Wisconsin-Madison (Smeeding & Thornton, 2020). The analysis in this series is generally based on the same Census microdata we have used, so it shares the same limitation in

its geographic detail; but it provides an excellent overview of the problem of poverty in Wisconsin.

## **Census Bureau**

The Census Bureau also provides summaries of ACS data at the county level – more detailed than in the IPUMS samples – for the five-year periods 2010-2014 and 2015-2019.

### **How Do We Define “Rural”?**

Our project’s focus on rural poverty in Wisconsin raises a fundamental question: how do we define *rural* places? Unfortunately, it is impossible to present a simple, unambiguous definition. Urban places in Wisconsin often contain small farms and undeveloped areas, while rural areas often are tied to regional urban centers by strong commuting or business connections. In our analysis, we adopt a working definition of “rural”; but we recognize that our definition is not perfect. At each step in our project, we have tested the robustness of our results under different definitions of “rural.”

Table 1 shows which PUMAs we identify as “rural” in our analysis. Our classification is based primarily on two criteria. First, we follow the U.S. Department of Agriculture in defining areas as rural if their population density is less than 500 people per square mile (USDA, 2019). Second, a non-metropolitan area is more likely to be rural if it does not contain a micropolitan area. The PUMAs we identify as rural have population densities less than 500 people per square mile and include counties with few or no micropolitan areas.

<Table 1>

Miller (2010) shows that comparisons of poverty rates between urban and rural areas are sensitive to the way “rural” is defined. Weber et al. (2005) show why this is the case. The U.S. Department of Agriculture classifies counties into nine categories in a rural-urban continuum based on their “degree of urbanization and adjacency to a metro area” (USDA, 2020), and Weber et al. show that poverty rates vary in a complicated way along the continuum. Average poverty rates tend to be lowest in suburban areas (such as St. Croix County) and highest in “nonmetro counties completely rural or less than 2,500 urban population, not adjacent to metro area” (such as Adams County), but do not increase uniformly from less-rural to more-rural counties.

### **Dimensions of Rural Poverty in Wisconsin**

How do Wisconsin’s rural poverty challenges differ from those of urban places? What are the characteristics of rural residents living in poverty? Using our large microdata collection, we can sketch a picture of Wisconsin’s rural poor, comparing and contrasting rural and non-rural measures.

## Poverty Rates

Earlier studies of rural poverty at the national level offer some guidance as we examine the Wisconsin data. Weber et al. (2005) provide a valuable review of quantitative research on determinants and consequences of rural poverty. Studies cited there have examined cases in which rural poverty rates exceed those in urban places and other cases where rural rates are lower; however, the evidence tends to support a presumption that rural poverty rates are higher. As we would expect, research shows that rural poverty is tied to higher unemployment rates, lower average levels of education, and the local industrial mix. Studies indicate that there is a limit to what can be explained by the data: “There appear to be unmeasured characteristics of rural places that increase the prevalence of poverty” (Weber et al., 2005, p. 395). In particular, studies show that poverty is especially deep-rooted in remote counties with small populations and in places with low levels of social capital (civic participation, social networks, social trust, etc.). Unfortunately, our data do not allow us to focus on small, remote Wisconsin counties and do not include measures of social capital.

Is the poverty rate higher in Wisconsin’s rural areas than in non-rural areas? Several different measures of poverty rates lead to the same conclusion: average poverty rates are somewhat lower in rural Wisconsin than in non-rural areas. Broadly speaking, rural areas in Wisconsin are not mired in the profound, seemingly hopeless poverty that we observe in some other regions of the U.S. (Menominee County is the only Wisconsin county in “persistent poverty” (Benson, et al., 2023).)

The U.S. Census Bureau’s most recent estimates of official poverty rates at the county level are based on ACS data from 2014 to 2019. Poverty rates vary widely across counties: rural rates range from 5.8% in Calumet County to 17.4% in Ashland County, and non-rural rates range from 4.6% in Washington County to 19.0% in Milwaukee County. (Menominee County is an outlier here, with an official poverty rate of 35.3%.) We calculated weighted averages of the county poverty rates to estimate the poverty rates for rural and non-rural Wisconsin, based on the definition of “rural” in Table 1. This measure indicates that 12.1% of Wisconsin’s rural population lived at or below the poverty line in 2014-19, compared with 12.9% in non-rural areas. These figures are roughly consistent with the averages for the same years in our IPUMS microdata, which are also based on the official Census poverty rate: 12.9% in rural areas and 13.9% in non-rural areas.

The Institute for Research on Poverty at UW-Madison has developed a superior measure of the poverty rate, aptly called the Wisconsin Poverty Measure (WPM), which was the basis for its annual reports on Wisconsin poverty from 2007 to 2018 (Smeeding & Thornton, 2020). This measure improves upon the official Census poverty measure in several ways: it is based on a more careful delineation of household units, takes into account a wider range of cash and non-cash benefits, and uses more accurate poverty thresholds. Based on our definition of rural areas in Table 1 and the WPM results for 2018 (published in the 2020 report), we calculate that the average WPM in rural Wisconsin in 2018 was 9.4%, and the average in non-rural areas was 11.4%.

## Income

Since the boundaries between rural and urban Wisconsin are generally not sharp, it is not surprising to see that these areas are fairly similar in their demographic and socioeconomic characteristics, as shown in the remainder of this section. Nevertheless, we observe some important and interesting distinctions in our microdata.

Table 2 compares several income measures between lower-income and higher-income residents in rural and non-rural areas. In this table, and the next three that follow, the lower-income group includes people whose total family income is less than or equal to 200% of the official poverty threshold (which depends on the size of the family, the number of children, and the age of the head of the household). The not-low-income group includes all other individuals in our sample. In our data, about 23% of Wisconsin's adult population falls into the low-income group, and the other 77% is classified as not low-income. (For convenience, we will use the terms *not-low-income* and *higher-income* interchangeably.) The sample in Table 2 is restricted to adults at least 24 years old (so most people in the sample have completed their education) and includes observations from 2016 through 2021.

<Table 2>

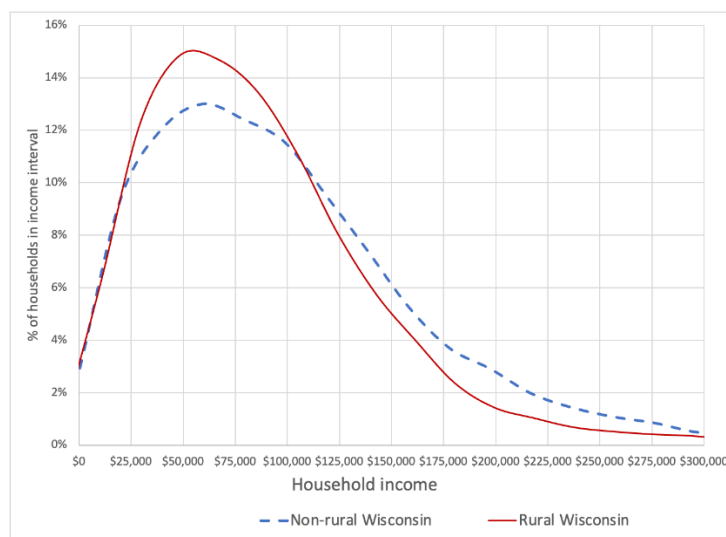
Among higher-income residents, median household income is higher in non-rural areas than in rural areas, while median household incomes among low-income adults are about the same between rural and non-rural areas. This is not surprising in light of the earlier observation that poverty rates are similar in rural and non-rural areas. Estimated hourly wages are lower in rural areas, although the difference is small among low-income workers. (We calculated estimates of hourly wages using data on annual wage income, hours worked per year, and usual hours worked per week.) The largest share of total income in all groups comes from wages. Among higher-income residents, wages provide a smaller share of total income in rural areas (60.2%) than in non-rural areas (68.3%), while rural residents earn larger shares from Social Security income (reflecting an older rural population, on average) and business and farm income than non-rural residents.

Not surprisingly, wages provide a much smaller share of total income for low-income adults, on average. Average business and farm income in rural areas is negative, indicating that farm and business losses push some residents' incomes below or near the official poverty line. Social Security income is a large share of total income – almost as large as the wage income share – in both rural and non-rural areas. The problem of poverty – especially in rural areas – is disproportionately concentrated among senior citizens.

Figure 1 compares the distribution of household income between rural and non-rural areas in Wisconsin. (The vertical axis in Figure 1 shows the percentages of the population that fall within each income interval in the data behind the scenes in the graph.) The graph reflects our earlier observations: median household income is higher in non-rural areas, and the income distributions are similar at lower income levels (resulting in similar poverty rates and median incomes among low-income residents). The income distribution in rural areas is narrower, with a peak around \$48,000 (compared with about \$59,000 in non-rural areas), which implies that there



is a lower degree of income inequality in rural areas. This conclusion is consistent with county-level Census data on Gini coefficients for households in 2021, which show a value of 0.42 for Wisconsin's rural areas and 0.44 for non-rural areas. (A smaller Gini coefficient indicates a lower level of income inequality.)



*Figure 1. Household income distribution – rural vs. non-rural areas*

## Demographics

Table 3 shows that rural residents in Wisconsin are older, on average, than non-rural residents, with a significantly higher percentage aged 65 years or more. Of low-income rural residents, 34.3% are at least 65 years old. (Additional calculations, not shown in Table 2, indicate that among residents at least 65 years old, 30.2% in rural areas and 26.6% in non-rural areas have family incomes 200% of the poverty line or less.) Senior citizens constitute a significant cluster among Wisconsin's rural poor.

<Table 3>

Rural residents are more likely to have been born in Wisconsin and are less likely to be foreign-born. The rural population is more likely to be white than the non-rural population. Lower-income rural residents are a little less likely to have been born in Wisconsin or to be white.

There are sharp distinctions in marital status between low-income and upper-income residents. A much lower percentage of low-income residents are married (compared with higher-income residents), and much higher percentages are divorced, never married, or widowed. Poverty status is strongly associated with household composition, especially in rural areas.

Table 4 presents data on educational attainment among adults. High school graduation rates are similar between rural and non-rural areas and are lower among low-income residents. (About 40% of the low-income rural residents without a high school education are elderly – 65 years or older – and another 11% are foreign born.) There is a much larger difference in college graduation rates between rural and non-rural areas: only 11.0% of low-income and 27.8% of higher-income rural adults have a college degree, compared with 42.1% of higher-income non-rural residents. The connection between educational attainment and socioeconomic status in rural areas is complicated, with causation running in both directions. Lower levels of educational attainment lead to narrower employment prospects and lower incomes in rural areas. On the other hand, rural areas offer fewer employment opportunities for highly educated residents, so rural residents have less incentive to pursue higher levels of education. Education is a key determinant of socioeconomic status, but anti-poverty initiatives focusing on education must strive for both more degrees and more high-skill jobs.

<Table 4>

## **Employment**

Summary data on employment patterns in rural and non-rural areas are presented in Table 5. Labor force participation rates, average weeks worked per year, and average usual hours worked per week are somewhat lower in rural Wisconsin than in non-rural places, which helps to explain why average incomes are lower in rural areas. Low-income residents – both rural and non-rural – have significantly lower labor force participation rates, well below 50%. For those who are working, average weeks worked per year are only a little lower than for higher-income adults, but their average usual hours of work per week are much lower, indicating that many lower-income rural residents are only working part-time.

<Table 5>

Our data also include a measure of occupational status, which shows that rural occupations require less education and pay lower salaries than non-rural occupations, on average. This suggests that rural residents work in a mix of occupations that require somewhat lower skill levels, on average, than the occupations of non-rural residents. This measure, the Nam-Powers-Boyd occupational status score (NPB), assigns a score to each occupation based on the median education level and median income of people working in that occupational classification. It can be interpreted as a percentile score: for example, the NPB of 39 for carpenters means that carpenters have higher median levels of education and income than 39% of all workers. The NPB occupational scores are based on national data, so they provide a uniform benchmark for rural and non-rural workers in our sample. Table 5 shows that the average NPB score for higher-income men in rural Wisconsin is 48.0, compared with 55.4 for higher-income men in non-rural areas. Low-income men work in lower-skilled occupations, with an average NPB of only about 35. Among low-income men, like higher-income men, the average NPB score is lower in rural areas than in non-rural areas.

About 12% of rural men report that they are self-employed, compared with about 8% of non-rural men. (Self-employment rates are about half as high for women.) The higher self-employment rate in rural areas suggests alternative possible hypotheses. It might indicate that there is a higher rate of entrepreneurial activity among rural residents, or perhaps it reflects a relative lack of opportunities for formal wage and salary employment in rural areas. The self-employment category includes a wide range of occupations, from low-paid casual labor to highly paid professional work. Therefore, it is hard to identify the implications of the higher rural rate for the livelihoods of these residents.

### A Closer Look at Income Inequality in Rural Wisconsin

Income is a critical factor that largely influences the standard of living, which is measured at both the individual and household levels in our study. Deaton (1997) claims welfare resides in individuals, not households. In this section, we present a big picture of economic well-being in rural Wisconsin in terms of income inequality at the individual level.

In the existing literature, the Gini coefficient has been commonly used to gauge income disparity. As noted earlier, the Gini coefficient is a number between 0 and 1 that describes the degree of evenness of the income distribution in a population. In general, a lower Gini coefficient indicates a more equitable distribution of wealth, while a higher Gini value implies a more economically polarized society. Figure 2 presents the Gini coefficients for counties in Wisconsin from 2013 to 2017. Different color codes indicate different ranges of Gini index. For instance, blue means the Gini index is between 0.3880 and 0.4041. Based on Figure 2, Sawyer County, a rural county, has the most unequal income distribution in Wisconsin, while Calumet County has the most equal distribution (Deller et al., 2019).

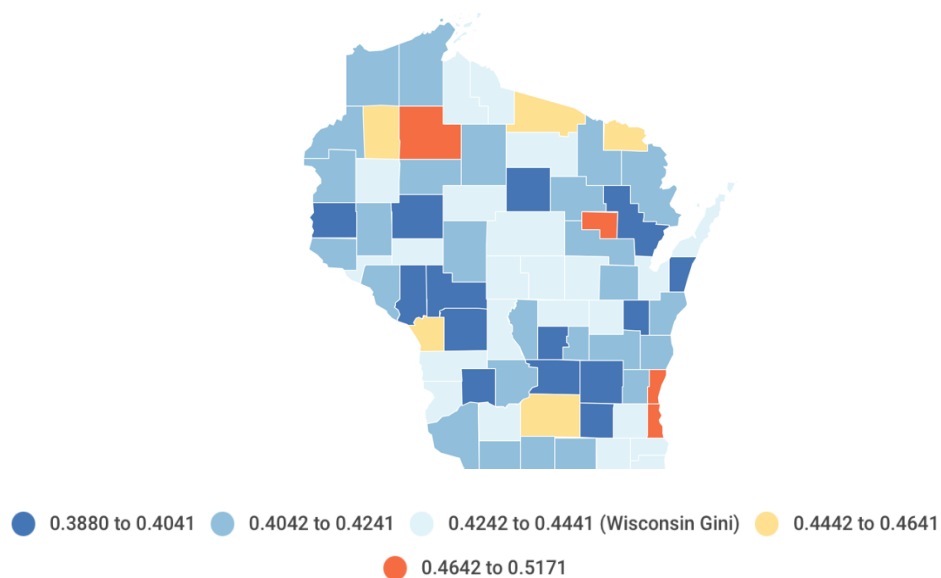


Figure 2: Income Inequality in Wisconsin for 2013-2017 (Deller et al., 2019)

However, a popular measurement is not necessarily an adequate one. In particular, the Gini coefficient is incapable of distinguishing different kinds of inequalities. Other measures,

such as the Atkinson index, can assign varying weights to different parts of the income spectrum and incorporate implicit social judgments (Atkinson, 1983). This index is more concerned about inequalities at the bottom of the income distribution, which might be more suitable for our study on rural income. (See the Appendix for a more detailed description of these measures). With these metrics, we can provide a more accurate and complete image of rural income inequality in Wisconsin. As Figures 3 and 4 show, all three inequality measures calculated based on personal income in Wisconsin have varied constantly between 2000 and 2021. The Atkinson index is relatively more volatile than the Gini coefficient, which implies the lower end of income distribution has experienced more fluctuations over time. The high volatilities in the coefficient of variation (CoV) presented in Figure 4 indicate that the variations in rural income distribution have been overall persistent and substantial over years. This phenomenon calls for more policy attention from decisionmakers at all levels.

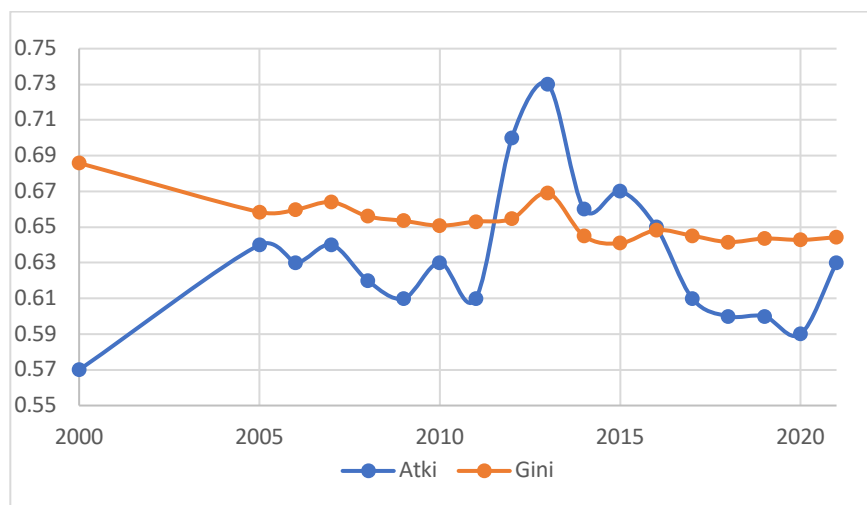


Figure 3: Gini and Atkinson Index for Rural Wisconsin (2000-2021)

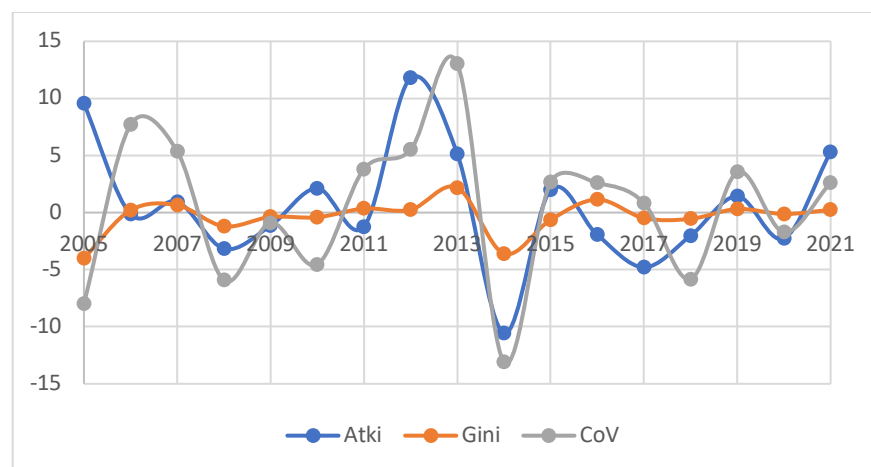


Figure 4: Variations of Wisconsin Rural Income Inequality (2000-2021)

## Determinants of Rural Income in Wisconsin: An Econometric Analysis

### Dependent Variable

Let us consider the following specification:

$$\ln(I_i) = \alpha_i + \theta_1 D_i + \theta_2 S_i + \theta_3 C_i + \varepsilon_i \quad (1)$$

Eq. (1) is a generalized linear regression model, where  $I_i$  describes the personal total income of individual  $i$ , which is transformed into a logarithmic value. Note that there are different types of income data available in the IPUMS including personal income, family income, household income, business income, and welfare income. For simplicity, we select the personal total income to examine factors that contribute to rural income in Wisconsin.

### Independent Variables

As summarized in Table 6, our independent variables fall into three major categories: demographic characteristics, socioeconomic factors, infrastructure and living conditions. On the right-hand side of Eq. (1),  $\alpha_i$  is the constant,  $D_i$  captures person  $i$ 's demographic profile,  $S_i$  depicts his or her socioeconomic status and  $C_i$  mainly describes the diffusion of “communication and information technologies” (CITs), for instance, the access to high-speed Internet and ownership of computers, smartphones, and various kinds of tablets.

Some of those independent variables are coded as dummies, and the rest are defined as either numerical or nominal. For instance, gender is a dummy variable, with “0” indicating females and “1” being males. A few other variables, like self-employment, being a household head, and access to broadband, are also dummies. Covariates such as income, age, and census years are numerical. By contrast, car ownership gauged by the number of vehicles is a nominal variable, with “0” meaning no vehicles associated with this person, “1” representing one vehicle owned, “2” two cars and “3” three cars or more, where the value of each category has no intrinsic ranking. Most variables that describe an individual's personal characteristics, including housing ownership, marital status, educational attainment, English proficiency, races, etc., are also nominal. In addition, the respondents are asked to report on some institutional factors, namely their medical insurance and social security benefits, which are nominal variables as well.

<Table 6>

In Eq. (1),  $\theta_1$ ,  $\theta_2$  and  $\theta_3$  are coefficients, but do not carry sub-index  $i$ , which means we assume that the dependent variable is comparable across individuals. Thus, a given change in  $D$ ,  $S$ , or  $C$  generates the same effect on  $I$  across  $i$ . The “ $\varepsilon_i$ ” is the individual-specific random error term, which might be partly attributed to the unobserved characteristics related to income (Chyi & Mao, 2012). In this project, our interest is to understand how factors including education, broadband, entrepreneurship, and vehicle ownership may account for Wisconsin's rural income between 2000 and 2021.

A generalized linear regression as outlined in Eq. (1) was run by controlling for other conventional variables that affect individual incomes. The person weight in the survey was applied to the regression as well. When analyzing incomes, the presence of a few very high outliers can distort averages. Therefore, we also used quantile regression methods, which allowed us to examine determinants of incomes at different points in the income spectrum, for instance, the 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> percentiles.

## **Main Statistical Results**

Our empirical findings in Tables 7 and 8 indicate that not every factor proposed above is found to be statistically significant in explaining rural income in Wisconsin. We will analyze some of the main results while centering on the variables we are interested in.

<Table 7>

<Table 8>

## **Socioeconomic Factors and Rural Income**

Individual income is influenced by a number of factors including age, sex, marital status, education, employment, welfare status, and so on (Proulx et al., 2007). For example, age and income are usually associated in an inverted U shape. Marriage is robustly and positively related to personal income. Education is an investment in human capital that is found to be a significant cause of higher income. Our regression outcomes in Table 7 shed light on these previous findings and sustain the importance of public policies to reform welfare system and escalate investment in education in rural areas.

One noteworthy result in Table 7 is how the interaction term between gender and the number of children affects personal income in rural Wisconsin. Females with children seem to be earning the least, pointing to the value and urgency of better childcare systems in rural areas.

Another interesting finding in Table 7 and Table 8 is regarding rural entrepreneurship. It looks like self-employment offers lower returns than being a wage earner for rural dwellers whose income is below the median. Most Wisconsin rural entrepreneurs still face hardships through lack of sufficient resources, infrastructure, and access to educated labor and “communication and information technologies” (CITs), which lowers their earning potential. However, for wealthier rural residents who locate in the higher half of the income distribution, entrepreneurship seems to help them earn more than their counterparts (i.e., wage workers).

## **Mobility and Rural Income**

The two forms of mobility, physical and virtual, symbolized by transportation and digital access, complement each other, which in turn improves overall productivity and drives economic growth in both rich and poor areas (Manyika & Roxburgh, 2011). Owning wheels has become a desirable and reliable solution to meet growing mobility needs in rural and remote areas where access to public transit is relatively limited. Car ownership, a symbol of the mobility revolution,

significantly reduces travel time and cost, supports rural entrepreneurship, and accelerates poverty reduction. Automobile possession has become a major growth driver, by bringing farmers tremendous resources and economic opportunities, and thus raising the average income of rural dwellers. The results in Tables 7 and 8 reveal that vehicle ownership contributes positively and significantly to rural income in Wisconsin even after we control for other variables.

Next, we discuss the virtual mobility enabled and nurtured by the innovations of CITs. The penetration of CITs has fundamentally changed the way we live, work, create and share information, and move passengers and freight. It helps enlarge our social networks, maximize informational access, empower swift exchanges, and build a healthy and competitive ecosystem to reap enormous economic benefits (Bahrini & Qaffas, 2019). Since the early 2000s, the Internet has no longer been a premium technology available only to a select few. Our findings in Tables 7 and 8 echo earlier studies and confirm the positive and significant association between broadband access and individual income.

Another type of technology penetration, or growth driver, is mobile phones, particularly Internet-enabled smartphones that have become prevalent and integral to modern lives (Asongu & Nwachukwu, 2016). Nie et al. (2021) contend that smartphone use can significantly increase both income and life satisfaction among rural residents in China. However, in half of Wisconsin counties, fewer than 60% of households own smartphones as of 2018. In a handful of western Wisconsin counties such as Richland, barely half of all households have a smartphone. Fewer than 10% of the nation's counties — mostly in the South — have lower rates of smartphone ownership than that in Wisconsin (Hubbuck, 2018). Table 7 and Table 8 clearly illustrate the positive effect of smartphone ownership on personal income.

## **Robustness of Results**

As shown in earlier sections, our regression outcomes are derived from a generalized linear regression and a quantile regression. When we investigate factors that influence personal income, it is important to note that a two-way linkage probably exists between income and those explanatory variables. For example, vehicle ownership is equivalent to expedited mobility which improves income, while people with higher income are more likely to purchase automobiles. Thus, car ownership is potentially endogenous. A few other factors, including education, health insurance coverage, house ownership, and the number of children have the same endogeneity concern. This implies that we should be cautious in making statistical inferences based on the results in Table 7 and Table 8 and avoid over-interpreting some of the regression outcomes. The endogeneity issue can be tackled by the 2-stage least squares (2SLS) method that can be pursued in our future study, if necessary.

## **Policy Implications and Recommendations**

In the spirit of the “Wisconsin Idea” – that university research should benefit the residents of the state – and supported by our study findings, we recommend the following policies to alleviate poverty and promote economic development in rural areas in Wisconsin.

## **Provide Better Access to Education and Skills Training**

Invest in rural schools at all levels – early childhood education, K-12, and vocational training and apprenticeship programs – to better prepare the rural populations for future challenges and economic opportunities. Expand high-speed broadband internet access to educators, students, and communities in general, to facilitate access to online learning resources, namely advanced placement (AP) courses, and numerous other opportunities. Strengthen collaboration between educational institutions and local businesses to match curriculum offerings with workforce skills demanded by an ever-evolving economy.

One in five of Wisconsin's students is enrolled in a rural school district (18.9%). Wisconsin's rural students perform better on standardized math and reading tests, and other measures of college readiness, than rural students in most other states. They also enjoy an above average high school graduation rate of 92.1%. However, and of note, Wisconsin displays a larger performance disparity between poor and non-poor rural students. (Showalter et al., 2019)

Wisconsin spent \$6,730 per rural student, about \$350 more than the national average. Despite higher relative costs in rural schools, twelve states allocate disproportionately less funding to them, and Wisconsin ranks sixth among those states. That contrasts with many other states that try to cope with rural-specific problems such as teacher recruitment and retention and higher transportation needs by providing a relatively larger share of state funds.

In addition, school funding in Wisconsin relies more heavily on local revenue relative to state aid compared to most other states. The national average ratio of state aid to local revenue in rural school districts is 1.23, but in Wisconsin that ratio is only 0.78. That means that some rural or smaller school districts are at a serious disadvantage due to a smaller local tax base and are likely to struggle to find resources to provide an adequate, not to mention equitable, level of instruction.

As suggested by our data analysis (Table 4) and mentioned in a previous section, anti-poverty measures targeting education must also focus on more high-skill jobs. Our research clearly shows that rural poverty is associated with lower average levels of education and higher unemployment rates. Higher levels of education result in better paying jobs, more economic opportunities and, ultimately, higher incomes.

## **Expand Broadband Infrastructure**

In the digital era rural communities may be left behind. As noted previously, it is of utmost importance to expand high-speed broadband internet to rural areas both for efficiency and equity reasons. Access to broadband is not only important for rural small firms (Galloway et al., 2011; Conroy & Low, 2021) but it has become a necessary condition for economic growth and development, even more important than highways when it comes to start-ups (Audretsch et al., 2015). It is essential for businesses, namely small businesses and start-ups, to have access to online markets, resources, and opportunities to effectively compete in the digital economy. Deller et al. (2022, p. 999) found that “access to broadband is increasingly relevant to rural



entrepreneurship” and that “broadband coverage does matter and that download speeds are more important than upload speeds.” This pattern also holds for mobile coverage.

Yet, vast areas of the country, primarily rural, lack access to high-speed internet, defined currently by the FCC as a download speed of 25 Megabits per second (Mbps) and upload speed of 3 Mbps – inadequate by current connectivity standards. Wisconsin ranks 38<sup>th</sup> among all states in terms of internet coverage, with 87.3% of people having access to 100 Mbps broadband, and 48<sup>th</sup> when it comes to access to 1G broadband, with only 26% of people (Wisconsin Internet Coverage, 2023). In the meantime, about 1.3 million Wisconsin residents still do not have the means – infrastructure or income – to acquire broadband service. The Wisconsin Broadband Office estimates that 650,000 residents lack access to high-speed internet whereas another 650,000 simply cannot afford it (Kaeding, 2022).

Rural Wisconsin has been plagued with inadequate broadband access, with 25% of the state’s rural population (over 430,000 rural residents) lacking access to hi-speed Internet. It ranked 36<sup>th</sup> nationwide in terms of rural broadband accessibility (Kaeding, 2021). Our findings in Table 7 and Table 8 lend support to existing work and confirm the positive and significant association between broadband access and individual income.

High-speed broadband would also make remote work more accessible. The movement to work remotely is likely to continue bringing workers into rural areas. That will not only expand the local economy, but it may also create new business opportunities, like spinoffs and start-ups. It will also increase the number of potential workers available to businesses.

Several statewide initiatives are under way to improve broadband access (Goovaerts, 2023), but access alone is not sufficient and should be coupled with programs that make the use of broadband affordable to low-income (rural) households and small businesses. The Affordable Connectivity Program, part of the “Internet for All” initiative, is an example of such a program, but much more is needed. Access to high-speed broadband offers multiple ways to potentially alleviate poverty as highlighted in other sections, namely education, healthcare, support services, social networking, and civic engagement.

## **Invest in Transportation Infrastructure**

In 2023, Wisconsin was among the worst five states in terms of quality of road infrastructure based on data from the U.S. Federal Highway Administration and other government agencies, assessment by the American Society of Civil Engineers (ASCE), and a consumer survey conducted by Consumer Affairs (McCants, 2023). In 2020, both Wisconsin’s roads and transit were given a grade of (D+) by the Wisconsin ASCE (2020) report card committee of engineering experts (infrastructure in general received a grade of C). Its recommendation is for Wisconsin to increase “overall investment across all infrastructure sectors to ensure safe, resilient, and reliable systems to maintain and improve the quality of life and economic health for the state’s residents” (ASCE, 2021, p.5).

TRIP (2018; National Transportation Research Group) found that in 2016, 67% of major roads in Wisconsin were in fair or poor condition with 19% of rural roads rated in poor condition

(16<sup>th</sup> highest in the country). TRIP estimates that inadequate roads cost Wisconsin drivers \$6 billion annually. In addition to poor road conditions, statewide transit cuts have translated into less frequency of service, fewer hours of operation, and even termination of low ridership routes, both in urban and rural areas. Naturally, reduced mobility makes it harder to get to a place of work, contributing to poverty.

According to the Institute for Research on Poverty (IRP) findings, work-related expenses, including transportation expenses, continue to have a significant negative impact on poverty. The Wisconsin Poverty Measure (WPM) “compares a measure of economic need to a measure of the economic resources available to meet that need” (Smeeding & Thornton, 2020, p.7). Those resources include federal refundable tax credits such as the Income Earned Tax Credit (IETC), and in-kind benefits such as SNAP (a.k.a. “FoodShare” in Wisconsin) and housing subsidies as well as state public benefits. Moreover, the WPM also considers out-of-pocket medical costs and work-related costs, including expenses on childcare and transportation. The IRP found that in 2018 the net poverty-increasing effects of work and medical expenses exceeded the poverty-reducing effects of noncash benefits leading to an increase in effective poverty rates (IRP, 2020).

Our empirical findings (see Tables 7 and 8) clearly indicate that vehicle ownership contributes significantly to rural income in Wisconsin, even after controlling for other variables. In areas poorly served by public transit, owning a vehicle offers a way not only to travel to work but also to reach markets and other resources. It also improves access to medical care and other support services. Upgrading and maintaining transportation infrastructure will have a broad economic impact from improving the quality of life and alleviating poverty to attracting new businesses, tourism, and creating job opportunities in rural areas.

### **Foster Rural Entrepreneurship**

Our findings suggest that entrepreneurship plays a significant role in determining rural income and that it is primarily necessity-driven as opposed to opportunity-driven (our results show lower levels of income for self-employed individuals than for their wage-earning counterparts). That suggests that individuals become entrepreneurs due to lack of other sources of income. Our data also shows that rates of self-employment are higher for rural men (12%) than for non-rural men (8%). Women report self-employment rates of about half of those reported by men. Fostering rural entrepreneurship would involve a variety of initiatives and programs including financial incentives, technical assistance, and institutional support with an emphasis on small business development and sectors where Wisconsin has a comparative advantage.

In Wisconsin, the occupations that attract most entrepreneurs are farming and construction. Small businesses in farming can be supported in a variety of ways, including agricultural support programs, technical assistance to increase productivity while promoting sustainable farming practices, and strengthening local food systems. Invest in traditional sectors such as agriculture and tourism but also expand into other sectors such as green energy and information technology.

Rural entrepreneurship can also be fostered by encouraging regional collaborations and partnerships to pool resources and information and by encouraging local initiatives. The UW-Eau Claire Small Business Clinics, an award-winning initiative (Wisconsin Rural Partners, 2023), offers an example of how to involve students in the promotion of rural entrepreneurship. This outreach initiative, run by student consultants at the Small Business Development Center at UW-Eau Claire, offers one-on-one technical assistance and resources to Wisconsin rural business owners in areas such as how to start a business, QuickBooks, marketing, finance, law, and cybersecurity. They assisted 52 clients in Barron, Clark, and Marathon counties in 2022 and new clinics are expected in 2023.

### **Support Agriculture and Tourism**

Encourage sustainable agricultural practices by offering grants and incentives, provide technical assistance to farmers, promote investment in farmers' markets and local food systems to strengthen the agricultural sector in rural areas.

A statewide collaborative project that brings together farmers, landowners and professionals interested in conservation is the Wisconsin Women in Conservation (<https://www.wiwic.org>). This non-profit organization was established in 2020 by Michael Fields Agricultural Institute in partnership with Renewing the Countryside, Wisconsin Farmers Union, Marbleseed, and the financial support of USDA's Natural Resources Conservation Service. WiWiC offers webinars, networking events, and technical support. Since its creation over 2000 women have been involved in its programs and at least 44 conservation plans were completed. Many others are under way (Wisconsin Rural Partners, 2023).

Capitalize on Wisconsin's natural beauty, state parks, and historical sites to create tourist attractions in rural areas and create opportunities for small businesses and local entrepreneurs. Tourism is an important economic sector in Wisconsin and an economic driver in most rural counties. It adds billions of dollars to the state economy every year and sustains thousands of jobs. About 8% of Wisconsin's workforce are employed in arts, entertainment and recreation, accommodation and food service (Wisconsin Economic Development Corporation, 2020). In the pre-pandemic years, tourism grew significantly, generating \$2 billion dollars in tax revenue in 2018. Post pandemic tourism revenues bounced back and reached \$23.7 billion in 2022, surpassing the previous record of \$22.2 billion set in 2019 (WPR, 2023). Tourism offers numerous opportunities for small businesses in rural Wisconsin.

### **Provide Better Healthcare and Support Services**

A more accurate measure of poverty must consider both public benefits as well as out-of-pocket medical costs and work-related expenses such as childcare and transportation. Our empirical results (Tables 6 and 7) underscore the importance of health insurance. We found a positive and significant relationship between personal total income and health insurance, although health insurance is endogenous.

According to the Institute for Research on Poverty (IRP) findings, work-related expenses, including transportation expenses, continue to have a significant negative impact on poverty. The

Wisconsin Poverty Measure (WPM) “compares a measure of economic need to a measure of the economic resources available to meet that need” (Smeeding & Thornton, 2020, p.7). Those resources include federal refundable tax credits such as the Income Earned Tax Credit (IETC), and in-kind benefits such as SNAP (a.k.a. “FoodShare” in Wisconsin) and housing subsidies as well as state public benefits. Moreover, the WPM also considers out-of-pocket medical costs and work-related costs, including expenses on childcare and transportation. The IRP found that in 2018 the net poverty-increasing effects of work and medical expenses exceeded the poverty-reducing effects of noncash benefits leading to an increase in effective poverty rates (Smeeding & Thornton, 2020)

Better access to quality affordable healthcare would positively impact the quality of life of rural populations as well as alleviate poverty. Low-income rural households would benefit from a strengthening of social programs such as Medicaid (Badger Care), Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF) and Wisconsin Shares Child Care Subsidy Program.

Financial and other incentives may facilitate the recruitment and retention of healthcare providers in rural areas. Making telemedicine options available would likely expand healthcare. Access to childcare is also essential to alleviate poverty of working families as illustrated by our findings (women with children have the lowest incomes in rural Wisconsin) and should be supported.

Alleviating rural poverty calls for action from all stakeholders. A shining example is demonstrated by the Antigo Child Center (Wisconsin Rural Partners, 2023), founded by a woman who, herself, needed childcare. Multiple agencies, including the Langlade County Economic Development Corporation, Antigo Housing Authority, and Wisconsin Economic Development Corporation supported the initiative and helped secure a building. The community supported a fundraising campaign and local employers, in turn, offered financial support through a monthly stipend and a nutrition program.

The Meadows in Darlington (Lafayette County), an affordable 32-unit housing complex for farm workers, is another successful initiative that resulted from the collaboration of local, state, and federal government agencies, namely Southwest Wisconsin Community Action Program, USDA-Rural Development, Wisconsin Housing & Economic Development Authority, Wisconsin Department of Administration, and non-profit organizations such as Cinnaire Solutions and United Migrant Opportunity Services. This complex will be supported by additional services such as childcare, a free health clinic, and a WIC nutrition program, funded by a Community Development Block Grant. The agricultural sector in Lafayette County accounts for about half of the local employment.

### **Promote Regional Collaboration and Community Engagement**

Community engagement can be promoted by encouraging grassroots efforts, supporting community organizations and finding ways of increasing residents’ participation in the decisions that will affect their communities.

Addressing rural poverty and promoting rural development calls for daring and innovative solutions that require the involvement and collaboration of multiple levels of government, community partners, or even multiple communities, working together and sharing knowledge and resources. Successful collaborations include the aforementioned Antigo Childcare Center, the Meadows in Darlington, and Wisconsin Women in Conservation.

The successful implementation of these, and other, policies would call for the active participation and collaboration of all stakeholders, namely state and local governments, private sector, non-profit organizations, and local communities, to tackle the unique challenges of rural poverty in Wisconsin.

## Conclusions

The focus of our study is rural poverty and income inequality in Wisconsin. To examine this issue in depth we used multiple data sources: (1) IPUMS data which consist of a 5% sample of the population in 2000 and 1% samples in subsequent years (for more accurate comparisons not only sample weights were applied but all dollar values were adjusted for inflation); (2) the *Wisconsin Poverty Report* annual series (2009-2020); (3) ACS data at the county level for (2010-2014) and (2015-2019) for more disaggregated data, since IPUMS sorts Wisconsin's 72 counties into only 40 PUMAs. PUMAs were classified as rural if their population densities were less than 500 people per square mile and include counties with few or no micropolitan areas.

We used several different measures of poverty rates and found that average poverty rates are somewhat lower in rural Wisconsin than in non-rural areas. Among higher-income residents, median household income is higher in non-rural than in rural areas, while median household incomes among low-income adults are about the same. The largest share of total income in all groups comes from wages. Among higher-income residents, wages provide a smaller share of total income in rural areas (60.2%) than in non-rural areas (68.3%), while rural residents earn larger shares from Social Security income (reflecting an older rural population, on average) and business and farm income than non-rural residents. Average business and farm income in rural areas is negative, indicating that farm and business losses push some residents' incomes below or near the official poverty line. Social Security income is a large share of total income – almost as large as the wage income share – in both rural and non-rural areas. Poverty – especially in rural areas – is disproportionately concentrated among senior citizens. The median household income is higher in non-rural areas, and the income distributions are similar at lower income levels. We also found a lower degree of income inequality in rural areas which is consistent with Census findings on Gini coefficients of 0.42 and 0.44 for Wisconsin's rural and non-rural areas respectively).

In addition, rural residents are older and more likely to have been born in Wisconsin and to be white and less likely to be foreign-born, except when it applies to very low income. High school graduation rates are similar between rural and non-rural areas but there is a large difference in college graduation rates. Labor force participation rates, average weeks worked per year, and average usual hours worked per week are somewhat lower in rural than non-rural Wisconsin, which helps to explain why average incomes are lower in rural areas. Low-income residents – both rural and non-rural – have significantly lower labor force participation rates,

well below 50%. For those who are working, average weeks worked per year are only a little lower than for higher-income adults, but their average usual hours of work per week are much lower, indicating that many lower-income rural residents are only working part-time. Our occupation analysis reveals that rural residents work in a mix of occupations that require somewhat lower skill levels, on average, than the occupations of non-rural residents. About 12% of rural men report that they are self-employed, compared with about 8% of non-rural men. (Self-employment rates are about half as high for women.) That suggests that rural entrepreneurship may arise from lack of job opportunities and is thus necessity driven rather than opportunity driven.

To get a better understanding of income inequality in rural areas, we considered not only Gini coefficient but also the Atkinson index. The latter assigns different weights to different ranges of the income spectrum with an emphasis on low income. In addition, the coefficient of variation was also adopted. All three income inequality measures based on personal total income show a great deal of volatility between 2000 and 2021. In specifics, the Atkinson index was relatively more volatile than the Gini coefficient, indicating that the lower end of income distribution has been subject to wider fluctuations over time.

We also examined the determinants of rural personal income in Wisconsin by using a generalized linear regression model. However, when analyzing incomes, a few very high outliers can distort averages, so quantile regression method was applied to explore the contributing factors to incomes at different points in the income spectrum, for instance, the 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> percentiles. Our results show that a wide array of explanatory variables are associated with personal total income in rural Wisconsin between 2000 and 2021, including education, broadband access, entrepreneurship, health insurance, race, the number of children and vehicle ownership. Among them, the diffusion of “communication and information technologies” (CITs), for example, access to high-speed Internet, is of particular interest and significance. A noticeable result is the economic hardship a rural single mother may encounter. Another interesting finding has to do with rural entrepreneurship. Self-employment leads to lower incomes than working for wages. That suggests that rural entrepreneurs may lack the infrastructure and resources to prosper. However, entrepreneurs in the higher income spectrum earn more than their counterparts. Targeted policy support should be given to these disadvantaged income groups.

Our research also offers insights into the importance of mobility both physical and virtual. First, vehicle ownership contributes significantly to higher rural incomes. Owning wheels is more crucial in rural areas than non-rural areas due to the lack of alternative means of public transportation, particularly in more remote areas. Second, our research lends support to existing studies by identifying a strong positive relationship between broadband access and rural personal income. Smartphones are also found to be a positive and significant factor. Access to a fast, reliable, and affordable digital network is not a prime good for a select few, but now a basic need.

Due to potential endogeneity among some of the variables our results should be interpreted cautiously. However, it is with a high level of confidence that we offer the following

policy recommendations to alleviate poverty and promote economic development in rural areas in Wisconsin: (1) Provide better access to education and skills training; (2) Expand broadband infrastructure; (3) Invest more heavily in transportation infrastructure; (4) Foster rural entrepreneurship, particularly the growth of female entrepreneurs; (5) Support agriculture and tourism; (6) Provide better healthcare and support services; and (7) Promote regional collaboration and community engagement.

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**Table 1 PUMA Classifications of Wisconsin Counties**

<b>PUMA</b>	<b>Population density<sup>a</sup></b>	<b>Estimated population (2019)</b>	<b>Rural</b>	<b>Counties</b>
100	44.9	174,552	X	Northwest Wisconsin (Ashland**, Bayfield**, Burnett**, Douglas, Iron**, Price**, Rusk**, Sawyer**, Taylor**, Washburn** counties)
101	7727.5	128,634		Madison City (Central)
102	742	195,831		Dane County (East)
103	1108.2	221,600		Dane County (West)
200	3000.4	105,838		Green Bay City
300	655.4	158,818		Outer Green Bay City
600	63.9	113,631	X	Oneida**, Lincoln*, Vilas**, Langlade** & Forest** Counties
700	70.9	207,692	X	West Central Wisconsin--Northern Mississippi Region (Buffalo**, Crawford**, Jackson**, Monroe**, Pepin**, Pierce, Trempealeau**, Vernon** counties)
800	70.3	145,878	X	Grant*, Green, Iowa, Richland** & Lafayette** Counties
900	911.4	118,035		La Crosse County
1000	124.1	121,585	X	Sauk* & Columbia Counties
1001	307.3	173,144	X	Dodge* & Jefferson* Counties
1300	64.1	110,763	X	Marinette*, Oconto, Door** & Florence* Counties
1301	289.4	99,569	X	Manitowoc* & Kewaunee** Counties
1400	76	155,746	X	East Central Wisconsin (Menominee*, Shawano*, Waupaca**, Waushara** counties)
1401	438.8	153,620	X	Fond du Lac & Calumet Counties
1500	963.4	188,360		Outagamie County
1501	1385.3	171,695		Winnebago County
1600	260.8	135,992	X	Marathon County
1601	182.9	190,926	X	Central Sands--Wood*, Portage*, Juneau** & Adams** Counties
2400	746.1	163,044		Rock County
2500	732.1	115,159		Sheboygan County
10000	1687	169,579		Kenosha County
20000	572.2	225,104		Washington & Ozaukee Counties
30000	1500.4	196,383		Racine County
40101	6381	113,930		Milwaukee County (Northeast)
40301	2140.7	115,912		Milwaukee County (South)
40701	4306.8	174,072		Milwaukee County (West)
41001	4249.5	108,268		Milwaukee City (North)

<b>PUMA</b>	<b>Population density<sup>a</sup></b>	<b>Estimated population (2019)</b>	<b>Rural</b>	<b>Counties</b>
41002	8448.5	113,888		Milwaukee City (North Central)
41003	10223.5	96,542		Milwaukee City (Central)
41004	12953.2	98,744		Milwaukee City (South Central)
41005	5759.1	122,987		Milwaukee City (South)
50000	341.6	103,220	X	Walworth* County
55101	55.2	133,983	X	Barron**, Polk**, Clark** & Chippewa (North) Counties
55102	168.5	136,429	X	St. Croix & Dunn* Counties
55103	475.8	159,134	X	Eau Claire & Chippewa (South) Counties
70101	513.8	113,538		Waukesha County (West)
70201	1330.1	161,066		Waukesha County (East)
70301	1617.5	129,543		Waukesha County (Central)
<b>Total:</b>		<b>5,822,434.00</b>		

<sup>a</sup>people per square mile

\* County includes a micropolitan area, but no metropolitan area

\*\* County includes no micropolitan or metropolitan area

**Table 2 Income for Wisconsin Adults Aged 24 Years or Older<sup>a</sup>**

<b>Income measurement</b>	<b>Not low-income</b>		<b>Low-income</b>	
	<b>Rural</b>	<b>Non-rural</b>	<b>Rural</b>	<b>Non-rural</b>
Median household income	\$89,040	\$99,900	\$24,864	\$24,380
Median hourly wage	\$21.74	\$24.92	\$11.01	\$11.57
<i><b>As share of total income</b></i>				
Wage income	60.2%	68.3%	46.8%	39.6%
Business/farm income	4.4%	2.9%	-7.0%	3.2%
Social Security income	18.1%	14.1%	41.9%	36.3%
Other retirement income	9.6%	8.4%	6.3%	5.7%
Public assistance	0.1%	0.1%	4.6%	1.2%
Investment income	4.0%	3.8%	-0.7%	2.4%
Supplemental Security income	0.8%	0.8%	4.6%	8.1%
Other income	1.9%	1.6%	3.5%	3.6%

<sup>a</sup>Based on 2016-2021 American Community Survey (ACS) samples**Table 3 Demographic Summary of Wisconsin Adults Aged 24 Years and Older<sup>a</sup>**

	<b>Not low-income</b>		<b>Low-income</b>	
	<b>Rural</b>	<b>Non-rural</b>	<b>Rural</b>	<b>Non-rural</b>
Average age	53.0	50.5	55.0	50.8
Over 65 years old	25.4%	21.2%	34.3%	26.2%
Born in Wisconsin	70.5%	66.3%	67.2%	59.9%
Foreign-born	3.1%	8.1%	4.8%	13.6%
White	95.5%	86.2%	90.6%	66.8%
Average number of children in household	0.66	0.69	0.72	0.76
Married	70.0%	64.1%	35.6%	27.2%
Divorced	10.6%	10.3%	22.4%	19.0%
Never married	13.9%	20.4%	26.3%	40.8%
Widowed	5.0%	4.4%	13.5%	10.5%

<sup>a</sup>Based on 2016-2021 American Community Survey (ACS) samples**Table 4 Educational Attainment of Wisconsin Adults Aged 24 Years and Older<sup>a</sup>**

	<b>Not low-income</b>		<b>Low-income</b>	
	<b>Rural</b>	<b>Non-rural</b>	<b>Rural</b>	<b>Non-rural</b>
At least high school	96.2%	96.8%	87.9%	85.9%
At least college grad	27.8%	42.1%	11.0%	15.4%

<sup>a</sup>Based on 2016-2021 American Community Survey (ACS) samples

**Table 5 Employment of Wisconsin Adults Aged 24 Years and Older<sup>a</sup>**

	<b>Not low-income</b>		<b>Low-income</b>	
	<b>Rural</b>	<b>Non-rural</b>	<b>Rural</b>	<b>Non-rural</b>
In the labor force: men	74.4%	78.6%	42.2%	46.6%
in the labor force: women	67.4%	69.5%	38.4%	43.3%
Average weeks worked last year: men	48.5	49.1	41.8	41.8
Average weeks worked last year: women	47.7	48.2	42.2	42.5
Average usual hours per week: men	33.6	34.6	18.3	18.1
Average usual hours per week: women	26.7	27.6	13.1	14.7
Occupational status score (NPB): men	48.0	55.4	34.4	35.9
Occupational status score (NPB): women	52.4	57.4	34.2	36.2
Self employed: men	11.4%	8.2%	12.4%	7.4%
Self employed: women	6.2%	4.9%	5.9%	4.3%

<sup>a</sup>Based on 2016-2021 American Community Survey (ACS) samples

**Table 6 Descriptive Statistics of Select Variables – Rural Wisconsin**

<b>Variables</b>	<b>Descriptive Statistics</b>	<b>Mean</b>
<i>Dependent Variable</i>	<i>Rural Income</i>	
<i>realinctot</i>	Total personal income adjusted for inflation	41411.22
<i>realinccarn</i>	Total personal earned income adjusted for inflation	31020.75
<i>realftotinc</i>	Total family income adjusted for inflation	83295.16
<i>realhhincome</i>	Total household income adjusted for inflation	87147.17
<i>Independent Variables</i>	<i>Demographic Characteristics</i>	
<i>age</i>	Age of the surveyed individual	50.43
<i>agesqr</i>	Squared age	2891.76
<i>sex</i>	0, female; 1, male	0.51
<i>marital</i>	1, single; 2, married; 3, divorced, separated or widowed	1.99
<i>edu</i>	1, high school or below; 2, college (two or four years); 3, college above	1.44
<i>multigen</i>	Multigenerational household: 1, one generation; 2, two; 3, three or more	1.48
<i>children</i>	0, no child; 1, one; 2, two; 3, three; 4, four or more	0.60
<i>children5</i>	0, no child younger than 5; 1, one; 2, two; 3, three; 4, four or more	0.11
<i>language</i>	0, not linguistically isolated; 1, yes, linguistically isolated	0.00
<i>English</i>	Do you speak English? 1, no; 1, only speak English; 2, speak okay or well; 3, do not speak well	1.04
<i>HHhead</i>	0, not household head; 1, yes	0.52
<i>race</i>	1, white; 2, black; 3, native Americans; 4, other races	1.07
<i>hispanic</i>	0, no Hispanic origin; 1, yes; 2, not reported	0.02
	<i>Socioeconomic Factors</i>	
<i>jobs</i>	0, unemployed; 1, employed; 2, not in the labor force	1.30
<i>selfemp</i>	Are you self-employed? 0, work for wages; 1, self-employed	0.51
<i>farm</i>	0, not in farm status; 1, farm status	0.06
<i>carown</i>	0, no vehicles; 1, one car; 2, two; 3, three or more	2.12
<i>houseown</i>	0, rented; 1, house owned	0.85
<i>mortgage</i>	0, house is free or paid clear; 1, yes, mortgaged; 2, unknown	0.86
<i>poverty</i>	0, not officially in poverty; 1, yes	0.07
<i>travel</i>	How long is your travel time to work (in minutes)?	13.91
	<i>Infrastructure &amp; Living Conditions</i>	
<i>Internet</i>	0, no access to Internet; 1, yes	0.86
<i>hispeed</i>	0, no access to Broadband; 1, yes	0.71
<i>phones</i>	0, no phones available; 1, yes	0.98
<i>smartphones</i>	0, do not have smart phones; 1, yes	0.79
<i>computers</i>	0, do not have laptops, desktops, or computers; 1, yes	0.81
<i>tablets</i>	0, do not have tablets such as iPad; 1, yes	0.63
<i>metropolitan</i>	0, not in metropolitan areas; 1, yes	0.00

<i><b>Social Benefits &amp; Programs</b></i>		
<i>foodstamp</i>	0, not a food stamp recipient; 1, yes	0.06
<i>healthinsur</i>	0, no health insurance coverage; 1, yes	0.94
<i>privathealth</i>	Do you have private health insurance coverage? 0, no; 1 yes	0.77
<i>pubhealth</i>	Do you have public health insurance coverage? 0, no; 1, yes	0.38
<i>healthemp</i>	Health insurance through employer or unions? 0, no; 1, yes	0.58
<i>incwelfr</i>	Total welfare (public assistance) income	31.25
<i>incss</i>	Social Security income	3304.70

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**Data Source:** US IPUMS data for rural Wisconsin (2000 - 2021) where N = 248,582. Individuals aged 16 years old and above and who have non-negative personal total income are chosen.

**Table 7 Factors Affecting Personal Income in Rural Wisconsin**

<b>Explanatory Variables</b>	<b>Coefficient</b>	<b>(STD Error)</b>
Age	0.090***	(0.0021)
Ages squared	-0.001***	(0.000)
Census year	0.016***	(0.0029)
Travel time to work	0.003***	(0.0002)
Not in the farm status	0.055+	(0.0298)
Do not have vehicles	-0.169***	(0.0435)
Have one vehicle	0.050**	(0.0166)
Have two vehicles	0.056***	(0.0108)
Home ownership: Rented	-0.063***	(0.0132)
Gender: female	-0.426***	(0.0124)
Children: no children (ref. = four children or more)	0.102*	(0.0461)
Children: one child	0.077+	(0.0475)
Children: two children	0.155***	(0.0329)
Children: three children	-0.048	(0.0364)
GenderChild = 0	-0.251***	(0.0615)
GenderChild = 1	-0.138*	(0.0648)
GenderChild = 2	-0.140*	(0.0656)
GenderChild = 2	0.050	(0.0726)
Not household head	-0.224***	(0.0105)
Marital: single	-0.134***	(0.0192)
Marital: married	0.032*	(0.0150)
Race: White	0.006	(0.0266)
Race: Black	-0.118+	(0.0700)
Race: Native Americans	-0.033	(0.0483)
Education: High school or below	-0.743***	(0.0201)
Education: college (two or four years)	-0.443***	(0.0198)
Do not have smart phones	-0.165***	(0.0191)
No access to broadband	-0.027**	(0.0115)
English: do not speak English	-0.022	(0.2106)
English: only speak English	0.029*	(0.0677)
English: speak English okay or well	-0.018	(0.0703)
Jobs: unemployed	0.156***	(0.0348)
Jobs: employed	0.806***	(0.0164)
Self employment: work for wages	0.177***	(0.0167)
No health insurance	-0.220***	(0.0211)

Data source: US IPUMS data for rural Wisconsin (2000 - 2021) N = 248,582.

Note: + p<0.10; \*p<0.05; \*\*p<0.01; \*\*\*p<0.001.



**Table 8 Factors Affecting Wisconsin Rural Income by Quantiles**

<b>Explanatory Variables</b>	<b>Q = 0.25</b>	<b>Q = 0.5</b>	<b>Q = 0.75</b>	<b>Q = 0.9</b>
Age	0.109*** (0.0003)	0.078*** (0.0002)	0.060*** (0.0002)	0.058*** (0.0003)
Ages squared	-0.001*** (0.0000)	-0.001*** (0.0000)	-0.001*** (0.0000)	0.000*** (0.0000)
Travel time to work	0.003*** (0.0000)	0.002*** (0.0000)	0.003*** (0.0000)	0.002*** (0.0000)
Not in the farm status	0.099*** (0.0041)	0.034*** (0.0030)	-0.042*** (0.0030)	-0.061*** (0.0039)
In the farm status	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Do not have vehicles	-0.105*** (0.0060)	-0.154*** (0.0044)	-0.114*** (0.0043)	-0.067*** (0.0057)
Have one vehicle	0.054*** (0.0023)	0.007*** (0.0017)	-0.006*** (0.0017)	-0.023*** (0.0022)
Have two vehicles	0.072*** (0.0015)	0.057*** (0.0011)	0.033*** (0.0011)	0.022*** (0.0014)
Have three vehicles or more	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Home ownership: rented	-0.078*** (0.0018)	-0.095*** (0.0013)	-0.114*** (0.0013)	-0.118*** (0.0017)
Home ownership: owned	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Gender: female	-0.495*** (0.0014)	-0.418*** (0.0010)	-0.394*** (0.0010)	-0.380*** (0.0013)
Gender: male	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Children: no children	-0.055*** (0.0044)	-0.073*** (0.0032)	-0.046*** (0.0031)	-0.083*** (0.0042)
Children: one child	-0.059*** (0.0045)	-0.054*** (0.0033)	-0.029*** (0.0032)	-0.074*** (0.0043)
Children: two children	0.055*** (0.0045)	0.013*** (0.0033)	0.007* (0.0033)	-0.036*** (0.0043)
Children: three children	-0.102*** (0.0050)	-0.051*** (0.0037)	-0.059*** (0.0036)	-0.097*** (0.0048)
Children: four children or more	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Not household head	-0.222*** (0.0015)	-0.203*** (0.0011)	-0.186*** (0.0010)	-0.192*** (0.0014)
Being household head	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Marital: Single	-0.202*** (0.0027)	-0.124*** (0.0019)	-0.097*** (0.0019)	-0.070*** (0.0025)
Marital: Married	0.078*** (0.0021)	0.041*** (0.0015)	0.037*** (0.0015)	0.038*** (0.0020)
Divorced, separated or widowed	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Race: White	0.016*** (0.0037)	0.021*** (0.0027)	0.005+ (0.0026)	-0.068*** (0.0035)
Race: Black	-0.185*** (0.0097)	-0.017** (0.0071)	-0.056*** (0.0069)	-0.007 (0.0092)
Race: Native Americans	-0.052*** (0.0067)	-0.080*** (0.0049)	-0.023*** (0.0048)	-0.024*** (0.0063)
Race: Others	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Education: high school or below	-0.657*** (0.0028)	-0.635*** (0.0020)	-0.653** (0.0020)	-0.827*** (0.0026)
Education: college (2 or 4 years)	-0.392*** (0.0027)	-0.382*** (0.0020)	-0.399*** (0.0020)	-0.578*** (0.0026)
Education: college above	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Do not have smart phones	-0.170*** (0.0026)	-0.151*** (0.0019)	-0.172*** (0.0019)	-0.194*** (0.0025)
Have smart phones	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>

<b>Explanatory Variables</b>	<b>Q = 0.25</b>	<b>Q = 0.5</b>	<b>Q = 0.75</b>	<b>Q = 0.9</b>
No access to broadband	-0.036*** (0.0016)	-0.018*** (0.0012)	-0.040*** (0.0011)	-0.023*** (0.0015)
Have access to broadband	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
English: do not speak English	0.278*** (0.0291)	-0.061** (0.0212)	0.392*** (0.0209)	0.070* (0.0276)
English: only speak English	0.086*** (0.0094)	0.119*** (0.0068)	0.180*** (0.0067)	0.140*** (0.0089)
English: speak English okay or well	0.017+ (0.0097)	0.040*** (0.0071)	0.171*** (0.0070)	0.094*** (0.0092)
English: do not speak English well	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Jobs: unemployed	-0.061*** (0.0048)	0.012*** (0.0035)	0.202*** (0.0035)	0.293*** (0.0046)
Jobs: employed	0.805*** (0.0023)	0.626*** (0.0017)	0.515*** (0.0016)	0.431*** (0.0022)
Jobs: not in the labor force	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
Self employment: work for wages	0.375*** (0.0023)	0.159*** (0.0017)	-0.036*** (0.0017)	-0.290*** (0.0022)
Self employment: self-employed	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>
No health insurance	-0.250*** (0.0029)	-0.223*** (0.0021)	-0.197*** (0.0021)	-0.183*** (0.0028)
Have health insurance	0 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	

Data source: US IPUMS data for rural Wisconsin (2000 - 2021), with N = 32,781.

The number in the parenthesis is the standard error for estimates and 0<sup>a</sup> indicates the baseline value.

Note: + p<0.10; \*p<0.05; \*\*p<0.01; \*\*\*p<0.001.

## Appendix

### Gini Index

The Gini index is derived from the Lorenz curve, which shows the percentage of total income earned by each cumulative percentage of the population. The overall Gini index in the U.S. in the past few decades has been above 0.40, a level typically interpreted by economists as an "unfair" income distribution. We follow Deaton (1997) and derive the Gini index in a computationally convenient form:

$$I_{Gini} = \frac{N+1}{N-1} - \frac{2}{N(N-1)\mu} \sum_{i=1}^N \rho_i x_i$$

where  $\rho_i$  is the rank of individual  $i$  in the income distribution,  $x_i$  is this person's income,  $N$  is the size of population, and  $\mu$  is the mean income.

### Atkinson Index

The Gini coefficient is easy to generate, but it is incapable of differentiating different kinds of inequalities. By assigning varying weights to different parts of the income spectrum and incorporating implicit social judgments, Atkinson (1983) introduced a new method – the Atkinson index, which is defined as below:

$$I_{Atkinson} = 1 - \left( \frac{1}{N} \sum_{i=1}^N (x_i / \mu)^{1-\varepsilon} \right)^{1/(1-\varepsilon)}$$

where  $\varepsilon \geq 0$  but  $\varepsilon \neq 1$ . Note that  $\varepsilon$  is a perception parameter and represents an aversion to the inequality. As  $\varepsilon$  increases, the marginal social utility of the poorest weighs more, and people under the poverty threshold would be more favored by government policies. Thus, this measure is more concerned about inequalities at the bottom of the income distribution. In our study,  $\varepsilon = 1.5$  that increases the Atkinson index in value and verifies that income is less equally distributed among the poor than the rich in rural areas over time.

### Coefficient of Variation

The third measurement of income inequality we employ is the coefficient of variation. This is a normalized measure of dispersion in income data, which is defined as the ratio of the standard deviation of personal income to its mean. We can define the coefficient of variation as below:

$$I_{CV} = \frac{\sigma}{\mu}$$

where  $\sigma$  denotes the standard deviation of income and  $\mu$  is the mean.