Predicting County-Level Food Insecurity and Hunger in Oregon

AN ABSTRACT OF THE ESSAY OF

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Title: Predicting County-Level Food Insecurity and Hunger In Oregon

Abstract approved:

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Oregon's high hunger and food insecurity rates have been a concern throughout the last decade. These high rates earned Oregon the dubious distinction as the most food insecure with hunger state in the late 1990's. While Oregon's ranking has improved in recent years, our understanding of why Oregon ranked so highly on such a distressing measurement is still being explored. Recent research has improved our understanding of food insecurity and hunger through the identification of some key socioeconomic conditions that correlate with increased likelihoods of household food insecurity (Tapogna, Suter, Nord, and Leachman, 2004). These socioeconomic conditions include: the rate of households that moved within a year, the state peak unemployment rates, the state poverty rates, the rate of renters spending over half of their income on rent, the state's racial demographics, and the fraction of population under 18 years old. This paper utilizes this state level model to evaluate whether similar county-scaled socioeconomic conditions produce useful estimates of food

insecurity and hunger. To accomplish such an objective, this analysis: 1) assesses the complexity in utilizing this state level model to predict county level food insecurity and hunger rates, 2) constructs county estimates derived from the socioeconomic model defined in Tapogna et al. (2004), and 3) assesses the county level estimates by comparing the results with available region-and-county level data relevant to food insecurity and hunger.

This examination is the first step in providing policymakers and county administrators with a broad and useable predictive equation to estimate the severity of food insecurity and hunger at the county level within Oregon.

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I understand that my essay will become part of the permanent collection of the Oregon State University libraries. My signature below authorizes release of my essay to any reader upon request.

Jay D. Grussing, Author

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Chapter 1: Introduction

Food insecurity and hunger have been major issues in Oregon over the last decade. Much of this anxiety revolves around Oregon's previous distinction as having the highest food insecurity with hunger rate in the nation. Although Oregon's ranking has steadily decreased in recent years, a great deal is still not understood as to why Oregon ranked so poorly on the food insecurity scale given the state's normalcy in other societal measures.[1] To understand this relationship, this analysis must first look at the measure of food insecurity and food insecurity with hunger.

The social conditions of food insecurity and hunger reflect the struggles of individuals and their families to meet the basic need of adequate food intake on a daily basis. In 1995, the Census Bureau began measuring this social condition using the Food Security Supplement (FSS) of the Current Population Survey (CPS) (Bickel, Nord, Price, Hamilton, Cook, 2000). The CPS is a monthly nationwide survey of approximately 60,000 households that primarily examines economic household and demographic characteristics. The FSS is included as an addendum to the CPS once a year, currently during the December CPS. The supplement asks a series of questions regarding the prevalence of food security within the last twelve months.[2] These questions gauge the environment and behaviors known to be displayed in households struggling to meet their basic food needs (Nord, Andrews, and Carlson, 2004). This questioning regime has gained a large degree of confidence in its accuracy due to

[1] Ascertained through reviewing Oregon Progress Board 2000 data for measures of per capita income, pay per worker, high-school completion, poverty, health insurance, and affordable housing. None of these measures ranked Oregon in the bottom fifth nationally. (Oregon Progress Board, 2005b)

[2] The number of questions asked varies from 12 for households with no children present to 18 for households with children present.

extensive testing throughout the last two decades (Wunderlich and Norwood, 2006). Households are classified via their answers and placed into one of three categories: food secure, food insecure without hunger, and food insecure with hunger (Nord et al. 2004).

This analysis uses socioeconomic characteristics shown to influence food insecurity and food insecurity with hunger to estimate Oregon's county-level variability.[3] These socioeconomic characteristics include: the 2000 rate of households that moved within the last year, the average 1999-2001 peak unemployment rates, 2000 poverty rates, the rate of renters in 2000 spending more than 50 percent of their income on gross rent, the 2000 population percentage of non-Hispanic whites, and the 2000 population percentage under 18 years-of-age (Tapogna et al. 2004). The state-level Tapogna et al. (2004) analysis regressed state food insecurity and hunger rates on these variables and determined that relationships exist. This research uses the Tapogna et al. analysis as a starting point for the county-level estimation process.

Since food insecurity affects a relatively small percentage of households, determining the rates at a level smaller then the state is not possible using the CPS results. The USDA's Economic Research Service (ERS) has overcome this methodology concern at the state-level by including three consecutive data years in order to generate large enough samples for adequate food insecurity and hunger accuracy (Hall, 2004). Given this difficulty, determining county levels of food insecurity are virtually unknown outside of an extrapolation based on poverty or other county level statistics. To overcome these limitations, this analysis proposes that an

[3] From this point forward, food insecurity with hunger will be referred to as hunger.

unadorned alignment of state socioeconomic correlations to county data could be beneficial to approximate food insecurity and hunger at the county level in Oregon.

While this analysis is unorthodox in its method of scaling different levels of analyses, the intent is to expand on the groundwork of food insecurity research that is largely removed from the community planning and application level. Applying these socioeconomic characteristics known to relate to food insecurity and hunger to county populations will allow for a more precise targeting of resources through identifying locations where there are likely higher levels of food insecurity and hunger.

Purpose

This paper tests the validity of using state characteristics previously deemed influential to predict food insecurity and hunger at the county level. These previously acknowledged state characteristics demonstrate the role that place and local influences, such as housing prices, employment levels, and age, play on food insecurity and hunger. This analysis proposes that these socioeconomic characteristics can be scaled in an equation to adequately estimate food insecurity at a level of analysis impossible under current survey regimes. The following objectives will be addressed throughout this analysis in order to achieve the paper's desired results.

Research Objectives

1. Identify the inherent difficulties in utilizing state level socioeconomic characteristics to predict county level food insecurity and hunger rates.
2. Explore whether county level socioeconomic characteristics, substituted into the Tapogna et al. state level food insecurity model, represent food insecurity accurately at this smaller unit of analysis.
3. Gain insight into the inherent strengths and weakness of such an approach and recommend future research inquiries regarding local levels of food insecurity and hunger.

Chapter 2: Literature Review

Food security and its alternative, food insecurity, entered the lexicon of societal indicators with the inception of the Food Security Measurement Project in 1992. This project was the culmination of previous academic and federal research focusing on establishing a more accurate measure of food insecurity and hunger within the United States. Under the authority of the National Nutrition Monitoring and Related Research Act of 1990, this important research was institutionalized at the federal level and vested to the US Department of Agriculture and US Department of Health and Human Services. The primary requirement of the policy was to establish a sound national measurement that could be consistently used throughout the federal, state, and local governments to address hunger and food related issues and policies (Bickel et al. 2000).

Since 1995, the culmination of this work has resulted in the Food Security Supplement (FSS), attached to the Census Bureau's Current Population Survey (CPS). In the survey, the FSS asks a series of questions evaluating the existing household conditions which impact food security. These questions measure:

- The experiences of running out of food while lacking the financial resources to acquire more;
- A household's anxiety as to whether the food supply and budget are adequate;
- A household's adjustment of food consumption and whether substitution of cheaper and fewer foods occurs;
- The perceptions of adequacy and quality of food eaten in the household;

- The household's level of reduction in food intake by adults and children and the physical sensation of hunger (Bickel et al, 2000).

The questions focus on the effect economic constraints have had on household food consumption over the previous twelve months, so the survey eliminates voluntary limitations to a household's food intake due to fasting and dieting (Nord, Andrews, and Carlson, 2005, p.2).

The measurement of food insecurity using the Core Module (the previously discussed questioning regime) allows for the severity of food insecurity to be demonstrated through a continuous linear scale. The gradation of severity in Core Module questions creates the scaling of food insecurity strength. The actual number of questions asked is dependent on whether the household has children present or not. Affirmative answers of two or less designate the household as food secure. Affirmative answers of three through seven if children are present or three through five if no children are present determine a household to be food insecure. The most severe cases with affirmative answers of eight or more with children present, or six or more with no children present are designated as food insecure with hunger. Extensive testing has determined this measure to be an accurate measure of household food insecurity (Bickel et al., 2000; Opsomer, Jensen, and Pan, 2003). Furthermore, Edwards and Weber (2003) illustrate the conservativeness of the measure by pointing out that eleven percent of Northwestern households with children and 6.7 percent of single households answered affirmative to one or two indications of food insecurity in 2000, and were still classified as food secure households (p.6). This degree of caution

ensures that the food insecurity classification is attained only when there are credible disruptions caused by economic hardship.

Defining Food Security

Food security, while conceptually simple to understand is not as theoretically simple when hunger is included in its definition. The established definition offered by the Life Sciences Research Office (LSRO) states that food security is:

> having access to enough food for an active, healthy life. It includes at a minimum (a) the ready availability of nutritionally adequate and safe foods and (b) an assured ability to acquire acceptable foods in socially acceptable ways…. Food Insecurity exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain. (Wunderlich and Norwood, 2006, p.43)

Alternatively, hunger is defined as the "(t)he uneasy or painful sensation caused by a lack of food, the recurrent and involuntary lack of food" (Wunderlich and Norwood, 2006, p.47). Yet, as measured in the core module, hunger is defined as starting at one point on a scale of food insecurity (Wunderlich and Norwood, 2006, p.47). The USDA clearly states this distinction in their assertion that they do not technically provide hunger statistics, but rather they simply construct the upper and lower bound estimates of the number of adults and children who were hungry at some time during the previous year (Nord, Andrews, and Carlson quoted in Wunderlich and Norwood, 2006, p.15). While this may seem like a small distinction, it illustrates that the measurement is not intended to define hunger outside of the greater food insecurity

category. This distinction is further illustrated with the replacement of 'food insecurity with hunger' terminology with the more ambiguous 'very low food security' in the 2005 ERS report (Nord, Andrews, and Carlson, 2006).

With the collection of the food insecurity and hunger statistics reported annually, the ERS research has undertaken the task of determining the socioeconomic situations that relate to increased food insecurity and hunger. This analysis breaks these socioeconomic situations into two broad categories, that of household characteristics and the contextual community or location specific characteristics.

Household Characteristics

This analysis limits household characteristics to those directly connected to households through personal characterization and household members participation. This follows Campbell's (1991) conceptualized food insecurity risk factors as limits to household resources, including but not limited to: money, time, information, and health. In using this conceptualization, strong connections are seen between food insecurity and a number of household factors.

One primary and obvious factor is the role poverty plays in determining food insecurity. Analysis has documented that households below the federal poverty line have higher rates of food insecurity. Nord, Andrews, and Carlson (2004) have determined that over 35 percent of households below the poverty line fall under the category of food insecure. This relationship is reiterated in numerous studies linking the likelihood of food insecurity to the poverty rate in various places and on various levels of analyses (Bartfeld and Dunifon, 2005; Alaimo, Briefel, Frongillo, and Olson, 1998; Furness, Simon, Wold, and Asarian-Anderson, 2004). While the poverty rate is

a major contributing factor, it is easy to overlook the fact that over half of all households in poverty are not deemed food insecure, so clearly there are other contributing factors influencing food security.

Income, while influencing the poverty measure, has an equally direct and powerful relationship with food insecurity. Generally this is seen as an inverse relationship where food insecurity decreases as income increases (Edwards and Weber, 2003; Nord, et al. 2004; Rose, Gundersen, and Oliveira, 1998). When breaking income into quintiles, Edwards and Weber illustrate this relationship in Oregon where households with incomes under $16,000 are food insecure 21 percent of the time, whereas households in the top quintile, making over $76,000, are food insecure 5.6 percent of the time (2004, p. 10). While these statistics reinforce the reality that income is a primary determining factor of food insecurity, it also illustrates that even in high-income households food insecurity can be found, alluding to the multiplicity of determining factors. Bernell, Weber, and Edwards (2007) speculate that income has a secondary impact on food insecurity due to the role transportation costs and automobile ownership play on a household's ability to obtain food. Rural areas may be more susceptible to this additional impact given Oregon's greater distances outside of the Willamette Valley, the lack of alternative transportation methods, and the lower average incomes. This secondary impact potentially becomes a prominent factor in the rural relationship to food insecurity and hunger.

Another household factor deemed to be connected to food insecurity and hunger is that of minority status. Research has shown households of racial and ethnic minorities are more likely to be food insecure (Nord et al. 2004; Rose et al. 1998).

Nord et al. (2004) report that households headed by African Americans or Hispanics are more than twice as likely to be food insecure than non-Hispanic White headed households (p. 8). In addition, Kasper, Gupta, Tran, Cook, and Meyers (2000) have found recent legal immigrants have staggeringly higher degrees of food insecurity, with over three-fourths of the immigrants surveyed reporting food insecurity.

Studies have also concluded that households with children present are more vulnerable to food insecurity (Tapogna et al. 2004; Furness et al. 2004). Nord et al. (2005) concluded that nationally, households with children experience double the rate of food insecurity than households without. Logically, the presence of children may cause households with lower incomes to find ways to stretch their food resources in order to get by, as indicated by parents going hungry or a reduction in quality of the food purchased. Single parent households with children have the added burden of a single supporting income, which results in drastically higher levels of food insecurity. Nord et al. (2005) find one-third of all female-headed households and one-fifth of all male-headed single parent homes experience food insecurity. Within the Northwest, Grussing and Edwards (2006) see similar statistics, with even higher rates of food insecurity if these susceptible households are located in rural areas.

Analyses have also shown that housing has a powerful relationship with food insecurity. Home ownership has an inverse relationship with food insecurity where locations with a lower percentage of homeownership experience higher food insecurity rates (Vozoris and Tarasuk, 2001; Edwards and Weber, 2003). Furthermore, household rent, measured as a percentage of gross income, has a strong positive correlation with food insecurity (Tapogna et al. 2004). Augmenting this

argument is the fact that food is a more elastic necessity than shelter's associated costs. Bhattacharya, DeLeire, Haider, and Currie (2002) point to such a conclusion with their findings that poor households reduce their caloric intake during winter months when their expenditure on heat increases. These results are not seen in higher income households. This reality of compounding variables affecting food security illustrates the complex relationships that surround households and their decision-making.

Along with shelter costs, Bernell, Weber, and Edwards (2006) determine that the length of habitation at a residence has an inverse relationship to food insecurity, such that as residence stability increases, food insecurity decreases. These researchers contend that social networks often become an important safety net guarding against food insecurity and households that frequently change residences may not have these pre-existing networks or the stability to build these relationships. Tarasuk (2001) reinforces such a conclusion by determining social isolation increases a household's vulnerability to food insecurity.

Educational attainment is another factor influencing food insecurity. Research concludes that high-school graduates are less likely to be food insecure then those without a high-school degree (Alaimo et al. 1998; Rose et al. 1998). Olsen and Rauschenbach (1997) further concluded that households with low education levels often have low food supplies.

In addition to education, age is associated with food insecurity. Nord et al. (2005) find that elderly households are more food secure than younger households. Likely factors for this improved condition may include the accumulation of wealth and

the various social safety nets in place for elderly households such as social security and Medicare.

Not surprisingly, the presence of household members who have physical and mental disabilities increases food insecurity (Bernell et al. 2006). Tarasuk's (2001) analysis of food insecurity among women exposed that women with activity-limiting conditions are more than twice as likely to report experiencing food insecurity. Furthermore, Vozoris and Tarasuk (2002) report food insufficiency rates roughly double for households with physical health conditions and more than triple in households with mental health conditions.

Another primary household characteristic profoundly affecting food security is the financial shock from a temporary or permanent loss of employment. This positive relationship where unemployment and food insecurity rise in chorus is evident at both national and regional levels (Bartfeld and Dunifon, 2005; Edwards and Weber, 2003). A fine-tuning of the unemployment variable is illustrated by Tapogna et al. (2004) demonstrating a relationship between state peak unemployment and higher hunger rates, and to a lesser degree between peak unemployment and food insecurity rates.

Societal and Community Characteristics

In addition to household characteristics, there are societal and location specific influences on food insecurity. Research has indicated these influences have profound effects on food insecurity at the state, county, and community levels. These relationships involve public and nongovernmental programs and entities interacting with households, such as public assistance programs and tax policies for low-income households and households with children. Additionally, nongovernmental

organizations interact with households through distribution of emergency food boxes and food kitchens. These community characteristics vary across locations and may influence food insecurity differently across place.

Public assistance, the generalized term for policies enacted to mitigate the less desirable social outcomes, has been theorized to lower food insecurity levels. The food security measure was initially created to measure the effectiveness of such programs. Analysis by Bartfeld and Dunifon (2006) identified differences in food insecurity rates among households with children through examining state differences in summer food programs. Food stamp participation was recognized as benefiting households close to poverty status (Bartfed and Dunifon, 2006). In Oregon, Bernell et al. (2004) concluded a county's access to food stamps possibly mitigates some of the effects of food insecurity. Borjas' (2001) examination of the limitations on immigrants in the federal public assistance program found that decreases in the percentage of population receiving public assistance increased food insecurity at a rate of two to one. Furthermore, the social stigma of receiving public assistance, especially food assistance where a lack of anonymity is more likely, may decrease the likelihood of household participation. This stigma may have a real bearing given Rank and Hirschl's (1993) finding that rural areas are much less likely to participate in food assistance programs.

A household's tax burden is also identified as having an association with food insecurity. Through the comparison of state tax policies, Barfeld and Dunifon (2005) found that the greater tax burden borne by low-income families increases the

likelihood that these families experience food insecurity. The analysis concluded this relationship disappeared when looking at the tax burden across all income levels.

These household and societal relationships as a whole illustrate the complexity of food insecurity as a measurement. Food insecurity is not simply about household characteristics but also the socioeconomic reality of a community or place. Bernell et al. (2007) have termed this dynamic relationship as the local community food security infrastructure in their contextual examination of the elements of food insecurity in Oregon.

Chapter 3: Method for Estimating County Variability

Capturing the degree of food insecurity for a specific location is difficult given the shortcomings of current measurement strategies and the small fraction of individuals that meet its conservative definition. The lack of place-specific questioning in the CPS and the small level of food insecurity measured in the biennial Oregon Population Survey (OPS) make it impossible to isolate food insecurity to any specific locale within Oregon. Therefore, to achieve a county level projection, this analysis estimates food insecurity using socioeconomic characteristics found to correlate with food insecurity at the state level. To reiterate, this is achieved by applying the Tapogna et al. (2004) food insecurity and hunger models to county data to estimate county rates of food insecurity and hunger.

While such a method eliminates the certainty associated with statistical analysis, implementing this state model at the county level increases our capabilities for identifying food insecurity and hunger at an otherwise unknown level of analysis. This section and the discussion section explore the strengths and weaknesses of this predictive technique through analyzing the model origins in the Tapogna et al. analysis as well as the resulting application of the model to Oregon's county data. This analysis is but one of the first building blocks toward establishing a valuable estimation technique of county rates of food insecurity within Oregon.

Model

The different scales present in using the Tapogna et al. model to determine county levels of food insecurity precludes the construction of traditional confidence

levels around the resulting values. However the Tapogna et al. model variables are accurately scalable to the county level given nearly identical data sources and similar variable descriptive characteristics seen in Table 1. Through shoehorning the best available societal and household data, this analysis creates a best guess to be established, in turn allowing for a county dialog to begin addressing food insecurity along county socioeconomic predictors.

Table 1. State and County descriptive statistics:

	Tapogna et al. State model[4]		Oregon Counties estimate	
	50 state Mean	Standard Deviation	36 county Mean	Standard Deviation
	Percent	Percentage points	Percent	Percentage points
Share of population in poverty	12.1%	3.3	12.4%	2.5
Peak unemployment during 1999-2001	5.0%	1.1	9.0%	2.5
Share of renters paying more than 50 percent of income on gross rent	16.4%	1.8	17.0%	4.2
Share of population non-Hispanic White	74.9%	16.1	89.0%	8.1
Share of population under age 18	25.5%	1.9	25.0%	2.5
Share of population in different house	16.4%	2.7	21.6%	3.5

The Tapogna et al. model uses the following state level household variables that originated in the 2000 census including: households that moved within 2000, state poverty level, renters spending over 50 percent of income on gross rent, population of non-Hispanic Whites, and population under 18 years of age. Average peak unemployment, also included in the model, comes from US Bureau of Labor Statistics' Local Area Unemployment Statistics series. These variables are modeled using the Ordinary Least Squares (OLS) regression analysis seen in Equation 1.

Equation 1

$$Y_i = \beta_0 + \beta_1 dh_i + \beta_2 pu_i + \beta_3 po_i + \beta_3 re_i + \beta_4 nhw_i + \beta_5 age_i$$

[4] Tapogna et al. (2004)

The variable Y_i represents the percentage of the population that is food insecure or food insecure with hunger. The variable dh_i represents the percentage of households that moved into a different housing unit between 1999 and March 2000. Pu_i denotes the peak twelve-month unemployment rate averaged for the three-year span 1999-2001. Po_i depicts the 2000 poverty level within the state. Re_i details renters spending over 50 percent of household income on gross rent in 2000. The non-Hispanic White rate in 2000 is the model variable nhw_i, and age_i delineates the population percent under 18 in 2000. Each of these variables will be explored more thoroughly in the following sections.

Data

Tapogna et al.'s (2004) selection of 2000 as an assessment year allows for the use of 2000 Decennial Census data. This rich set of detailed demographic, economic, and household data allows scalability given the accuracy of the decennial methodology in effect permitting this exploration of county food insecurity and hunger.

This analysis uses an exact reconstruction of the Tapogna et al. model including the constant variable. This constant is represented as β_0 throughout this analysis and is applied across all county estimates. As such, the constant influences evenly at a negative .164 across all county equations for food insecurity and negative .069 for hunger.[5]

The Tapogna et al. variable representing the households that moved within the last year, dh_i, was obtained from the Census Supplemental Survey. The Census

[5] See Equation 2 and 3 for detailed Tapogna et al. model coefficients values.

Summary file 3 estimated this statistic at the county level through sampling approximately 1/6th of the entire Census population (Census, 2000). This estimation variable differs from Tapogna et al.'s "moved" variable for Oregon.[6] While this data change reflects a significant three-percentage point difference for Oregon, county variability should not be severely affected given the consistency of the county data source. This characteristic represents households that have moved between 1999-2000. Tapogna et al. (2004) theorize that such moves are predominately due to negative household distress such as job loss or divorce. These instances may induce a move and therefore increase the likelihood of food insecurity. These assumptions are reinforced by research within Oregon finding a positive relationship between food insecurity and households that had moved with the past five years (Bernel et al. 2006).

The average peak unemployment rate for 1999 – 2001, variable, pu_i, is used to duplicate the three-year timeframe of the 2001 CPS food security estimation. Tapogna et al. (2004) justify using peak unemployment rather than average unemployment believing it is a stronger predictor of economic shock that may induce hunger. The expectation is households experiencing a sudden loss of employment are thought to endure a greater disruption to the access and acquisition of adequate food provisions. Alternatively, average unemployment rates may capture many households that have adjusted to their unemployed situation and regulated their household food consumption patterns. Peak unemployment data were gathered from the Oregon Employment Department from 1999-2001; the peak monthly rate of each twelve-month cycle is averaged to create the three-year mean. Table 1 displays the county

[6] Tapogna et al. (2004) used "a moved" variable rate of 21.1 percent for Oregon whereas this analysis uses an Oregon rate of 24.1 percent. Tapogna et al. state this variable originates from the same sources as this analysis however this analysis has been unable to duplicate their Oregon rate.

mean and standard deviation in comparison to the Tapogna et al. state rates. This increased county variability should predict greater fluctuation in food insecurity and hunger than the state assessment. Theoretically, this makes sense given counties are often dominated by few employment opportunities and more susceptible to greater fluctuations in business cycles than at the state level.

The poverty level, variable po_i was constructed using Census small area estimate data for 2000, closely following the Tapogna et al. (2004) state poverty variable. However, there is a discrepancy in the source data with the 2000 Census small area estimate resulting in Oregon's poverty rate being calculated at 10.7 percent whereas Tapogna et al. (2004) presents Oregon's poverty rate at 11.7 percent for 2000 (p. 19). As with peak unemployment, county poverty data consistencies should not be adversely characterized by this discrepancy at the state level. Given the plethora of research documenting a significant relationship between poverty rates and food insecurity and the similarity of the poverty rates expressed in Table 1, this estimate variable presents a significant food insecurity influence on Oregon's counties.

The variable "renters spending over 50 percent of their income on gross rent" duplicates Tapogna et al. in both its construction and source.[7] Census statistics from 2000 for each of the 36 Oregon counties are used to construct re_i. This rationale follows in the footsteps of previous research that found renters are more food insecure than homeowners (Rose et al., 1998; Gundersen & Oliveira, 2001). Tapogna et al. (2004) document that the incidence of renters with higher housing costs should correlate with increases in state food insecurity rates. The average county housing

[7] Gross Rent includes utility expenses in its calculation. Household that pay no monetary value for rent are excluded from this census variable.

affordability measure is near the state mean seen in Table 1. Yet, the county standard deviation is over twice what is seen at the state level, this may reflect unique county housing composition characteristics in certain counties. The results section will explore this finding in detail.

The race variable, nhw_i, controls for non-minority status precisely as Tapogna et al. carried out in the state analysis. The county data source is the 2000 Census, mirroring Tapogna et al.'s state level data. Race and ethnic minority status has been positively correlated with food insecurity (Nord et al. 2004; Rose et al. 1998). As such, an inverse correlation between food insecurity and the rate of non-Hispanic White headed households would be expected. However, Tapogna et al. (2004) define no expectations for this variable in their analysis and therefore it is included simply to duplicate the analytical model.

The age_i variable captures the percent of non-adults residing in each county and this has been indicated to influence food insecurity due to increases in family size (Nord et al. 2005; Tapogna et al. 2004; Furness et al. 2004). This relationship shows that older households and those without children are more food secure (Nord et al. 2005; Furness et al. 2004). The data originates from the 2000 census, which allows for both Tapogna et al.'s state level variable and this paper's Oregon county statistics. Given the influence of this household variable and the similarity of counties to states seen in Table 1, this variable should drive rates of food insecurity and hunger in counties much the same as seen in the state model.

Tapogna & Colleagues' findings

Tapogna et al. (2004) find a clear correlation between household and socioeconomic characteristics and food insecurity and hunger. Their analysis achieved a R^2 value (unadjusted) of over 70 percent for food insecurity and 64 percent for hunger. Such results, while limited by the small sample of states and the District of Columbia (N=51), offer promising guidance in understanding food insecurity and hunger. This section outlines these results and offers a structure for using this information to explain food insecurity at the county level.

Equation 2: Food Insecurity*

$$FI_i = -.164 + .280dh_i + .187pu_i^* + .360po_i + .276re_i + .014nhw_i^* + .434age_i$$

Equation 3: Hunger*

$$FI/Hunger_i = -.069 + .132dh_i + .314pu_i + .034po_i^* + .130re_i + .011nhw_i^* + .112age_i$$

Equation 2 shows the Tapogna et al. (2004) food insecurity model coefficients, whereas Equation 3 shows the coefficients from their hunger model. These equations are the basis for constructing the county estimates in this analysis.

Tapogna et al. (2004) find that the variable for households who have experienced a move within the last year, dh_i shows a statistically significant relationship with food insecurity and hunger. Peak unemployment, pu_i, however, is statistically significant only in the hunger model (Equation 3). This finding reinforces Tapogna et al.'s theorized relationship that sudden economic shocks seen in increased peak unemployment would greatly impact households that have not developed strategies for mitigating hunger, while households with persistent unemployment

*Variables statistically insignificant in the model

would have "developed ways to avoid hunger by relying on family, friends, and local institutions and by altering their consumption patterns" (Tapogna et al. 2004, p. 18). The opposite is seen when considering the poverty level, po_i which is statistically significant in the food insecurity model and not the hunger model. Tapogna et al. (2004) theorize that assistance programs and policies can mitigate hunger but are ill equipped to root out the economic basis of food insecurity.

The analysis of renters paying more then 50 percent of their income on gross rents, re_i and the variable gauging the share of population under 18, age_i reveal strong statistically significant relationships in both models. However, the rate of non-Hispanic Whites, nhw_i is statistically insignificant in both models. A possible explanation is that the rate of non-Hispanic Whites by itself has little impact outside of economic conditions captured in other variables on food insecurity and hunger. This suggestion does not imply that race or ethnicity does not correlate with food insecurity and hunger but rather is measured in the unfortunate role increased poverty rates play in minority households. This may be inferred in Nord et al.'s (2005) analysis where poverty is not controlled for while finding greater rates of food insecurity in racial and ethnic minority households.

Overall, the Tapogna et al. model presents a beneficial starting point in constructing estimates of county variability in food insecurity and hunger in Oregon. Therefore, the results section uses both equations with all regression coefficients in constructing the estimated county rate of food insecurity (Equation 2) and hunger (Equation 3).

Goodness of Fit

While measuring the results will be thoroughly undertaken in the discussion section of this report, assessing how these results are evaluated is described in the following paragraphs. Fundamentally, there is a precedent for fitting larger statistical findings into smaller levels of analysis. The techniques of small area estimates, such as the synthetic method, apply state demographic variables to counties through weighting state variability to county populations (Jia, Muennig, and Borawki, 2004). Such techniques are predominately used in health related research in order to predict vulnerable populations where accurate measuring is not possible.

To assess the scaling technique this analysis uses existing measurements of food insecurity and county hunger related assistance rates to create regional and county ranks. Using Kendall's tau rank order correlation test, this analysis determines the strength of relationship between these ranks and the ranks of the estimated food insecurity and hunger rates.

Kendall's tau rank correlation coefficient test evaluates the level of similarity between two ranked order sets (Abdi quoted in Salkind 2007). This test assesses the degree of distance seen in each ranking pair to determine the probability that the two orders are similar. Results range from a perfect rank correlation at 1, with a perfect reversed rank order at -1, while no correlation between the ordered sets results in 0. This test allows for a level of assurance within the food insecurity and hunger estimation process that the method is capturing the intended county vulnerability.

One of the measures of assessing is to compare the estimation findings to the results of the Oregon Population Survey (OPS). The OPS is a survey conducted by

the State of Oregon to gauge various demographic and societal characteristics throughout the state. This survey is administered every even-numbered year and asks the short version Food Security questionnaire (six questions regardless of the presence of children in the household), yet sample sizes at the county level are not sufficient to estimate food insecurity or hunger rates. As such, this analysis uses the 2000 OPS for a regional rank order comparison, which is the smallest significantly sized sample available. To create estimated rates at the regional level, estimated county rates are multiply by 2000 county populations to create an estimated household sample at the counties. These samples are aggregated at the regional level and returned to an estimated rate through dividing by the regional population.

In addition to comparing them with the OPS results, the estimated county food insecurity and hunger rates will be compared using Kendall's tau rank correlation to the county ranks of food stamp participation. As earlier stated food stamps have been determined to correlate with food insecurity and hunger rates for certain demographic groups. However, Tapogna et al. (2004) suggests that households with lower incomes and dependent on local institutions may have developed ways to avoid hunger (p. 18). Under this assumption food stamp participation rates should not influence hunger, but given the economic nature of food insecurity is expected to relate to food insecurity. The following sections will explore these assessment methods in testing the validity of the county estimated food insecurity and hunger rates.

Chapter 4: State & County Estimates

This section reports county food insecurity and hunger estimation results. But initially a comparison of state level food insecurity and hunger rates from the various methods is discussed since it offers some degree of comparability. An examination of the state statistics reveals the estimation results strongly resemble the ERS findings, while the OPS results seem to underreport food insecurity and hunger.

Table 2: Oregon food insecurity and hunger results for 2000.

Oregon 2000 statistics	ERS/USDA	OPS[8]	Tapogna et al.	Estimate
Food insecurity	13.7	*6.8*	12.2	12.7
Hunger	5.8	*3.2*	4.6	4.9

Table 2 details Oregon's food insecurity and hunger rates from the 2002 ERS report, the 2000 OPS results, the Tapogna et al. rates, and the estimates created in this analyses.[9] Oregon's estimated food insecurity rate using the food insecurity model is 12.7 percent . This compares well to the ERS Oregon rate of 13.7 percent (Nord, Andrews, Carlson, 2002). A half a percentage point discrepancy between the estimate and Tapogna et al. (2004) food insecurity rate exists because of the previously discussed source data differences for poverty rates and share of population in a different house, this is also apparent in the 0.3 percent discrepancy between the hunger results of these two estimates. However, the hunger estimate of 4.9 percent compares favorably to the ERS hunger rate of 5.8 percent (Nord et al., 2002).

[8] State OPS results are weighted. The 2000 Oregon Population Survey (OPS) estimated food insecurity and hunger results utilize the 6-question food insecurity short format, while including additional questions regarding respondent hunger levels that may influence accuracy of the core module. This questioning regime and the small sample size raise concerns about the survey's overall accuracy.

[9] ERS results cover the years of 1999-2001 (Nord et al. 2002). OPS results from the Oregon Progress Board and the Office of Economic Analysis' 2001 Oregon Population Survey. Oregon estimation data was gathered along with the county data and is displayed in Appendix A.

The difference between the ERS rates and the analysis estimate establish the credibility of the Tapogna et al. model. An initial validation of the estimation technique is gained with 1-percentage point differentiating the actual ERS results from the food insecurity estimate and slightly less then 1-percentage point differentiating the hunger estimate. These estimates seem plausible in comparison to the 2000 OPS results for Oregon of 6.8 percent for food insecurity and 3.2 percent for hunger. Considering that the Tapogna et al. model reflects data embedded in the three-year ERS report timeframe, it is no surprise some difference in the resulting rates of food insecurity and hunger exist. With this degree of assurance in the estimation process derived from comparing state food insecurity and hunger, the next step is exploring the county estimation results.

Applying both Equation 2 and Equation 3 to county data demonstrate patterns of food insecurity may exist within the state. These patterns offer a glimpse at the geographic specific socioeconomic conditions steering food insecurity and hunger counties range from 15.4 percent in Malheur County to 7.3 percent in Wheeler County; the county mean is 12.5 percent. Malheur County claimed the distinction of having the highest 2000 poverty rates[10] in Oregon and this subsequently influenced its food insecurity rate. Of interest are the Kendall's tau rank order results that show a small but significant positive correlation of .235 between the county population rank and food insecurity rank; this implies that more populous counties have higher food insecurity rates.[11] This is interesting given that the large counties of the Portland

[10] Appendix A offers the census poverty rates for all Oregon counties in 2000. Poverty rate dispersion in Oregon is presented in Figure 1.
[11] Appendix C lists the 2000 census figures by county and results of Kendall's tau test on food insecurity.

implies that more populous counties have higher food insecurity rates.[11] This is interesting given that the large counties of the Portland metro area don't reflect these rank correlations, and are situated toward the bottom of the food insecurity county rank ordering seen in Table 2.

The estimated hunger rates for the 36 Oregon counties range from 6.4 percent in Klamath County to 2.7 percent in Morrow County; the county mean is 5.1 percent. Population ranks in comparison to hunger ranks utilizing Kendall's tau test do not reveal the same significant relationship that was seen in the food insecurity rank order correlation.[12] These population characteristics will be further examined in the following discussion section.

[11] Appendix C lists the 2000 census figures by county and results of Kendall's tau test on food insecurity.
[12] Appendix C lists the 2000 census figures by county and results of Kendall's tau test on hunger.

Table 3: Food Insecure Estimate 2000[13]

Oregon[15]	12.65%	Rank
Malheur County	15.44%	1
Klamath County	15.19%	2
Jefferson County	14.36%	3
Lane County	14.34%	4
Linn County	14.17%	5
Marion County	14.09%	6
Jackson County	14.01%	7
Benton County	13.95%	8
Union County	13.87%	9
Josephine County	13.77%	10
Deschutes County	13.65%	11
Crook County	13.54%	12
Umatilla County	13.23%	13
Baker County	13.11%	14
Coos County	13.04%	15
Lake County	13.02%	16
Harney County	12.76%	17
Polk County	12.66%	18
Clatsop County	12.44%	19
Wallowa County	12.27%	20
Lincoln County	12.24%	21
Hood River County	12.19%	22
Douglas County	12.19%	23
Wasco County	12.11%	24
Sherman County	12.07%	25
Washington County	11.99%	26
Morrow County	11.90%	27
Multnomah County	11.88%	28
Yamhill County	11.77%	29
Grant County	11.45%	30
Columbia County	10.89%	31
Curry County	10.35%	32
Clackamas County	10.01%	33
Tillamook County	9.19%	34
Gilliam County	8.85%	35
Wheeler County	7.28%	36

Table 4:
Food Insecure with Hunger Estimate 2000[14]

Oregon[16]	4.94%	Rank
Klamath County	6.39%	1
Wallowa County	6.00%	2
Lake County	5.97%	3
Crook County	5.93%	4
Grant County	5.93%	5
Linn County	5.90%	6
Deschutes County	5.88%	7
Lane County	5.70%	8
Malheur County	5.69%	9
Harney County	5.61%	10
Benton County	5.55%	11
Union County	5.53%	12
Baker County	5.53%	13
Josephine County	5.51%	14
Coos County	5.48%	15
Jackson County	5.47%	16
Jefferson County	5.27%	17
Marion County	5.17%	18
Douglas County	5.17%	19
Wasco County	5.16%	20
Lincoln County	5.13%	21
Umatilla County	5.02%	22
Clatsop County	4.95%	23
Hood River County	4.93%	24
Polk County	4.87%	25
Sherman County	4.73%	26
Curry County	4.71%	27
Multnomah County	4.66%	28
Washington County	4.62%	29
Yamhill County	4.39%	30
Columbia County	4.34%	31
Clackamas County	3.78%	32
Wheeler County	3.76%	33
Tillamook County	3.53%	34
Gilliam County	3.39%	35
Morrow County	2.73%	36

[13] ***Bold Italic*** documents Metro counties.
[14] Ibid.
[15] See appendix A for food insecurity independent variable statistics used in the equation construction.
[16] See appendix A for hunger independent variable statistics used in the equation construction.

Chapter 5: Discussion

The estimation results suggest some interesting conclusions for Oregon counties if a measure of certainty can be ascertained. This section undertakes this validation process while proposing the usefulness of this estimate to help identify food insecurity and hunger susceptibility in counties across Oregon.

Throughout this section, the estimated results will be examined in detail through exploring additional county and regional data to determine the reasonableness of these estimates. First, Oregon is a diverse place and this diversity often reflects the differences in county geography and populations. A regional approach will also be explored using the 2000 OPS regional results to test the estimate's viability at such a level.[17] Secondly, since the food insecurity measure is economic by its very nature, county economic and employment characteristics are examined. Third, further validation of the estimation process is achieved by comparing county food insecurity and hunger estimates to county food assistance program rates. Finally, a synopsis of recent food insecurity and hunger trends in Oregon helps to determine the usefulness of this estimation technique while suggesting further avenues for improving the county estimation process.

Geography and Population Differences

A primary question when using state estimates at the county level is what scale differences exist between states and counties. Demographics demonstrate major differences in shifting this analysis scale and were addressed earlier and in Table 1,

[17] Regions are the smallest geographic areas for which reliable OPS estimates are available for food insecurity rates within Oregon. Results at this level have a high degree of variability across regions, see Appendix B.

with standard deviations for counties greater than states in four of the six variables. States are more aggregated in their geographic, population, and economic characteristics, while counties are more likely defined by their local influences of population and place. Oregon's localities vary from cosmopolitan urban to remotely rural and these locations function in dramatically different ways. The 2000 Census reports Oregon's population to be 3,421,399, with county populations ranged from 660,486 in Multnomah to 1,547 in Wheeler.[18] Clearly these communities and populations function differently, yet the Tapogna et al. state model aggregates these community differences into their state variables.

To untangle these population distinctions, the Office of Management and Budget (OMB) designations of metropolitan and non-metropolitan are used. These designations are only loosely comparable to the Census' urban and rural distinction since Crandall and Weber (2005) find significant rural populations in metropolitan-designated Oregon counties and urban populations in designated non-metropolitan Oregon counties. However, this metro/non-metro distinction does offer an important county-scaled population characteristic as well as a general proxy for county amenities and location. This designation also reflects the distance individuals have to travel to reach major population centers where additional food security abatement programs are more likely found. While no overall metro/non-metro food insecurity and hunger distinctions were found in Grussing and Edwards (2006) analysis of the Northwest, when specific sub-groups were compared metro/non-metro differences became evident.

[18] A complete list of county population is found in Appendix C.

Metro and non-metro counties are differentiated in Tables 2 and 3, with metro counties in bold italics. While no definitive conclusion can be made given the interspersion of non-metro counties, clearly the metro counties nearest the Portland metropolitan area are clustered near the bottom of both the food insecurity and hunger estimates. The hunger rates are striking for the counties near Portland with their clustering of rates between 3.78 percent and 4.66 percent. These rates are comparable to Oregon's estimated average (of which their proportional influence is seen) and are lower than most of the non-metro counties. Portland metro county estimates are roughly 1 percentage point higher than the US hunger average of 3.1 percent, yet below the Oregon state rate of 5.8 percent (Nord et al. 2002). These estimate results reflect the influence of the low peak unemployment and poverty rates found in the Portland metro counties and their primary role in the Tapogna et al. estimation equation described earlier.[19]

Other metro counties do not reveal the same positive food insecurity estimates that the Portland area experiences. Lane, Marion, Jackson, Benton, and Deschutes counties all rank above average in the food insecurity estimations. While population and geographic characteristics vary greatly in these counties, as they do in the metro designated Portland counties of Columbia, Multnomah, Washington, Yamhill, and Clackamas, the food insecurity advantages of greater proximity to the larger urban area are not seen. However, this observation does not carry over to the hunger results.

Maintaining the metro/non-metro distinction, both the best and worst estimated results in food insecurity and hunger are seen in non-metro counties. Klamath County clearly stands out with its high estimated food insecurity and hunger, while Gilliam,

[19] Appendix A details the poverty rates and peak unemployment rates within Oregon in 2000.

Wheeler, and Tillamook occupy the opposite situation where their small size reflects low food insecurity and hunger rates.

A population characteristic of interest is households with children, where increases in food insecurity and hunger rates correlate to increases in household size under 18. The coefficient related to this variable in the food insecurity estimation model illustrates this relationship with each percentage point increase in population under 18, the rate of food insecurity increases nearly a half of a percentage point. This determining characteristic shows a wide variation across the geographic and population characteristics of Oregon.[20] Morrow County with just under 11,000 residents has the highest population rate under 18 with 30.8 percent, while Benton with a population of 78,000 is second lowest with 21.3 percent. Oregon's state rate for the share of population under 18 is 24.7 percent. No clear distinction or trend is observable for the under 18 population across metro or non-metro counties. However, a possible interpretation of the results suggests counties with large higher educational institutions may experience a lower under 18 rate given their student population characteristics. Benton and Lane are both in the lower quartile for population under 18.

The OPS allows for rank ordering among regions given its survey design.[21] These regions include multiple counties within geographic proximity, allowing for distinctions to be drawn between OPS results and the estimated food insecurity and

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[20] Appendix A lists the rates and rankings of share of population under age 18 for all the counties in 2000.

[21] The OPS surveys a minimum of 400 households per region in order to ascertain regional comparisons. However, state weighting reduces regional representation and is therefore not used in this sub-state analysis. Food insecurity results range from 5.8 percent to 9.4 percent across all state regions while unweighted food insecurity rates with hunger range from 1.9 percent to 4.5 percent across the regions. Standard Error at these rates reflect +/- 3 percentage points (Oregon Progress Board, 2001)

hunger predictions of this paper. Table 5 displays the counties within each OPS region; starting with the Portland metro area and working down the Willamette Valley through the southwestern counties, mid-eastern counties and ending with Region 9 in eastern Oregon. Table 6 and Table 7 report the regional food insecurity and hunger estimation and OPS rankings.[22]

Table 5: Oregon Population Survey (OPS) Regions

Region 1: Clackamas, Multnomah, Washington
Region 2: Clatsop, Columbia, Tillamook
Region 3: Marion, Polk, Yamhill
Region 4: Benton, Lane, Lincoln, Linn
Region 5: Coos, Curry, Douglas, Jackson, Josephine
Region 6: Gilliam, Hood River, Sherman, Wasco, Wheeler
Region 7: Crook, Deschutes, Jefferson
Region 8: Klamath, Lake
Region 9: Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, Wallowa

Table 6: Regional Food Insecurity Ranks

	Estimated	OPS
Region 1	8	5
Region 2	9	9
Region 3	5	8
Region 4	2	4
Region 5	6	2
Region 6	7	6
Region 7	3	7
Region 8	1	3
Region 9	4	1

Table 7: Regional Hunger Ranks

	Estimated	OPS
Region 1	8	5
Region 2	9	9
Region 3	6	8
Region 4	3	1
Region 5	4	6
Region 6	7	3
Region 7	2	2
Region 8	1	4
Region 9	5	7

Generally, the 2000 OPS regional food insecurity ranks do not reflect the estimated county ranks created in this analysis. Using Kendall's tau correlation test, no significance is obtained in the coefficient of .333 between the estimation and OPS rank results.[23] This discrepancy may reflect the aggregation of county results, the small number of Regions in the rank comparison, and the OPS question design shortcomings.

[22] Full 2000 OPS results and regional estimate results are presented in Appendix B.
[23] Appendix B lists complete Kendall tau rank correlation results as well as detailed regional estimations.

Alternatively, using the same Kendall's tau method the 2000 OPS regional hunger ranks reflect a significant positive .444 correlation to the rank hunger estimate. Of interest is the low correlation results seen between OPS food insecurity and OPS hunger ranks with a coefficient just over .05.[24] This test result reflects the food insecurity and hunger rank differences in the OPS Regions outside of the Portland area, with the Regions of 5, 6, 7, and 9 ranking drastically different in their OPS food insecurity and hunger positions. It is important to contextualize these results in OPS regional sample size shortcomings, where rural regional samples include only 400 respondents, while the largest Region 1 has over 1000 respondents.

Table 6 and 7 rank results reinforce the speculation that population characteristics and distance may have some influence on food insecurity and show an even stronger relationship between hunger and distance. Such proximity is seen in the model estimates at the county scale as well; where distance from the Portland metro area seems to relate to increases in both food insecurity and hunger estimation rates.

Economic Opportunity

Broad economic drivers and employment opportunities at the state level are likely less diverse at the county level, adding an additional concern in using the Tapogna et al. equation for county estimates. Furthermore, economic drivers become less diverse when moving away from primary metropolitan and population centers so the estimating equation sees greater fluctuations in county rates then was present at the aggregated state level. This is evident in Table 1 where the peak unemployment mean is nearly double and standard deviation is two and a half times greater at the county

[24] Kendall's tau results detailed for both estimate and OPS food insecurity and hunger in Appendix B.

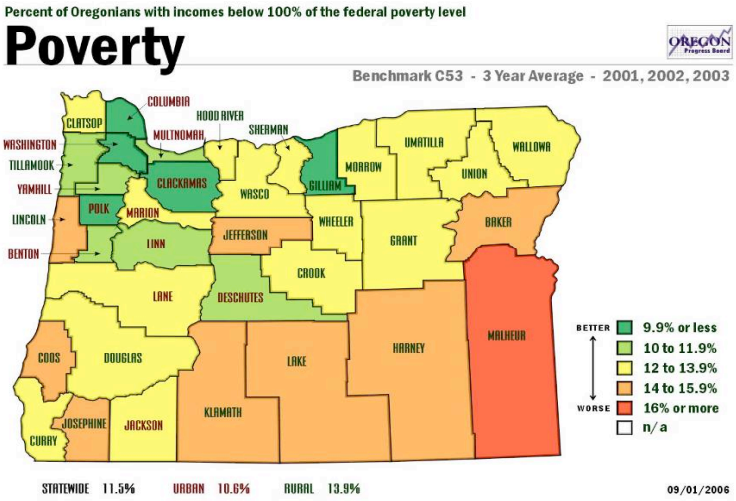
level then at the state level. Additionally, the larger geographical distances outside of the Willamette Valley should insulate county variability from cross-county commuting creating a more representative estimation for these non-metro counties. These factors distinguish the volatility of economic characteristics at the county level and the estimation process will reflect this variability in the rates of county food insecurity and hunger.

Principal among these economic attributes is the peak unemployment variable used in the county food insecurity and hunger estimates. A great deal of fluctuation in peak unemployment exists within Oregon, as Table 1 documents. Rates are greater in non-metro counties given their lack of diversified employment opportunities and greater susceptibility to boom and bust business cycles.[25] Grant County with 15 percent and Benton County at just under 4.5 percent illustrate this divergence of employment stability. Given this variable's influence on the estimate with its coefficient of .280 for food insecurity and .314 for hunger, peak unemployment has a resounding influence in dividing Oregon counties along the metro/non-metro divide.

Research explaining Oregon's higher rates of unemployment and its geographical characteristics offer some insight into the county peak unemployment results seen in this analysis. The Oregon Labor Department theorizes the comparatively large labor force living outside of major metropolitan areas as well as Oregon's weather create higher levels of unemployment in the state (Ayre, 2007). This reality is further illustrated in the Oregon Progress Board's (2005) county data book's finding that unemployment rates as a percentage of the U.S. unemployment

[25] Non-metro counties having higher rates of peak unemployment in nearly all cases detailed in Appendix A.

Figure 1.



rate are significantly higher for rural counties than urban counties (p. 10).[26] This reality pins much of Oregon's higher unemployment rates on non-metro county labor markets, which is picked up in the estimates of food insecurity and hunger. Grussing and Edwards (2006) find food insecurity and hunger rates nearly double for unemployed households in non-metro counties when analyzing recent CPS statistics for the Northwest.[27] Fundamentally these results point to the structure of the dominant resource driven industries of timber and agriculture as well as tourism in non-metro counties and the cyclic nature of their seasonal employment needs.

In tandem with unemployment, poverty has a strong influence on the estimates of food insecurity and hunger. The 2000 poverty variable used for this analysis results in a county dispersion similar to that of peak unemployment. Oregon's poverty rate for 2000 was 10.6 percent, with county rates ranging from 19.1 percent in Malheur County to 6.6 percent in Washington County with metro counties consistently

[26] Oregon Progress Board's distinction of rural and urban counties follows the metro/non-metro classification used in this analysis with the exception of adding Linn County to the urban classification.
[27] Non-metro rates of 49.8 percent and 21.3 percent were seen in food insecurity and hunger for unemployed households while metro rates were 27.9 percent and 11.2 percent respectively (Grussing and Edwards, 2006). Northwestern states include Oregon, Washington, and Idaho.

experiencing lower poverty rates.[28] Figure 1 displays the county poverty rate dispersion in Oregon (Oregon Progress Board, 2005a).[29] Of interest is the fact that the metro counties of Jackson, Marion, and Lane along with all non-metro counties, except for Gilliam, have poverty rates greater then the state average. This exposes a possible relationship where poverty rates increase without the benefit of the higher average incomes of the Portland metro area. This dramatic county dispersion influences the estimates of food insecurity and hunger along the mostly metro/non-metro dichotomy.

The affordable housing variable, the percentage of renters spending over 50 percent of their income on rent, breaks from the clear metro/non-metro trend seen in poverty and peak unemployment statistics. As articulated in the literature review, rent over 50 percent of income is seen to increase food insecurity by reducing the food budget given the greater inelasticity of rent. This variable expresses a greater proportional influence on the estimate for hunger than for food insecurity. This finding adds credibility to the proposed food budget/rent connection that speculates when resources are scarce food expenses are cut in order to meet rent, which can result in increased food insecurity and hunger. Oregon counties reflect widely different rates of rents over 50 percent of income, with a standard deviation over double what was seen in the Tapogna et al. state level analysis.[30] This increased fluctuation will result in greater variation in estimated food insecurity and hunger across counties then was seen in the state model.

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[28] Appendix A has a complete listing of the poverty statistics used in this analysis.
[29] Figure 1 reflects the average of years 2001, 2002, and 2003. While these differ from the 2000 poverty statistic used in this analysis the dispersion pattern is identical across Oregon counties.
[30] Table 1 documents these descriptive statistics.

An interesting result is seen when evaluating food insecurity in relation with rents. Rents are dramatically higher in Benton (27.1 percent), Lane (24.8 percent), Linn (24 percent), Union (22.4 percent), and Polk (22.2 percent) counties than the Oregon rate of 19.3 percent.[31] While this rent measurement reflects the wage market in comparison to the rental market, there is a possibility that medium-sized counties do not experience the wage premiums and rental market competition that larger counties do. Of note, is the relationship Oregon's universities may play in this rental market variable, since Benton and Lane rank 1st and 2nd. This relationship may artificially inflate the estimated food insecurity rate of counties with large educational institutions given the particular household characteristics of university students where incomes are structurally low and rents high. The following section will look at levels of support in these counties to deem if such a conclusion is warranted.

The influence of housing on food insecurity and hunger is examined through the variable for households that moved within the past year. This variable affects both the food insecurity and hunger models in similar proportions. While no clear pattern appears across Oregon's counties or between the metro/non-metro distinctions, the counties of Benton (29.4 percent) and Lane (25.7 percent) are two of the top four and above the Oregon state average of 24.1 percent for the moved within the last year variable.[32] Once again, the role universities play within these counties may factor into the results.

These variable influences on the food insecurity and hunger estimates suggest more than a metro/non-metro distinction although they do reiterate the metro/non-

[31] Appendix A offers the county ranks and rates for the rent over 50 percent of income variable.
[32] Appendix A offers the county data rates and ranks for the moved household variable.

metro relationship that others have documented. The county estimation process exhibits a disposition that reflects distance from the largest metropolitan region in the state. The economic opportunity of the Portland metro area and the immediate outlying counties is evident in reduced estimates of food insecurity and hunger, while the metro counties beyond Portland's immediate vicinity do not see the same estimated gains against food insecurity and hunger. The 2000 OPS food insecurity results reinforce such a conclusion but only at the regional level.[33] The following section examines another food insecurity and hunger proxy measure in order to further validate the estimated county results.

Involvement at the County

The examination of services measured at the county level allows for an additional evaluation of the validity of county estimates of food insecurity and hunger. This analysis examines county participation rates for the federal food stamp program. Food stamp participation, as addressed in the literature review, has been correlated to food insecurity and hunger and there is an expectation that county estimates will reflect this relationship.

A county's food stamp participation level is one measurable assistance program likely to reduce hunger that has readily available statistics at the county level. This program has been identified as successful in lowering the food insecurity rates of households near the poverty level (Bartfeld and Dunifon, 2006). However, food stamp assistance cannot resolve food insecurity and hunger alone as indicated in an Oregon

[33] Appendix B details the OPS food insecurity results by region and county.

Food Bank report (2004) stating that 54 percent of people receiving emergency food boxes also receive food stamps.

The temporary and relatively small economic benefit of the food stamp program is not a long-term fix expected to reduce rates of food insecurity but may, by offering just enough benefit, eliminate some level of hunger. Table 8 displays the county food stamp participation percentage in relationship to estimated food insecurity and hunger rates.

Food stamp use in comparison to estimated food insecurity exposes a positive relationship between the two, where increased estimated food insecurity counties have increased food stamp use. Kendall's tau rank order correlation test concludes a coefficient of .369 at the 99 percent confidence

Table 8: Food stamp participation /Estimated Food Insecurity

	Food Insecurity		Food stamps[34]	Hunger	
Oregon	12.65%	Rank	11.3%	4.94%	Rank
Sherman County			*		
Wheeler County			*		
Coos County	13.04%	15	16.5%	5.48%	15
Jefferson County	14.36%	3	16.2%	5.27%	17
Lincoln County	12.24%	21	16.2%	5.13%	21
Wasco County	12.11%	24	15.8%	5.16%	20
Marion County	14.09%	6	15.7%	5.17%	18
Klamath County	15.19%	2	15.6%	6.39%	1
Josephine County	13.77%	10	15.3%	5.51%	14
Linn County	14.17%	5	14.9%	5.90%	6
Malheur County	15.44%	1	14.5%	5.69%	9
Douglas County	12.19%	23	14.3%	5.17%	19
Jackson County	14.01%	7	14.3%	5.47%	16
Baker County	13.11%	14	13.7%	5.53%	13
Multnomah County	11.88%	28	13.6%	4.66%	28
Lane County	14.34%	4	13.3%	5.70%	8
Umatilla County	13.23%	13	13.1%	5.02%	22
Crook County	13.54%	12	12.3%	5.93%	4
Harney County	12.76%	17	12.2%	5.61%	10
Union County	13.87%	9	12.1%	5.53%	12
Morrow County	11.90%	27	11.4%	2.73%	36
Deschutes County	13.65%	11	11.2%	5.88%	7
Curry County	10.35%	32	10.9%	4.71%	27
Columbia County	10.89%	31	10.4%	4.34%	31
Grant County	11.45%	30	10.2%	5.93%	5
Tillamook County	9.19%	34	10.0%	3.53%	34
Clatsop County	12.44%	19	9.9%	4.95%	23
Hood River County	12.19%	22	9.5%	4.93%	24
Wallowa County	12.27%	20	8.6%	6.00%	2
Lake County	13.02%	16	8.5%	5.97%	3
Yamhill County	11.77%	29	7.6%	4.39%	30
Benton County	13.95%	8	6.3%	5.55%	11
Clackamas County	10.01%	33	5.8%	3.78%	32
Gilliam County	8.85%	35	5.7%	3.39%	35
Polk County	12.66%	18	5.5%	4.87%	25
Washington County	11.99%	26	4.9%	4.62%	29

* No food stamp data is available for Sherman or Wheeler Counties.

[34] Food stamp rates reflect 2003 data, which allows for general rank ordering but is not wholly comparable with survey estimation source data. (Bowman, Schuster and Weber, 2003).

level when assessing the rank order of estimated food insecurity and the rank order of food stamp participation.[35] This robust rejection of the null hypothesis of no correlation offers some insight into the estimation as a measure as well as a possible glimpse of how households cope with food insecurity.

One glaring exception to this positive correlation is Benton County where food stamp use was 5th lowest at 6.3 percent, yet estimated food insecurity was 8th highest at 13.95 percent. As earlier hypothesized, the estimation process does not accurately capture the unique socioeconomic characteristics of this university-dominated county.

The metro/non-metro division is also evident in county food stamp use with Portland metro counties excluding Multnomah all ranking at the bottom for food stamp use. The metro counties outside of the Portland area: Marion, Lane, and Jackson reflect their estimated higher food insecurity rates with higher food stamp rates.

On the other hand there is not a strong a relationship between county food stamp rates and estimated hunger rates. Once again using Kendall's tau correlation test, no statistically significant relationship is revealed between the rank order hunger rates and the rank order food stamp participation rates.[36] While statistically no relationship is identified there are some interesting counterintuitive rankings between the estimated hunger rates and food stamp use. The rankings seem to identify a

[35] Appendix D presents the full Kendall's tau test results.
[36] Appendix D presents the full Kendall's tau test results.

condition in some rural counties where hunger rates are high while actual food stamp use is quite low. These five counties are:[37]

- Wallowa – estimated 2nd most hungry, yet 8th lowest in food stamp use.
- Lake – estimated 3rd most hungry, yet 7th lowest in food stamp use.
- Grant – estimated 5th most hungry, yet 12th lowest in food stamp use.
- Deschutes – estimated 7th most hungry, yet 15th lowest in food stamp use.
- Union – estimated 12th most hungry, yet 17th lowest in food stamp use.

Two possible explanations exist for these results. The estimation process may predict higher hunger than is accurate. Logically, this could be the case given the state model ignores rural effects. The state statistics used in Tapogna et al. are driven by characteristics that represent urban realities to a greater degree given their size. Smaller rural characteristics are possibly averaged away in the Tapogna et al. national model. Therefore, rural county estimates may not be as good as those for urban counties given the Tapogna et al. state model coefficients used. This rationale is supported by research results that do not generally see non-metro counties in Oregon with higher rates of hunger than metro counties (Grussing and Edwards, 2006; Edwards and Weber, 2003).

The second explanation is that these county rates are reasonable estimates, but the low county food stamp rates reflect under-utilization of the food stamp program in mainly non-metro counties. Since many of the counties in question have the burden of traveling increased distances in order to obtain food assistance (such as food banks) and the stigma associated with assistance programs may deter utilization in these rural localities, as Rank and Hirschl suggests (1993) this possibility exists.

[37] A 6th estimated most hungry county met this condition, this was Benton, which was excluded give the likelihood of estimation error caused by the unique county characteristics caused by Oregon State University being located in the county. See Table 6 for detailed listing.

Conclusions

Estimating food insecurity and hunger as constructed in this analysis offers a point of departure from modeling the causes of food insecurity to predicting food insecurity using socioeconomic characteristics. While such an approach will never fundamentally understand the physiology of place as it relates to food insecurity, estimating county food insecurity and hunger adds value to Oregon and its counties. Given the dearth of food insecurity information for counties, this technique allows for the targeting and customizing of hunger abatement programs at the county level.

Findings suggest possible connections exist between food insecurity and hunger and county characteristics, such as location. Estimates suggest distance from the major metropolitan areas increase the susceptibility of food insecurity and hunger. Additionally, this metropolitan benefit is not shared equally, with the Portland region figuring prominently in lower estimated rates of food insecurity and hunger. However, the estimation process may reflect bias detrimental to rural counties. This bias may be evident in the relationship food stamp participation rates appear to have on food insecurity and hunger estimations. Further research exploring whether outreach and food stamp rates in rural areas has increased and whether this has influenced rates of food insecurity and hunger may abate such concern.

The technique used in this research more accurately measures the fundamental socioeconomic determinants of food insecurity and hunger but is not qualified to assess hunger abatement programs or changes to these programs. Since 2000 Oregon's food stamp use has dramatically increased along with the distribution of food bank emergency food boxes while the rates of hunger and food insecurity have

decreased.[38] (Oregon Food Bank, 2006; Oregon Hunger Relief Task Force, 2006) Yet, the socioeconomic nature of the Tapogna et al. model does not isolate abatement programs and would be unable to capture Oregon's program changes. Given this fact the estimated results presented in this analysis reflect counties' socioeconomic susceptibility to food insecurity but does not represent actual food security statistics.

This susceptibility can be measured in an accurate manner from readily available data and could be updated through census estimates and county socioeconomic statistics at various intervals. Such a step would be beneficial in testing the food insecurity and hunger equation across time and would reveal the limitation of missing a variable that captures mitigation policies and programs. Furthermore, measuring the susceptibility could have the immediate impact of helping counties determine where services are needed, while also stimulating the discussion of the long-term economic underpinnings of food insecurity and hunger.

[38] In 2000, Oregon began an extensive food stamp outreach program that has increased food stamp participation rates 80 percent by 2005.

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Appendix A: County Source Data

	Poverty 2000*		Peak Unemployment*			Rent over 50% income*			Share of pop non-Hisp White*			Share of pop under age 18*			Different house*		
Oregon	10.6	Rank	**Oregon**	6.70%	Rank	**Oregon**	19.3%	Rank	**Oregon**	83.52%	Rank	**Oregon**	24.74%	Rank	**Oregon**	24.10%	Rank
Malheur	19.1%	1	Grant	15.33%	1	***Benton***	27.1%	1	Gilliam	96.03%	1	Morrow	30.79%	1	***Benton***	29.40%	1
Josephine	15.8%	2	Lake	13.17%	2	***Lane***	24.8%	2	Wallowa	95.74%	2	Jefferson	29.81%	2	***Washington***	28.40%	2
Lake	15.2%	3	Wallowa	12.70%	3	Linn	24.0%	3	Baker	94.61%	3	Hood River	27.97%	3	***Deschutes***	27.30%	3
Coos	14.9%	4	Harney	12.00%	4	Union	22.4%	4	Grant	94.59%	4	Umatilla	27.77%	4	***Lane***	25.70%	4
Baker	14.4%	5	Wheeler	11.77%	5	***Polk***	22.2%	5	***Columbia***	93.15%	5	Malheur	27.63%	5	***Multnomah***	25.60%	5
Harney	14.3%	6	Morrow	11.70%	6	***Jackson***	21.7%	6	Union	93.12%	6	***Marion***	27.37%	6	Jefferson	24.40%	6
Klamath	14.3%	7	Malheur	10.77%	7	Josephine	21.5%	7	***Deschutes***	92.90%	7	***Columbia***	27.32%	7	Morrow	24.00%	7
Jefferson	13.9%	8	Crook	10.67%	8	Coos	21.2%	8	Wheeler	92.50%	8	***Yamhill***	26.88%	8	Crook	23.90%	8
Lincoln	13.9%	9	Klamath	10.47%	9	Klamath	20.7%	9	Sherman	92.14%	9	***Washington***	26.86%	9	***Marion***	23.70%	9
Sherman	13.6%	10	Hood River	10.20%	10	***Multnomah***	19.7%	10	Douglas	91.94%	10	Crook	26.59%	10	***Jackson***	23.60%	10
Umatilla	13.6%	11	Baker	10.17%	11	***Deschutes***	19.6%	11	Josephine	91.43%	11	Sherman	26.42%	11	Clatsop	23.50%	11
Grant	13.2%	12	Wasco	10.13%	12	Sherman	19.0%	12	Crook	91.40%	12	***Clackamas***	26.16%	12	Lincoln	23.00%	12
Curry	12.9%	13	Coos	9.57%	13	Baker	18.7%	13	Linn	91.21%	13	Linn	26.03%	13	Klamath	22.80%	13
Douglas	12.9%	14	Douglas	9.57%	14	***Marion***	18.4%	14	Tillamook	91.03%	14	Harney	25.96%	14	Umatilla	22.70%	14
Jackson	12.8%	15	Curry	9.47%	15	Clatsop	18.3%	15	Curry	90.86%	15	Klamath	25.83%	15	Harney	22.10%	15
Union	12.6%	16	Sherman	9.30%	16	***Yamhill***	18.2%	16	Clatsop	90.83%	16	Grant	25.77%	16	***Polk***	22.00%	16
Marion	12.5%	17	Josephine	9.17%	17	Lincoln	18.1%	17	Coos	90.18%	17	Wasco	25.37%	17	Union	21.80%	17
Wasco	12.4%	18	Jefferson	9.00%	18	Douglas	17.1%	18	Harney	89.67%	18	***Polk***	25.35%	18	Curry	21.80%	18
Hood River	12.3%	19	Umatilla	9.00%	19	***Clackamas***	16.9%	19	Lake	89.15%	19	Lake	24.89%	19	Malheur	21.40%	19
Wallowa	12.2%	20	Lincoln	8.90%	20	Curry	16.7%	20	***Clackamas***	89.11%	20	***Deschutes***	24.78%	20	***Yamhill***	20.90%	20
Crook	12%	21	Linn	8.43%	21	***Columbia***	16.6%	21	***Jackson***	88.71%	21	Union	24.65%	21	Lake	20.90%	21
Lane	12%	22	***Deschutes***	7.97%	22	***Washington***	15.7%	22	***Lane***	88.58%	22	***Jackson***	24.42%	22	Wallowa	20.80%	22
Clatsop	11.9%	23	Union	7.73%	23	Wasco	15.5%	23	Lincoln	88.27%	23	Wallowa	24.29%	23	Linn	20.70%	23
Tillamook	11.8%	24	Clatsop	7.37%	24	Wallowa	15.2%	24	***Benton***	86.77%	24	Baker	24.22%	24	***Clackamas***	20.60%	24
Linn	11.1%	25	***Columbia***	7.30%	25	Crook	14.9%	25	***Polk***	85.59%	25	Douglas	23.98%	25	Douglas	20.50%	25
Wheeler	10.8%	26	***Jackson***	7.30%	26	Hood River	14.7%	26	***Yamhill***	84.34%	26	Clatsop	23.67%	26	Wasco	20.30%	26
Morrow	10.6%	27	Tillamook	7.20%	27	Malheur	14.5%	27	Klamath	84.14%	27	Gilliam	23.24%	27	Coos	20.20%	27
Gilliam	10.5%	28	***Marion***	7.07%	28	Tillamook	14.3%	28	Wasco	83.93%	28	Josephine	23.07%	28	Josephine	19.80%	28
Multnomah	10.5%	29	Gilliam	6.83%	29	Gilliam	13.3%	29	***Washington***	77.75%	29	***Lane***	22.86%	29	Baker	19.40%	29
Deschutes	9.6%	30	***Lane***	6.50%	30	Lake	13.0%	30	Umatilla	77.49%	30	Wheeler	22.69%	30	Grant	18.70%	30
Polk	9.6%	31	***Multnomah***	6.13%	31	Umatilla	12.9%	31	***Multnomah***	76.53%	31	***Multnomah***	22.29%	31	Tillamook	18.30%	31
Benton	9.3%	32	***Yamhill***	6.10%	32	Jefferson	12.3%	32	***Marion***	76.49%	32	Tillamook	22.24%	32	***Columbia***	18.30%	32
Yamhill	9.2%	33	***Polk***	5.97%	33	Morrow	11.5%	33	Morrow	71.95%	33	Coos	21.93%	33	Gilliam	18.20%	33
Columbia	8.5%	34	***Washington***	5.23%	34	Wheeler	11.3%	34	Hood River	70.68%	34	Lincoln	21.44%	34	Hood River	18.10%	34
Clackamas	6.7%	35	***Clackamas***	5.17%	35	Harney	11.1%	35	Malheur	68.80%	35	***Benton***	21.31%	35	Sherman	13.70%	35
Washington	6.6%	36	***Benton***	4.43%	36	Grant	9.0%	36	Jefferson	64.89%	36	Curry	19.23%	36	Wheeler	11.90%	36

*Data sources on the following page. (***Bold italics*** designates metropolitan designated county.)

Appendix A – Data Sources

Poverty 2000: data from the U.S. Census Bureau, Small Area Income & Poverty Estimates. The data is Oregon counties by all ages in poverty 2000. <http://www.census.gov/cgi-bin/saipe/saipe.cgi>

Peak unemployment: peak month of unemployment averaged across the years of 1999,2000, and 2001. Unemployment data from Oregon Employment Department: <http://www.qualityinfo.org/olmisj/labforce?key=startregion&areacode=4101000000>

Rent over 50% of household income: data from U.S. Census Bureau, 2000 Census summary file 3 (SF3), table QT-H13 (Matrices H69, H70, and H73). <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_lang=en&_ts=193519330548&_ds_name=DEC_2000_SF3_U&_program=DEC>

Share of population non-Hispanic white: data from U.S. Census Bureau, 2000 Census summary file 1 (SF1), DP-1. Profile of General Demographic Characteristics: 2000. <http://factfinder.census.gov/servlet/QTGeoSearchByListServlet?_lang=en&_ts=193519702368>

Share of population under the age of 18: data from U.S. Census Bureau, 2000 Census summary file 1 (SF1), DP-1: Profile of General Demographic Characteristics: 2000. <http://factfinder.census.gov/servlet/QTGeoSearchByListServlet?_lang=en&_ts=193519702368>

Share of population moved to different house in the last year: data from U.S. Census Bureau, 2000 Census summary file 3 (SF3), DP-4: Profile of Selected Housing Characteristics: 2000. (Matrices of P3, P4, H3, and H4). <http://factfinder.census.gov/servlet/QTGeoSearchByListServlet?ds_name=DEC_2000_SF3_U&state=qt&qr_name=DEC_2000_SF3_U_DP4&_lang=en&_ts=193520362954>

Appendix B: OPS 2000 Results and Correlations

Kendall's tau Rank Correlation Coefficient: Estimate Results by OPS Results

		Estimated food insecurity	Estimated hunger	OPS food insecurity	OPS hunger
Estimated food insecurity	Correlation Coefficient	1	0.833**	0.333	0.389
	Sig. (1-tailed)	.	0.001	0.105	0.072
	N	9	9	9	9
Estimated hunger	Correlation Coefficient	0.833**	1	0.278	0.444*
	Sig. (1-tailed)	0.001	.	0.149	0.048
	N	9	9	9	9
OPS food insecurity	Correlation Coefficient	0.333	0.278	1	0.056
	Sig. (1-tailed)	0.105	0.149	.	0.417
	N	9	9	9	9
OPS hunger	Correlation Coefficient	0.389	0.444*	0.056	1
	Sig. (1-tailed)	0.072	0.048	0.417	.
	N	9	9	9	9

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

Regional Food Insecurity

	Estimate	Rank	OPS	Rank
Region 1	11.47%	8	7.71%	5
Region 2	11.03%	9	5.83%	9
Region 3	13.43%	5	6.63%	8
Region 4	14.06%	2	7.77%	4
Region 5	13.24%	6	8.25%	2
Region 6	11.86%	7	7.27%	6
Region 7	13.73%	3	7.24%	7
Region 8	14.96%	1	8.21%	3
Region 9	13.48%	4	9.36%	1

Regional Hunger

	Estimate	Rank	OPS	Rank
Region 1	4.44%	8	3.38%	5
Region 2	4.36%	9	1.94%	9
Region 3	4.97%	6	2.28%	8
Region 4	5.62%	3	4.47%	1
Region 5	5.38%	4	3.30%	6
Region 6	4.94%	7	3.86%	3
Region 7	5.81%	2	4.30%	2
Region 8	6.35%	1	3.79%	4
Region 9	5.22%	5	2.77%	7

OPS 2000 Food Insecurity Results – Unweighted [39]

Region	County	Food Secure	FI without Hunger	FI With Hunger	Total N= Survey Households
Region 1	Clackamas	144	3	3	150
	Multnomah	708	42	31	781
	Washington	214	5	5	224
	Region total	1066	50	39	1155
Region 2	Clatsop	126	8	6	140
	Columbia	171	6	1	178
	Tillamook	91	2	1	94
	Region total	388	16	8	412
Region 3	Marion	300	15	10	325
	Polk	62	4	1	67
	Yamhill	89	2		91
	Region total	451	21	11	483
Region 4	Benton	73	4	2	79
	Lane	263	8	15	286
	Lincoln	51	2	4	57
	Linn	88	3	2	93
	Region total	475	17	23	515
Region 5	Coos	62	5	4	71
	Curry	26	1		27
	Douglas	105	4	4	113
	Jackson	169	12	7	188
	Josephine	83	2	1	86
	Region total	445	24	16	485
Region 6	Gilliam	18			18
	Hood River	172	5	2	179
	Sherman	16	1		17
	Wasco	189	9	15	213
	Wheeler	13			13
	Region total	408	15	17	440
Region 7	Crook	50		3	53
	Deschutes	295	11	12	318
	Jefferson	65	2	4	71
	Region total	410	13	19	442
Region 8	Klamath	398	19	16	433
	Lake	38	2	2	42
	Region total	436	21	18	475
Region 9	Baker	39	4		43
	Grant	17	2	1	20
	Harney	19	3	3	25
	Malheur	85	9	2	96
	Morrow	23	1	1	25
	Umatilla	170	8	6	184
	Union	56	4		60
	Wallowa	17			17
	Region total	426	31	13	470
	State totals	***4505***	***208***	***164***	***4877***

[39] OPS 2000 results are not significant at the county level.

Appendix C: County Populations and Correlations

County Populations 2000 Census

County	Population	Rank	County	Population	Rank
Multnomah County	660,486	1	Clatsop County	35,630	19
Washington County	445,342	2	Malheur County	31,615	20
Clackamas County	338,391	3	Union County	24,530	21
Lane County	322,959	4	Tillamook County	24,262	22
Marion County	284,834	5	Wasco County	23,791	23
Jackson County	181,269	6	Curry County	21,137	24
Deschutes County	115,367	7	Hood River County	20,411	25
Linn County	103,069	8	Crook County	19,182	26
Douglas County	100,399	9	Jefferson County	19,009	27
Yamhill County	84,992	10	Baker County	16,741	28
Benton County	78,153	11	Morrow County	10,995	29
Josephine County	75,726	12	Grant County	7,935	30
Umatilla County	70,548	13	Harney County	7,609	31
Klamath County	63,775	14	Lake County	7,422	32
Coos County	62,779	15	Wallowa County	7,226	33
Polk County	62,380	16	Sherman County	1,934	34
Lincoln County	44,479	17	Gilliam County	1,915	35
Columbia County	43,560	18	Wheeler County	1,547	36

Kendall's tau Rank Correlation Coefficient: Population Rank by Estimate Result Rank

		Estimated Food Insecurity Rank	Estimated Hunger Rank	Population Rank
Estimated Food Insecurity Rank	Correlation Coefficient	1	0.556**	0.235*
	Sig. (2-tailed)	.	0.000	0.022
	N	36	36	36
Estimated Hunger Rank	Correlation Coefficient	0.556**	1	-.006
	Sig. (2-tailed)	0.000	.	0.478
	N	36	36	36
Population Rank	Correlation Coefficient	0.235*	-.006	1
	Sig. (2-tailed)	0.022	0.478	.
	N	36	36	36

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Appendix D: County Food Stamp Participation Correlations

Kendall's tau Rank Correlation Coefficient: County Food Stamp Participation Rank by Estimate Result Rank

		Estimated Food Insecurity Rank	Estimated Hunger Rank	Food Stamp Participation Rank
Estimated Food Insecurity Rank	Correlation Coefficient	1	0.556**	0.369**
	Sig. (2-tailed)	.	0.000	0.002
	N	36	36	34
Estimated Hunger Rank	Correlation Coefficient	0.556**	1	.191
	Sig. (2-tailed)	0.000	.	0.113
	N	36	36	34
Food Stamp Participation Rank	Correlation Coefficient	0.369**	.191	1
	Sig. (2-tailed)	0.002	0.113	.
	N	34	34	34

** Correlation is significant at the .01 level (2-tailed).