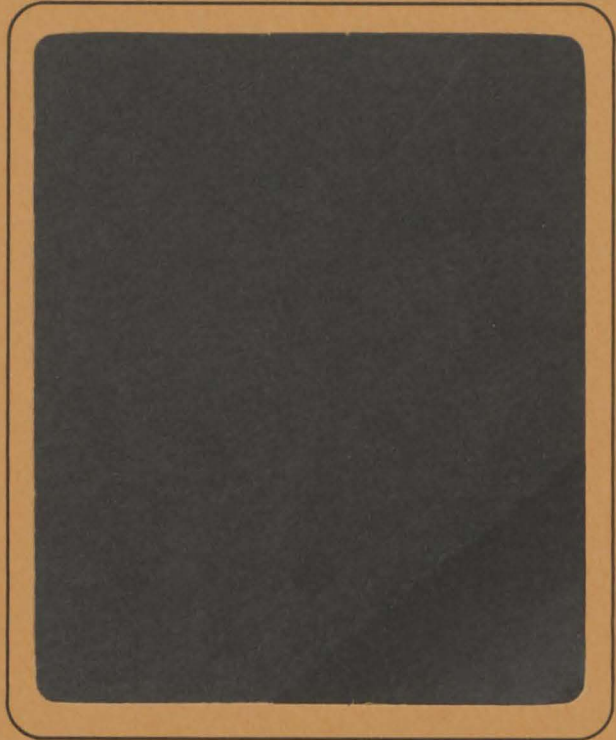


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REGIONAL CONSUMER PRICE
COMPARISONS - WITH SPECIFIC
APPLICATIONS TO MINNESOTA*

by

Brenda K. Burk**
Glenn L. Nelson

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** Graduate research assistant and professor, respectively, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. David Chein, Ben Senauer, Eric Sheppard, and John Yunker provided helpful information and comments during the course of this study.

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Many people assume that substantial differences in the cost of living exist between regions in the United States and also between regions in Minnesota. These geographic differentials are of great interest because of their effects on real wages and, in turn, on migration between regions. Despite the interest, little empirical work has been done because of the perceived expense of creating sufficiently precise measures. This study formulates and evaluates a procedure that concentrates on two variables, land and wage costs, and is, thus, much less expensive to implement than complete consumer price surveys.

Although many complex factors underly the movement of labor and the determination of wages, this study addresses wages and consumer price relationships from the perspective of neoclassical economics. The paper begins with a brief review of household choices as the context for the analysis of price indices. The next major section of the paper focuses on the role of land costs and wages as important factors determining consumer prices. The paper next discusses the implications of varying natural amenities, public services, and shopping time as potential sources of bias in the results. Following this, the paper presents the empirical results for regions within Minnesota and compares these results with those in a recent study by the Minnesota Office of the Legislative Auditor. Finally, the study suggests conclusions with regard to the importance of regional differences in the cost of living and with regard to needed research.

Household Budget Choices

In the neoclassical analysis of expenditures on purchased goods, household budget choices are derived through a framework of maximizing utility subject to a budget constraint. Household expenditures can be expressed as:

$$E_j = \sum_i P_{ij} * Q_{ij} \quad i = 1, \dots, k \quad [1]$$

where E_j is the expenditure of a household in region j ,

P_{ij} is the price of good i in region j ,

Q_{ij} is the quantity of good i in region j , and

k is the number of purchased goods in the market basket.

Expenditure levels (E_j) vary by region because of variations in both prices (P_{ij}) and quantities (Q_{ij}). The prices and quantities vary over regions because of differences in, for example, incomes, resource endowments, and preferences. This region-specific index would be appropriate for assessing differences in total costs of living for typical families in different regions.

Common market baskets over all regions are typically substituted for these region-specific market baskets in measures of the "cost of living" (Bureau of Labor Statistics, 1988) for several reasons. First, as already noted, market baskets differ with respect to composition and scale because of regional differences in people's purchasing power. Thus, region-specific market baskets are not good inputs to the calculation of the relative well-being of people with comparable incomes in different regions. Second, common market

baskets are often used to minimize the high data collection costs associated with identifying and quantifying the consumption items which would enter an appropriate index specific to each region.

Following typical procedure, we define and use a common market basket (\bar{Q}) which implies the expenditures for the market basket in each region are represented by:

$$\bar{E}_j = \sum_i P_{ij} * \bar{Q}_i \quad [2]$$

and then the regional cost of living index is given by:

$$\bar{I}_j = \bar{E}_j / \bar{E}_1 \quad [3]$$

where \bar{I}_j is the cost of living index for region j relative to region 1,

\bar{E}_j is the expenditure for region j on market basket \bar{Q} ,

\bar{E}_1 is the expenditure for reference region 1 on market basket \bar{Q} .

A fixed market basket reflects neither substitutions due to price changes nor regional quantity (or quality) differences. The welfare differences attributed to these two factors are addressed in the following two subsections. A third subsection notes a variety of other problems important to both creators and users of price indices.

Price Variations

Relative prices may vary by region for a number of reasons. Differing income levels will change relative prices for those items whose supply is not perfectly elastic, such as land or housing. Preferences vary by region--as does the natural environment, levels

capital, and the technology of production. According to microeconomic theory, as prices increase the quantity demanded decreases. Therefore, if relative prices vary by region, consumption in each region will shift towards goods and services with relatively lower prices. The market basket (Q^*) common to all regions will be unrepresentative of any specific region because a common market basket does not allow for substitution. In general, these substitutions lead to smaller differences in real welfare than in measured real income. Furthermore, the changes in the price index will most overstate the change in nominal prices for people in those regions experiencing the greatest relative price variation in the specified market basket items.

The equivalent income function has been useful in comparing the level of utility under a set of given prices to the same level of utility obtained from a different level of income and prices. Quantifying the differences in this manner accounts for household utility differences due to price variations in the market basket items. The result is an expression which measures household welfare through an indirect utility function. The derived money metric utility can be combined with consumer demand data to form a money metric for households with "quasi-homothetic preferences."¹ Thus, the theoretical and methodological underpinnings exist for a largely rigorous analysis of the differences in welfare, measured in income, because of price differences for consumed goods.

¹ Boadway, Robin W., and Neil Bruce, Welfare Economics, Basil Blackwell Publisher Limited, New York, NY, (1984), p. 38-39.

Quantity Constraints

The analysis by Boadway and Bruce of welfare differentials due to quantity constraints provides a theoretical perspective on the cases of fixed-quantity items and regional availability of goods.² Quantity constraints may be due to fixed quantities of public goods, institutional constraints on decisions, inflexibility of durable goods purchases, and time requirements. Examples of these quantity constraints include the level of publicly provided goods, such as national defense and garbage collection, which cannot be easily altered by individual households. Living space, in the form of lot sizes, is often predetermined through local zoning ordinances. Also, the existence of incomplete or imperfect markets can be a quantity constraint because of the inability of households to create contracts adequately addressing uncertainty of future events.

Although the work of Boadway and Bruce is useful for general understanding, application is difficult because shadow (implicit) prices are required but not observed directly; these implicit prices are household specific, and market prices for certain goods may not exist or may not reflect the marginal value of an extra unit of a good due to other constraints. Unavailability of the imposed market basket item may lead to substitution of a good completely different in nature. Therefore, quantitative analysis of these differentials in welfare is complicated. This empirical study will not delve more deeply into the theory but, rather, refer interested readers to Boadway and Bruce.

² Ibid., p. 43-46.

Other Problems

The formulation of the national consumer price index (CPI) has been debated extensively for both scholarly and programmatic reasons. The resulting critique applies to regional as well as national consumer price measures. Six broad problem areas in this index were identified by DeMilner in 1981:

- (1) Treatment of homeownership - The equity component of housing had been included in the index instead of the flow of services from housing; this has since been corrected.
- (2) Fixed market basket - As previously noted, a fixed market basket does not compensate for substitution effects which occur within consumption during relative price changes.
- (3) Aggregation of family budgets by expenditure weights instead of population weights - This may overstate the relative importance of items such as education, entertainment and housing, while understating the importance of necessities like food.
- (4) Treatment of taxes - The CPI includes sales, excise, payroll, and other indirect business taxes but excludes income taxes. The resulting CPI measure may bias legislators against consumption taxes and toward income taxes with intentions of lessening measured inflation and of minimizing benefit increases.
- (5) Treatment of nonmarket consumption - The benefits of nonmarket consumption are not captured in the CPI. However, the increase in product prices associated with the creation of these benefits is reflected in the CPI. Examples are environmental protection and product safety programs.

- (6) Use of an aggregate or average consumption pattern for escalation of income to a specific demographic group - The imposed market basket may not be representative of a specific region or of a particular segment of the population. For example, the market basket associated with consumption patterns in the Minneapolis-St. Paul area has a higher weight for housing and a lower weight for food than the national market basket. Also, examination of particular social and age groups reveals the current market basket weights may be especially inadequate for older persons. For example, the housing component may be too high for those approaching retirement with a paid mortgage, and this group may also require a higher weight for medical services. Special CPIs have been suggested but high data collection costs and hypothesized small levels of variation have resulted in no significant action. The Bureau of Labor Statistics (BLS) does collect data for some metropolitan areas. These data represent 85 urban areas and five population classes located in the four major census regions of the United States, with the CPI-U and the CPI-W covering approximately 80 percent and 32 percent of the total population, respectively (CPI Detailed Report, 1988). These indices show relative price changes at each location but cannot reveal where prices are higher. The American Chamber of Commerce Researchers Association (ACCRA) has also collected price data and compiled cost of living indices for many major metropolitan areas including St. Paul, Duluth, and Rochester.

Role of Land Costs and Wages in Regional Prices

As noted in the introduction, a major motivation of this study was to explore the usefulness of a measure of regional cost of living differences that concentrated on land and wages as determining factors. If workable, such a measure would be much less expensive to produce than those based on comprehensive surveys of consumer prices. In this section we discuss the determinants of regional land values and wages.

Summarizing points that will be developed in more detail in later sections, the location decisions of individuals are influenced by land values, and land values are, in turn, affected by location decisions. In addition to this, land values are reflected in the CPI measures which, in turn, affect real wages. This can be represented as in equation [4].

$$\text{CPI} = f(W_N, L_N, Z) \quad [4]$$

where W_N is nominal wage value,
 L_N is nominal land value, and
 Z is other cost factors.

An extension of this equation for use in deriving real wages is shown in equation [5].

$$W_R = \frac{W_N}{\text{CPI}} = \frac{W_N}{f(W_N, L_N, Z)} \quad [5]$$

where W_R is real wage value.

In deciding where to live, people consider a wide variety of factors. These include purchased goods obtained through wages and nonpurchased items, primarily natural amenities, culture, family and friends, and public services. The nonmonetary returns from these nonpurchased items can be reflected in both nominal wages and land values. As the availability of these nonpurchased items increase, the lower the real wages required to employ a work force.

The next two subsections address the determinants of land values and wages at a regional level. These discussions will be followed by major sections on natural amenities and public services and on shopping time, respectively, both of which will be shown to have the potential to influence land values and wages to a large degree.

Land Values

Land values increase as productivity increases in the presence of a limited supply of land. This increase in productivity can occur in a number of contexts, including firm production functions, household production functions, location advantages, agglomeration economies, and public services.

Land enters production functions for goods and services sold in markets such as the products from agriculture, mining, forestry, and manufacturing. Land is also a factor entering the determination of household utility; for example, items associated with location such as scenery and climate affect household satisfaction. Where such factors produce a relative regional advantage, rents will accrue to land if its supply is limited.

Socioeconomic factors affecting land values have been identified by regional economists. These factors include location decisions by individuals to access previous spatial investments, economic activities which encourage agglomeration economies, and availability of regionally-defined public services (Mishan, 1971).

The existing pattern of spatial investments affects subsequent investment patterns. More specifically, some locations offer the advantage of lower transportation costs. For example, existing population centers cause rents to accrue to areas which are convenient housing locations for workers or shopping facilities for consumers.

Agglomeration economies are lower unit costs realized by locating related economic activities in groups. Examples include high technology "corridors" sharing a common labor pool and basic sectors such as manufacturing locating in close proximity to related processing plants.

Turning to implications, the land values associated with the productivity of land used to produce items in the market basket should be included in consumer price measurements. For example, the increased costs due to agricultural productivity, location to markets, and agglomeration economies would be included to deflate wages in order to compute a measure of real welfare.

Wages

The extent to which a labor surplus is present is an important determinant of the level of real wages. The scale and persistence of a labor surplus depends upon the level of real wages, the migration costs for labor, employment opportunities elsewhere, and the

relocation costs of capital. Minimum wage laws and other institutional constraints may contribute to a portion of surplus labor being reflected through higher unemployment rather than through lower real wages. In other words, real wages are not necessarily a complete characterization of regional labor demand and supply.

A relatively lower wage component for a region because of the presence of surplus labor will result in a lower CPI measure for a particular region. For example, hypothesized lower wages found in outstate Minnesota result in lower CPI measures due to the wage component. Lower relative nominal wages due to labor surpluses would be expected to lead to lower real wages; that is, a more marked lowering of nominal wages than of the regional CPI.

Implications of Natural Amenities and Public Services

Amenities reflect the availability of nonpurchased goods that are valued by people. The presence of desirable amenities in a location reduces the real wage necessary to attract and hold people in the location relative to other places. Conversely, people in locations with undesirable amenities must be paid higher real wages relative to other locations. In this section, we first consider the implications of amenities in a general framework and then consider specific implications in the Minnesota context.

General Framework

Amenities in this discussion are nonpurchased goods and services. These may be natural amenities, such as a pleasant climate, beautiful surroundings, or close proximity to pleasing natural settings such as

lakes or mountains. Amenities also include publicly provided goods and services available by virtue of living in a jurisdiction.

Land values, wages, and the public service portion of amenities are simultaneously determined within regions; natural amenities are an important exogenous influence on the solution. Other authors have derived rigorous solutions based upon simplifying assumptions that illustrate the principles at work and that provide underpinning for applied work such as this (see Blomquist, Berger, and Hoehn; Clark and Kahn; Hoehn, Berger, and Blomquist; and the references cited therein). This study does not attempt to extend these results but rather to explore their implications for regional cost of living measures; readers interested in a more detailed theoretical treatment will find it in the cited references. The following discussion summarizes the results most relevant to this study.

Positive natural amenities decrease the real wages necessary to attract and retain people in a location relative to places with fewer positive natural amenities. The lower real wage may come about through either one or a combination of two factors: higher location rents and lower nominal wages. If land is a limiting factor in activities realizing the natural amenity, the value of the amenity will be capitalized into land values. The increase in land values will have a pervasive effect on local prices through the direct and indirect impacts on all goods and services using land as an input.

If land is not limiting access to the amenity, residents pay rent based on the best alternative use without regard to the amenity value; for example, the open plains enjoyed by some are sufficiently

numerous relative to residential demand that residents pay rent based on agricultural uses without regard to the amenity value. In the case of land not limiting access to the amenity, wage levels will adjust to a level that reflects people's valuation of the amenity. Wages will, in turn, be reflected throughout the local price structure to the extent that goods and services utilize local labor in their production and distribution.

The system is simultaneous because wages are, in turn, a function of local prices. A higher local price level leads people to demand higher local nominal wages relative to other location, all other things being equal.

The determination of wages and land values is further complicated by the provision of public services. Public services are usually provided within well-defined regions such as states, counties, and school districts. Many of these services are available without fee once produced through the process of general taxation and program implementation. These public services take on many of the characteristics of natural amenities because the services are not purchased at the margin. However, public services differ markedly from natural amenities in that they are endogenous to the economic system rather than exogenous. Indeed, the work of some analysts is motivated in part by developing guidelines for jurisdictions as to whether to invest in public services (for example, Clark and Kahn).

Public service provision within well-defined regions may positively affect land values through superior services relative to the tax prices of the services. Superior services relative to

jurisdictional costs can arise through various means--including both laudatory and despicable methods. The spectrum of these methods includes, for example, superior efficiency in public institutions and exploitation of other regions through political power. Conversely, inferior services relative to costs can lower local land values, all other things being equal. As described above in the case of natural amenities, land values, in turn, affect wages and all other prices affected by local wages and land values.

Turning to implications, natural amenities and public services are nonpurchased items likely to vary across regions in a systematic fashion. The interpretation of regional consumer price indices should include consideration of any biases introduced by these factors. Land values reflecting the productivity of land in producing amenities would ideally not be included in consumer price measurements. Including these land values in a consumer price index would result in an overstatement of costs because the relatively higher welfare derived from higher productivity in household production functions and superior services given a set of taxes would be excluded. The effect would be to capture the higher costs in the consumer price index through the increased land values but not the higher consumption (satisfaction) level. If these characteristics are included as higher land values resulting in a higher COL measure, real welfare will be understated.

As noted above, some of the value of nonpurchased items will be reflected in regional wages and land values. The proportion of the value reflected in wages and rents will vary. The value added to land

by nonpurchased items will be included in the CPI measure. But individuals experience increased levels of satisfaction from non-purchased items not included in the market basket framework, so higher nominal wages are not required to compensate for the higher land costs caused by amenities. Therefore, a deflation of observed income or wages by the resulting higher CPI index leads to an understatement of welfare because income is not an adequate proxy for total consumption (DeMilner, Cagan and Moore, 1981). In regions with low real wages for this reason, the traditional inferences for labor relocation incentives will be biased.

Lower nominal wages may exist due to the presence of nonpurchased items which have not been capitalized into land values. This occurs when land is not a binding constraint. This is again a case where conventionally calculated real wages understate the well-being of people and where inferences concerning incentives for relocation are subject to biases.

Implications in the Minnesota Context

Large regions in Minnesota may be influenced by natural amenities. Locating in outstate Minnesota offers the lake country in the northern part of the state, and most of the remaining part of the state offers the farmland accompanied by its lifestyle. More specific regional amenities, such as shorelines, are valued even higher.

Public services may also affect location decisions. The metropolitan area has a reputation for providing high quality public services, including school districts. However, metropolitan areas carry higher costs associated with some public services. For example,

high costs are associated with public safety which some people emphasize as a reasonable objective. Rural Minnesota, in general, may possess poorer public services. This may prove costly in obtaining equivalent health services and educational systems.

Perhaps the region with the greatest possibility for distortion is the Iron Range. The natural amenities and public services which are present in the this region are not reflected in higher land values because land sharing in these amenities is not in limited supply relative to the demand. Thus, the index of costs of regional goods and services is understated relative to their availability. Land values would be expected to reflect the productivity of natural resource use. That is, the value of land in enterprises such as forestry, agriculture, and tourism would enter into the regional cost index. The standard of living index computed as nominal wages deflated by a conventionally calculated price index may slightly understate the welfare for the region.

Implications of Regional Variations in Shopping Time

Regional variation in the time required for searching and purchasing activities involved in consumption would influence the interpretation of regional cost of living measures, as discussed in more detail below. Thus, this topic warrants careful exploration. In this section we first discuss the theoretical foundations of this issue and then summarize available empirical work.

Theoretical Foundations

Becker (1965) proposed a theory for the optimal allocation of time that primarily described the behavior of individuals as consumers. Time was a constraint on maximizing utility through consumption. Becker's applications of time theory extended into the areas of: hours worked, productivity of time, income elasticities, transportation, and division of labor within families. Becker accounted for the "opportunity cost" of time with underlying direct and indirect costs of time spent in work-related versus consumption-related activities.

Becker's full-income approach to time theory can be extended to regions which may contain specific regional time constraints. Some regions may possess characteristics which require higher relative time requirements for attaining the goods in a market basket. This time may be related to distance traveled in searching and shopping. However, differences in congestion may be as important, or even more important, than distance--thus rendering distance an inadequate measure of the time devoted to activities of searching for and purchasing market basket items. Time requirements may also be affected by relatively longer supply lines, transportation, or less provision of child care and health care.

The typical consumer price index does not reflect the time required for purchases. When the time required for shopping is relatively high for a particular region, the typical uncompensated consumer price index understates total costs. When the index is used

to deflate wages or incomes, the resulting measure of real welfare overstates actual welfare for such regions.

In addition, because income and earnings differ geographically, foregone earnings per unit of time also differ. Thus, the cost of consumption may differ even when individuals face identical retail prices and time requirements. As a specific illustration, people in regions with high average earnings probably consume goods with higher retail prices and lower time requirements relative to the goods in the market basket; for example, lawn care services rather than lawn mowers, fertilizers, and pesticides. The substitution, based in part on the time intensity of goods, is analogous to the substitution between goods based on differences in relative prices, as discussed earlier. These substitutions cause less difference in real welfare than in nominal income adjusted for a standard market basket, as noted by Becker.

Summary of Empirical Studies

Data on expenditures by households are extremely scarce and that pertaining to expenditures of time allocated to differing activities by households is subject to much debate. Some surveys of the use of time have been completed. In 1977, U.S. agricultural experiment stations compiled a data bank for urban and rural families' use of time (Family Time Use, 1981). Further research developed from this study and included efforts by Bryant, Gauger, Walker, Goldschmidt, Clermont, and Simmons encompassing valuation of time by opportunity costs, value added, and market wages of specialists.

The data from the Family Time Use Study in the state of Wisconsin (the closest state to Minnesota that was sampled) indicated that urban households allocated more time to household work, paid work, and volunteer activities than rural families; this also held individually for the homemakers and spouses. Mean minutes per day for homemakers in all household work were 353 minutes in the urban area and 319 minutes in the rural area, with 63 percent of the surveys completed in both areas. Several subcategories of household work, however, ran counter to this pattern; rural time use tended to be higher for shopping and children's contribution to household work as well as the category of paid work. While people in rural areas may spend more time at paid work and less time at household work than those in urban communities, rural residents apparently spend more time in the "other than household work."³

Rural households and firms may have consumption intertwined with the time spent at work to a greater degree than urban households. This mixture of work and "leisure" can be found in self-proprietorships where the manager chooses more work time at a slower rate. For example, the percentage of full-service gas stations is higher for outstate Minnesota than in the metropolitan area (AAA Fuel Survey, 1988). Thus, the technology is available for decreasing time requirements but this technology is not chosen by many rural proprietors.

³ The "other than household work" categories included: school, paid or unpaid work, organization participation, social and recreational activities, personal care of self, eating, and "other."

Within this study of consumer price comparisons, adjustments for time expenditures will not be incorporated except to the extent they are reflected in regional land values and wage rates. The implication of the observation that more time is required for shopping in rural areas (Family Time Use, 1981) is that rural regions have a higher cost component that is being ignored. Ignoring the time constraint leads to an understatement of rural cost of living indices.

An Empirical Analysis of Regional Price Indices

The empirical portion of this study focuses on regions within Minnesota. The section begins with a review of previous studies of regional cost of living in Minnesota, continues with a presentation of the model used in this study, then discusses the data base, and concludes with the presentation of the results.

Previous Studies Focused on Minnesota

Previous studies of regional costs of living in Minnesota focused primarily upon estimating the wage levels needed to attract a specific labor force to a region. Recent studies have addressed the cost of living as a potential factor in determining teachers' salaries needed to provide an adequate educational system in all regions of Minnesota. A Survey of Costs of Living in Selected Minnesota Communities (1988) was prepared by teachers, administrators, and school board members as an input for analyzing equivalent school program delivery. Since state appropriations to school districts are made in nominal dollars, regional price differentials affecting

educational services would lead to unequal services despite equal expenditures.

The scope of the above study was narrowly defined to address those items associated with the educational labor force. The survey created a cost of living index, with respect to educators, for 28 cities (selected county seats). However, some costs measured in previous studies were not included; data including clothing, heating fuel, and certain food products were not used. The conclusions were:

- (a) Higher metropolitan housing costs are partially offset by higher outstate costs due to factors such as lack of competition, long supply lines, and higher utility costs.
- (b) Living costs are not uniform in Minnesota.
- (c) Housing cost differentials are the major factor in cost of living differentials.
- (d) Other cost components (besides housing) are deserving of critical attention.
- (e) Areas with high living costs will experience high education costs.
- (f) School districts in high cost municipalities will have to compensate labor accordingly, as education is a labor intensive enterprise (70-80 percent of general fund expenditures were determined to be allocated to labor).

The report, and other forces, spurred additional research into regional the costs of living in Minnesota by the Office of the Legislative Auditor. The results of this study became available after the

completion of this research and are discussed in the next major section.

The Model

The following model attempts to create a deflator for wages and incomes through a regional consumer price approach. Differentials in land and wage costs are the primary factors used in deriving the cost of a market basket. The underlying assumptions in this model are that local prices reflect local costs of land and labor, that real wages are equal across regions and, thus, that land cost differentials lead to differences in nominal wages and prices.

The indices derived will be presented as indices relative to the seven-county metropolitan area (reference region). For example, the metropolitan area will have an index equal to one for an overall CPI measure and also for all factors and measures discussed.

The model is constructed by starting from the generic CPI formula:

$$CPI = \sum_i P_i * Q_i \quad i = 1, \dots, k \quad [6]$$

where P_i is price for good i ,

Q_i is CPI weight for good i ,

k is number of CPI market basket items,

$$\sum_i Q_i = 1 \quad i = 1, \dots, k. \quad [7]$$

The price for individual market basket items can be attributed to wage (W_i) and land (L_i) components with the remainder allocated to "other costs" (Z_i).

$$P_i = W_i + L_i + Z_i \quad [8]$$

where W_i is the percent of P_i attributed to wage cost,

L_i is the percent of P_i attributed to land cost, and

Z_i is the percent of P_i allocated to "other" costs.

Equation [6] can be expanded to include the wage and land components by substituting [8] into [6]. The result is shown in equation [9].

$$CPI = \sum_i Q_i * [W_i + L_i + Z_i] \quad i = 1, \dots, k. \quad [9]$$

However, the entire set of prices in the market basket cannot be divided into wage and land costs. Some market basket items (P_{m+1}, \dots, P_k) are not directly related to the local economy's land and wage costs. This set of components is then separated from the first, yielding:

$$CPI = \sum_i Q_i * [W_i + L_i + Z_i] + \sum_h Q_h * P_h \quad [10]$$

where $i = 1, \dots, m$, and

$$h = m+1, \dots, k.$$

This equation has market basket items (Q_1, \dots, Q_m) containing land and wage components and items (Q_{m+1}, \dots, Q_k) with no land or wage components. Furthermore, the last term which contains no land or wage components may be viewed as a combination of constant and varying regional costs relative to the reference region. In this model, energy items (Q_{m+1}, \dots, Q_{m+3}) are assumed to vary in price across regions. The prices in a region ($P_{j,m+1}, \dots, P_{j,m+3}$) which vary are then introduced into the regional CPI_j through per unit prices. These

prices are then expressed in ratios relative to the reference region. Those prices assumed to be constant over regions ($C = \sum_h Q_h * P_h$, where $i = m+4, \dots, k$) are also made explicit. The equation can now be expressed as:

$$CPI_j = \sum_i Q_i * [W_i + L_i + Z_i] + \sum_h Q_h * P_{hj} + C \quad [11]$$

where $h = m+1, \dots, m+3,$

$i = 1, \dots, m,$ and

$j = 1, \dots, 6.$

If regional wage (W_j) and land (L_j) differentials are inserted into equation [11], the result is:

$$CPI_j = \sum_i Q_i * [(W_i * W_j) + (L_i * L_j) + Z_i] + \sum_h Q_h * P_{hj} + C \quad [12]$$

In equation [12], two variables have been introduced. These variables represent the land differential and the wage differential for region j relative to the reference region. To obtain the weights of these differentials in the market basket, like terms are gathered obtaining equation [13].

$$CPI_j = \sum_i (Q_i * W_i) * W_j + \sum_i (Q_i * L_i) * L_j + \sum_h Q_h * P_{hj} + \sum_i Q_i * Z_i + C \quad [13]$$

If the composition of the market basket is simplified to represent the relative percentage of each of the factors, the equation becomes:

$$CPI_j = a_1 * W_j + a_2 * L_j + a_3 * E_j + C'. \quad [14A]$$

Equation [14A] reveals the weights of the factors in the generic market basket format and the relationship to the regional factor differentials. The market basket factor weights are expressed for wages (a_1), land (a_2), and energy (a_3). The last term (C') now includes the portion of constant "other" costs $(\sum_i Q_i * Z_i,$ where $i = 1, \dots, m)$ along with the constant market basket items (C).

The Data Set

Since consumption may be biased in favor of one region by using only one regional market basket, the Minneapolis-St. Paul market basket was not used. Although a Minneapolis-St. Paul market basket is available, the weights may overstate housing costs and understate food costs for outstate communities. Instead, the national market basket was used for weights in this model. The relative importance of market basket items in the Consumer Price Index for All Urban Consumers (CPI-U) was taken from the CPI Detailed Report for April 1988.

Expected price differentials in major market basket items were computed by assessing their land and wage components which reflect regional cost differentials in these two factors. A major market basket item is housing, but the existing housing stock in the state of Minnesota is not uniform in size, age, or quality. The housing component in this model uses costs based on a standardized house. Definition of a standard house was done after a review of information from the Metropolitan Council Data Center's publication of Prices of New and Existing Homes in the Twin Cities Metropolitan Area, the Inter-City Cost of Living Index published by ACCRA, and Means Square Foot Costs. The house chosen to represent this component consists of

1800 square feet of living area (some of which may be unfinished) with all utilities on a lot of approximately 10,000 square feet. This was then compared to sales prices in the Multiple Listing Service's Residential Real Estate Report for three-bedroom home sales in the metropolitan area in 1987.

Estimates for the land and labor components of the value of such a house were made through conversations with the Minnesota Society of the American Institute of Architects (MSAIA) and major home builders operating throughout the state of Minnesota. The value of the land component, a 10,000 square foot lot, was estimated in the seven-county metropolitan region at \$25,000 after discovering over 500 lots in the metropolitan area had a range of \$20,700-\$29,900. Based on input from experts and on our synthesis of the information, the labor component was estimated at 37 percent of housing cost, including both construction and sales costs.

Estimates for land and labor components for housing rentals were based on information relating to three-story apartment complexes from the Minnesota Housing Finance Agency Research Division and are among the most uncertain figures because of the varied nature of apartment buildings and because only one source was used. These estimates included: an average living space in an apartment of approximately 700 square feet, a three-story apartment building at 20 units per acre, \$3,000-\$4,000 in land costs per unit in the metropolitan region, and 50-50 construction costs for labor and material.

Since the cost structures were hypothesized to vary considerably, the expenditure category for food was divided into two parts: food at

home and food away from home. Food at home costs were estimated to include 10 percent for labor and 1.24 percent for rent. These estimates were arrived at from "Review and Evaluation of Price Spread Data for Foods" and then adjusted through review of reports from the Food Marketing Institute. For food away from home, estimates of 5 percent of sales relating to the cost of rent and 25 percent of sales relating to payroll expenses were derived through a subjective evaluation of the marketing bill and publications from The Cornell Hotel and Restaurant Administration Quarterly which looked at two types of restaurants: full-menu and fast food.

The categories for apparel and upkeep as well as transportation were investigated but due to data deficiencies were not included in this study.

Energy costs affect two major categories: housing through fuel oil, piped gas, and electricity, and also transportation through motor fuel. Fuel oil, natural gas, and electricity price differentials were obtained from a Legislative Auditor Office's Economic Analysis Report modeling annual space heating costs for a single family dwelling. Fuel prices at the pump for full service and self-service were obtained from AAA's Fuel Survey, with the Computer Petroleum Corporation collecting the data.

The land values originally intended for use in this land-wage model were residential lot values. These were desired since the largest influence of land on the market basket enters through housing. However, outstate Minnesota has no systematic method of collecting data for residential lot values.

To obtain regional land differentials, the ratios were formed from regional agricultural land prices. This is consistent with the notion that the opportunity costs of transportation and amenity values are in equilibrium at the urban-rural fringe (Henderson, 1982). While a preferred measure would be residential lot values, these data are not published for regions within Minnesota and are expensive to obtain because of the need to do a survey. The values for land differentials and the regional designations were taken from the adjusted sales price for 1986 by region in The Minnesota Rural Real Estate Market in 1986.

Appendix A contains a detailed summary of the data described above.

Empirical Results

Substituting the above data on cost components into equation [14A] derived in the section on the model yields:

$$\begin{aligned} \text{CPI}_j = & .1259 * W_j + .0633 * L_j + .0329 * G_j \\ & + .00426 * H_j + .03902 * E_j + .73459 \end{aligned} \quad [14B]$$

where CPI_j is the consumer price index for region j relative to the reference region,

W_j is the wage differential for region j relative to the reference region,

L_j is the land differential for region j relative to the reference region,

G_j is the price ratio of gasoline for region j relative to the reference region,

H_j is the price ratio of heating fuel for region j relative to the reference region,

E_j is the price ratio of electricity and natural gas for region j relative to the reference region.

Appendix A contains a detailed derivation of these weights. The differentials of the CPI with respect to land and wages are shown in [15],

$$\frac{dCPI_j}{dW_j} = a_1 = .1259$$

$$\frac{dCPI_j}{dL_j} = a_2 = .0633. \quad [15]$$

This indicates that a 10 percentage point differential in nominal wages leads to a 1.3 percentage point regional differential in nominal consumer price levels. Likewise, a 10 percentage point differential in land values leads to a .6 percentage point differential in the consumer price index.

Synthetic Wages: From [14B], a "synthetic" wage rate can be derived. "Synthetic" wage rates are derived by assuming that real wages are equal across the regions which differ by land and energy costs. The computational procedure is to set the wage rate equal to the CPI ratio for the region and then allow wages to adjust through the land and energy differentials. This can be done because all indices are relative to the reference region.

Therefore, equation [14A] becomes,

$$W_j = a_1 * W_j + a_2 * L_j + a_3 * E_j + C' \quad [16]$$

and by solving for the synthetic wage (W_j), gives equation [17A],

$$W_j = \frac{a_2 * L_j + a_3 * E_j + C'}{(1 - a_1)} \quad [17A]$$

Substitution of the actual data into [17A] yields:

$$W_j = .0724 * L_j + .0376 * G_j + .0049 * H_j \\ + .0445 * E_j + .8404. \quad [17B]$$

The differential of wages with respect to land [17B] relative to the reference region for this system is given by,

$$\frac{dW_j}{dL_j} = \frac{a_2}{1 - a_1} = .0724. \quad [18]$$

This result indicates that each 10 percentage points of differential in land values leads to 0.7 percentage points of differential in regional nominal wages and nominal price levels. For example, an outstate region with land costs of one-half those of the metro region is estimated to have 4 percent lower nominal wages and prices solely due to the differential in land values--that is, before adjustment for other factors.

The resulting synthetic wage ratios [17B] can be calculated from the data relating each region to the metropolitan base. The results from these calculations for Minnesota regions are shown in Table 1.

The wages (relative to the metropolitan area) required to compensate the regions for land and energy differentials are shown in Table 1. Most regions in Minnesota show approximately a 2 to 3 percent lower nominal wage needed to compensate for cost differentials. The northeastern part of the state shows a 5 percent lower equilibrium nominal wage due mostly to the lower land costs in the region.

Table 1. Minnesota Regional Indices

Synthetic Wage Base	
<u>Region</u>	<u>Wages (Nominal)</u>
Metropolitan	1.00
Southeastern	.98
Southwestern	.98
Central	.97
Northwestern	.97
Northeastern	.95

Observed Nominal Wages: The previous section derived "synthetic" wages which would yield the wage rates required for real wages to equilibrate across regions given regional land and energy differentials. This section studies the relationship between observed nominal wages and the consumer price measures. The wage data included in the analyses covered 74 occupations taken from the Minnesota 1987 Salary Survey published by the Minnesota Department of Jobs and Training. The median (50 percentile) monthly wage for each occupation was selected to represent the regions. Occupations were excluded if the data appeared undersurveyed or not reported. The data may include biases due to reporting practices. These practices include coverage of only larger companies and, therefore, the likelihood of over representation of unionized wages. This may result in a higher set of wages reported and, hence, less variation between metropolitan and outstate wages than exists for all workers. While controlling for occupational mix aids greatly in producing wage ratios descriptive of people's actual options, we were not able to adjust for training and experience. Thus, wage differentials are overstated if metropolitan

workers within occupations tend to have more training and experience than their nonmetropolitan counterparts, as some evidence indicates.

The wage data were averaged by occupation for each region and expressed as a ratio relative to the metropolitan area. The results are shown in the first column of Table 2. Outstate nominal wages are lower relative to nominal wages in the metropolitan region as compared to outstate versus metropolitan synthetic wages, with the exception of the northeastern region where the ratios for synthetic and nominal wages are approximately equal. Appendix B describes an alternative regression analysis of the wage data that offers insights but was not used in the cost of living analysis.

These average wage ratios were then substituted into equation [14B] to reflect the observed regional level of wages in the consumer price measures. The results are shown in the second column of Table 2. The estimated regional CPI is lowered by 2 or 3 percentage points relative to that using synthetic wages for all outstate regions, except for the northeastern region which is unchanged.

Table 2. Minnesota Regional Wages, Estimated Regional Price Levels, and Real Wages

Region	Nominal Wages	Estimated CPI	Real Wages	
			Level (Col.1/Col.2)	Difference from Metropolitan
Metro	1.00	1.00	1.00	0.00
SE	.86	.96	.90	-.10
SW	.79	.95	.83	-.17
CT	.83	.95	.87	-.13
NW	.81	.95	.85	-.15
NE	.97	.95	1.02	+.02

Real Wages: Finally, real wages were estimated by dividing nominal wages by the estimated CPI. These estimates of real wages are shown in the third column of Table 2. The results show outstate real wages less than the metropolitan real wages with the exception of northeastern Minnesota. Perhaps the most interesting result is that the northeast is enjoying the highest real wages. Abstracting from the availability of jobs, those finding work in northeastern Minnesota appear to benefit from the combination of lower costs of living and higher wages.

The results in the last column of Table 2 are reasonable, when noting that relatively depressed economies will yield incentives for people to leave the region. Lower real wages in depressed economies encourage out-migration.

However, lower real wages may not accompany regional recessions if firms choose to lay off workers rather than lower wages (DeFina, 1988). This behavior enhances wages relative to market levels. If this occurs, the effects can be a rise in average regional wages while regional unemployment increases. Unionized labor may contribute to these effects and is found in high proportions in the Iron Range.

Another method of evaluating regional real wages is through comparisons of the nominal wages and the "synthetic" wages, as shown in Table 3. The "synthetic" wages are the nominal wages required to equilibrate real wages in a region given the existing land and energy differentials.

Table 3. Nominal and Synthetic Wages in Minnesota Regions

<u>Region</u>	<u>Nominal Wages</u>	<u>Synthetic Wages</u>	<u>Nominal Less Synthetic Wages</u>
Metro	1.00	1.00	0.00
SE	.86	.98	-.11
SW	.79	.98	-.19
CT	.83	.97	-.14
NW	.81	.97	-.16
NE	.97	.95	+.02

The results from this comparison are consistent with the differences expressed in Table 2. The differentials between nominal and synthetic wages are slightly higher than the differentials between estimated real wages by region, but the proportions are similar. The northeast region is experiencing an overall gain of about 2 percent from the nominal wages the region is receiving. And southwestern Minnesota shows a decrease of about 19 percentage points in nominal wages relative to the metropolitan area.

Sensitivity Analysis: Changes in land values prompt changes in CPI measures and, in turn, changes in real wages. If observed nominal wages do not change, a change in relative land values is positively related to the consumer price index and negatively related to the real wage index. Variations of the ratio of outstate to metropolitan land values by 5 percent increments reveals the sensitivity of consumer price measures and real wages based on observed nominal wages to the land component. The results are shown in Table 4.

A decrease of 10 percentage points in relative land values is associated with a decrease of 6 percentage points in the CPI index. The sensitivity of real wages to land prices is lower than expressed

Table 4. Minnesota Regional Sensitivity Analysis to Land Value Differentials⁴

Region	Change in Land Values (percentage points)										
	(-10)		(-5)		(0)		(+5)		(+10)		
	CPI	Real Wage	CPI	Real Wage	CPI	Real Wage	CPI	Real Wage	CPI	Real Wage	
Metro	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	.95	.90	.96	.90	.96	.90	.97	.89	.97	.89	.89
SW	.95	.83	.95	.83	.95	.83	.96	.82	.96	.82	.82
CT	.95	.88	.95	.88	.95	.87	.96	.87	.96	.87	.87
NW	.95	.86	.95	.86	.95	.85	.96	.85	.96	.85	.85
NE	.94	1.03	.95	1.02	.95	1.02	.95	1.02	.96	1.01	1.01

in equation [13] because of no feedback of lower land values to lower wage rates; that is, equation [10] is the relevant estimate.

Wages are also an important influence on the consumer price measure. Table 5 displays the results of a test for wage sensitivity. Because wages are derived rather than assumed in the synthetic measure, that is, endogenous rather than exogenous, the synthetic measures are undefined and do not appear in Table 5.

The CPI changes as expected from equation [10]; that is, a 3 percentage point change in nominal wages results in an approximate 0.4 percentage point change in the CPI.

⁴ The "CPI" estimate includes the nominal wages and land values. The "Real Wage" estimate is based on observed nominal wages deflated by this "CPI" index.

Table 5. Minnesota Regional Sensitivity Analysis to Wage Differentials

Region	Change in Observed Nominal Wages (Percentage Points)									
	(-6)		(-3)		(0)		(+3)		(+6)	
	CPI	Real Wage	CPI	Real Wage	CPI	Real Wage	CPI	Real Wage	CPI	Real Wage
Metro	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	.95	.84	.96	.87	.96	.90	.96	.92	.97	.95
SW	.95	.77	.95	.80	.95	.83	.96	.85	.96	.88
CT	.95	.82	.95	.85	.95	.87	.96	.90	.96	.93
NW	.94	.80	.95	.83	.95	.85	.96	.88	.96	.91
NE	.94	.97	.95	.99	.95	1.02	.95	1.05	.96	1.08

Regional changes in real wages are more responsive to realistic changes in nominal wage rates than land values. Real wages are inelastic with respect to changes in nominal wages; that is, a 1 percentage point change results in less than a 1 percentage point change in real wages.

Comparison with Legislative Auditor's Report

The Office of the Minnesota Legislative Auditor recently issued a report on regional differences in the cost of living. Its subject matter closely overlaps our research, so the report warrants particular attention. The purpose of the Legislative Auditor's study was to analyze regional differences in the cost of living as a potential factor for use in state formulas for funding education.

Methodology: The methodology of the Legislative Auditor's study has important similarities to our study. It uses U.S. Bureau of Labor Statistics weights on the goods and services in the market basket; a minor difference is that it uses the Minneapolis-St. Paul weights rather than the national weights used in our work. It assumes the

items in the market basket not specifically considered have equal prices over all regions.

The Legislative Auditor's study also differs in important respects from our study. Whereas our study gathered price information on only a few items, the Auditor's study collected price information on 83 items, representing about two-thirds of the market basket; this is a major strength of the Auditor's report. Because the Auditor's report focused on implications for educational funding, it emphasized teacher salaries rather than a broader array of wages such as that examined in this study.

Another important difference between the studies is that the Auditor's study uses median home prices and average costs for household energy consumption; whereas our study uses standardized items based on average consumption across the United States. The Auditor's approach has the advantage of being less expensive because it makes use of available data. It has the disadvantage of reflecting the level of income of a region as well as price differences. For example, people in outstate Minnesota have a lower average per capita income so they spend less on housing on average; the Auditor's approach interprets this as having a lower cost of living. This problem was noted at the outset of our report and is a major reason for our use of a standard market basket.

Auditor's Results: The Legislative Auditor's report finds that the cost of living in outstate Minnesota is about 11 percent lower than that in the Minneapolis-St. Paul metropolitan region. Non-shelter costs (costs other than home prices, rents, property taxes,

and homeowner's insurance) are roughly equal over the state. The variation in the regional cost of living is primarily due to shelter costs being 40 percent lower in outstate Minnesota than in the metropolitan region.

Outstate teacher salaries are about 17 percent lower than metropolitan salaries. However, about half of the difference is due to metropolitan teachers having more years of experience and higher levels of training. A comparison of teacher salary schedules, which control for experience and training, showed that outstate schedules are about 9 percent lower than metropolitan schedules.

Real teacher salaries are about equal over the state. The significant exception is northeast Minnesota which has real salaries about 5-7 percent higher than other regions of the state.

Comparisons and Discussion: The Auditor's results show approximately twice the differential in metropolitan and outstate housing costs as we impute from our assumed input proportions and prices for land and labor. The difference in housing costs is the major factor in their conclusion that the differential in the cost of living between outstate Minnesota and the metropolitan area is a little over twice our estimate of about 5 percent in Table 2.

We suspect that the best estimate of the differential is between that of the auditor and ours. As noted above, our estimates of lot values likely underestimate the differential between outstate and metropolitan regions. In addition, outstate housing markets may be depressed to such an extent that home prices are significantly below

the costs of building. These factors would lead us to underestimate the differential in the cost of living.

Also noted above, the Auditor's estimated differential is subject to the criticism that it reflects the lower purchasing power of outstate residents as a lower cost of living. Correcting for this would lessen the estimated differential. The authors of the Auditor's report recognize this. Based on analyses by others of age of housing and number of bedrooms, they calculate their estimate of outstate home prices would rise by only 1.5 percent if a standard house were utilized; the impact on the differential cost of living would be a minor 0.3 percent. While we have no empirical basis for refuting this, our intuition is that they understate the impact of such a correction. Differences in per capita income on the order of 20-30 percent seem likely to have a larger impact on housing quantity and quality than the 1.5 percent estimate in the Auditor's report. The best way to resolve the difference is to mount a survey of the value of a standard house in different regions of the state.

The nominal wage differential found in our study (shown in Table 2) is about equal to the 17 percent for teachers as a group and about twice the 9 percent found in the Auditor's analysis of teacher salary schedules. As noted before, we think our estimate of the differential, controlling only for occupation, is probably too small. We had no means of correcting for experience and training in our analysis of wage rates in 75 occupations. Our intuitive feel is that such correction would lessen the differential between outstate and metropolitan wages but not close it completely--perhaps in a manner

analogous to the case of teachers. Thus, results with respect to nominal wages appear comparable even though at first glance the Auditor's use of 9 percent and our use of about 15-20 percent (ignoring the northeast) are at first glance quite different.

The pattern of real wages over the state emerges with some clarity. The Auditor and we agree that the highest real wages occur in northeastern Minnesota and that real wages in the remainder of outstate Minnesota do not differ markedly from those in the metropolitan region. The high real wages in the northeast are a result of a cost of living roughly comparable to elsewhere in outstate Minnesota and of nominal wages intermediate between the remainder of outstate Minnesota and the metropolitan region. Outside of the northeast, the lower nominal wages in the outstate region relative to the metropolitan region are approximately offset by the lower cost of living.

More precise comparisons of real wages continue to be disputed because of uncertainty in the precise level of both nominal wages and of the cost of living. After considering the biases in our results and in the work of the Auditor, we estimate that the northeast probably has real wages about 3-6 percent above those of comparable workers in the metropolitan region. Our estimate for the remainder of outstate Minnesota is that real wages are about 2-6 percent lower than those for comparable workers in the metropolitan region. The Auditor estimates that real teacher salaries in outstate Minnesota, other than in the northeast, tend to be about 1-2 percent above real salaries of comparable teachers in the metropolitan region.

While we have concluded this discussion with specific reference to the differences between our work and that of the Legislative Auditor's Office, we wish to emphasize that we are struck much more by the commonality of the results than by the differences. Our information on regional cost of living differences within Minnesota is much improved relative to the state of knowledge before these studies.

Concluding Comments

Our empirical conclusions based on quantitative evidence are summarized immediately above and will not be repeated here. These results include consideration of the items in the consumer market basket and of nominal wages.

The above results do not take account of qualitative factors, and we address these next. Finally, we will offer some observations on research that would further clarify differences in regional well-being of people.

Qualitative Factors

Amenities are most relevant for smaller areas, such as specific towns or communities. However, northeastern Minnesota seems most likely to be affected by positive amenities, and these amenities are more likely to be reflected in lower real wages rather than higher land values because of the abundance of land. Therefore, the true level of well-being for people in this region relative to the remainder of the state would be even higher than indicated by this analysis if amenities were explicitly included.

Time spent in consumption--specifically searching and purchasing activities--has not been analyzed to the point of calculating empirical results. However, the weak evidence that more time is required in rural communities leads us to believe that our results slightly understate the cost of living in outstate Minnesota relative to the metropolitan area, as compared to a measure explicitly including time.

Quantity constraints are more important in outstate Minnesota since many goods and services are lacking (or inferior) to the metropolitan region. Correcting for this bias would increase the measured cost of living in outstate Minnesota relative to the metropolitan region and, thus, decrease relative real wages in the outstate regions.

Overall, a consideration of amenities, time spent in consumption, and quantity constraints indicate that our results for outstate regions other than the northeast are biased in the direction of too low of cost of living and too high of real wage relative to the metropolitan region. Thus, these outstate regions probably have somewhat lower real wages relative to the metropolitan region than the empirical estimates indicate.

In the case of the northeast, a consideration of qualitative factors has an indeterminate effect on the relative cost of living and real wages. Amenities work in the opposite direction of time spent in consumption and quantity constraints. We are inclined not to suggest adjustment of the results for northeastern Minnesota based on qualitative factors.

Helpful Research

A survey of the price of a standard home, including a standard lot, across the regions of Minnesota would do more than anything else to improve our knowledge of regional differences in the cost of living. As noted numerous times, the cost of housing is the key factor underlying regional differences in the cost of living.

Our methodology of using land and wages as the key explanatory variables would be more powerful with two obvious improvements. First, better data by region on lot values and on wages would lead to more accurate cost of living estimates. Second, additional items in the consumer market basket could be analyzed to ascertain the degree to which their cost is affected by changing land values and wage levels. This would improve the comprehensiveness of the analysis, that is, leave fewer items in the category of being assumed to have equal prices in all regions. This work could be made more detailed by an identification of the particular occupations and, thus, wages that influence particular items in the market basket.

Repeating this analysis for population groups with different income levels would be of great interest. Different income groups have quite different market baskets. An analysis that takes this into account might conclude that the relative cost of living differential between outstate and metropolitan Minnesota varies significantly by income level. This would, in turn, indicate differential incentives for low, middle, and high income people to live in different regions.

Finally, an analysis based upon the more rigorous approach outlined by Boadway and Bruce and noted in our discussion of the

theory of household budget choices would contribute to both disciplinary knowledge and to applied understanding. Such an analysis would handle substitution among goods and services because of varying price and income levels more satisfactorily than the market baskets employed in our analysis and in most other studies.

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APPENDIX A

Table 1. CPI Market Basket Items Wage and Land Components

CPI item (k)	Relative Importance (Qk)	Wage Component (Wk)	Land Component (Lk)	Constant Other Costs (Zk)
Housing	.19673	.37	.26	.37
Apartment	.07924	.35	.10	.55
Food at home	.09864	.10	.0124	.8876
Food away from home	.06192	.25	.05	.70
Gasoline	.03290	--	--	--
Heating fuel	.00426	--	--	--
Energy (NGas & Elect)	.03902	--	--	--
Other	<u>.48729</u>	--	--	--
	1.0000			

Table 2. Weighted CPI Market Basket Items Wage and Land Components

CPI item (k)	Relative Importance (Qk)	Wage Component (Qk*Wk)	Land Component (Qk*Lk)	Constant Other Costs (Qk*Zk)
Housing	.19673	.0728	.0511	.0728
Apartment	.07924	.0277	.0079	.0436
Food at home	.09864	.0099	.0012	.0876
Food away from home	<u>.06192</u>	<u>.0155</u>	<u>.0031</u>	<u>.0433</u>
	.43653	.1259	.0633	.2473

Table 3. Minnesota Average Self-Service Fuel Prices November 12, 1987-August 1, 1988

	<u>Average</u>	<u>Relative Index</u>
Northern	1.0285714	1.0457212
Central	.9899571	1.006463
Metropolitan	.9836	1.00
Southern	.9961	1.0127084

May be understated due to more small, full-service stations in rural areas leading to higher fuel costs.

Table 4. Minnesota Relative Market Basket Components Regional Energy Values

Region (j)	FUEL		
	Oil (Fj)	Energy (Ej)	Gas (Gj)
Metro	1.00	1.00	1.00
Southeast	.88	1.00	1.01
Southwest	.84	.95	1.01
Central	.96	1.10	1.01
Northwest	1.05	1.21	1.05
Northeast	1.10	1.19	1.04

Table 5. Minnesota Regional Indices Land Values and Synthetic Wage Base

Region	AGRICULTURAL		Synthetic Index
	Land Value	Land Ratio	
Metro	\$1119	1.00	1.0000
Southeast	744	.66	.9752
Southwest	823	.73	.9778
Central	592	.53	.9706
Northwest	503	.45	.9716
Northeast	134	.12	.9467

Appendix B

Table 1. Minnesota Regional Wages Relative to Twin Cities, Regression Results

Relative to Twin Cities	NW	SW	CT	NE	SE
Intercept	186	206	191	465	170
Coefficient	.718	.678	.730	.718	.769
R ²	.76	.83	.71	.73	.82
Rbar ²	.76	.83	.70	.73	.81
St.error intercept	92	70	108	101	84
Coefficient	.05	.04	.05	.05	.04
T-value intercept	2.0	3.0	1.8	4.6	2.0
Coefficient	15.2	19.0	13.2	13.9	17.9

The observed monthly wages by occupation in each outstate region were regressed on the metropolitan area to reveal the wage structure across regions. The results indicate that differences in wages by occupation in outstate regions are about 73 percent of differences across occupations in the metropolitan area. Thus, the wage structure in outstate regions is compressed as well as lower in level. The equations explain a substantial portion of the variation--about 75 percent of variation. The higher wage structure in the northeast relative to the other outstate regions, has its source in a higher level for the entire structure, as revealed by the larger intercept rather than in less compression among occupations.