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DISSERTATION

EQUILIBRIUM AND DISEQUILIBRIUM COMPONENTS OF REGIONAL ECONOMIC GROWTH: A STUDY OF THE DENVER LABOR AND HOUSING MARKET

Submitted By

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Dept. of Agricultural and Resource Economics

In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY ERIC SCORSONE ENTITLED EQUILIBRIUM AND DISEQUILIBIRUM COMPONENTS OF REGIONAL ECONOMIC GROWTH: A STUDY OF THE DENVER LABOR AND HOUSING MARKET BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

EQUILIBRIUM AND DISEQUILIBRIUM COMPONENTS OF REGIONAL ECONOMIC GROWTH: A STUDY OF THE DENVER LABOR AND HOUSING MARKET

Household and businesses are distributed across regional economies based on a number of factors including location-specific natural and fiscal amenities and local and regional employment conditions. Very different hypotheses are proposed in past research to explain the determinants of this spatial distribution. In particular, it is argued that households must weigh the benefits of potential amenities against the costs of employment losses, lower wages or higher housing prices. The relative strength of these two categories determines the potential for government intervention in the market. This research project analyzes this issue in the specific case of the Denver labor market area. This region has experienced large swings in economic activity over the past decade, but more recently, has been one of the fastest growing metropolitan areas in the United States. As growth occurs, the role of fiscal amenities in this process needs to be understood since governments may inhibit, promote or have no effect on regional population and employment growth.

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DEDICATION

This dissertation and research project is dedicated to my family, Kendra and Anthony, for their patience and understanding throughout this long process. I look forward to our new adventures in the Commonwealth of Kentucky.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

Households and businesses are allocated across locations within local labor market areas based on a number of factors, including distance to production and consumption points, fixed amenities of an area, labor supply and demand, relative local prices, cost of living and government policies and programs. As these economic agents locate in different regions, households and their associated labor supply may travel to distant employment (or labor demand) sites in other locations. Site-specific activity and resource holding by households, employees and employers generate government taxes and fees that are used to finance local public goods. When economic conditions change, the spatial distribution of households and businesses may be reallocated based on new incentive structures or comparative advantage.

Many factors determine the location decisions of households and firms. In particular, a debate has ensued in the economics literature regarding the relative role of employment opportunities versus natural and fiscal amenities in determining population migration. Historically, economists have imagined that people would move based on economic differences between regions. "Differences in net economic advantages, chiefly differences in wages, are the main causes of migration," (Hicks, 1932, p. 76). So for example, wage differentials between states are arbitraged by households. Thus, differentials exist only until movement occurs to eliminate them.

Household Location Determinants

Employment opportunities have long been considered a major factor driving population movement. Within this literature, wages, income, and unemployment rates have been used to proxy employment opportunity and income differentials. For many years, researchers assumed that regional differentials in unemployment rates or incomes would be arbitraged away as households and firms move in response to utility or profit enhancing opportunities. Unfortunately, studies were confronted with a large number of estimated wrong signs given expectations. In short, their findings revealed that population continued to flow into high rent and/or lower wage areas.

However, in the 1950's a new chain of thought began to emerge. Non-employment based amenities were identified as major drivers of migration behavior. Amenities are location-specific, non-traded attributes of a region or local area. Factors such as sun, low rainfall and humidity, topography and visual beauty are determinants of household migration. As early as the 1950's, migration to California appeared to be based on "amenities" rather than economic advantage. As quoted in Ullman (1954), "For the first time in the world's history pleasant living conditions–amenities–instead of more narrowly defined economic advantages are becoming the sparks that generate significant population increase, particularly in the United States". Subsequently, over the past twenty years, attempts have been made to develop a theory about the role of amenities in regional development and migration.

Amenities help define the character and quality of life of a regional or local economy. They can be divided into natural and produced amenities, both of which could be identified as driving forces behind the distribution of population and employment in

regional economies. Natural amenities are those goods and services that are a part of the landscape of a region, such as climate, topography and water access. Although they are natural to a region, human activities may play a major role in their subsequent quality and quantity through production and consumption.

These initial analysts focused their attention on natural amenities, such as climate and topography. In a related vein, Charles Tiebout (1956) introduced the notion of fiscal amenities driving differential migration between jurisdictions. Tiebout claimed that people would "vote with their feet" and move to an area based on government-provided amenities, such as educational quality. These produced, fiscal amenities differed from natural amenities in that they had an explicit cost (taxes or fees) and were the result of human activity. Cities and counties may even explicitly use fiscal amenities in an attempt to manipulate population and employment growth. This theory was an attempt to circumvent the problems of demand for public goods as espoused by Samuelson. Tiebout argued that migration served as a revealed preference mechanism for local and state public goods.

Produced amenities are site-specific attributes that reflect local and state government, as well as private market activities. These may include sports stadiums, restaurants, museums and zoos and other activities that are dependent on a critical mass of consumers. Although many of these activities are privately produced and assigned private property rights, they are site specific and require presence for consumption to occur.

Fiscal amenities are the result of state, local and federal government action. Governments may provide services such as road and highway infrastructure, utilities,

park and recreation services and other activities. Similarly, many government-provided goods and services require presence for consumption. In some cases, government or fiscal amenities may be related to agglomeration effects. Also, fiscal amenities may interact with natural amenities to produce a mixed fiscal-natural amenity such as a campground in a state park or road access to a wilderness area. Nevertheless, the debate continues as to the degree which household location is based on employment conditions, natural amenities or fiscal amenities.

Employment Location Determinants

Profit maximization or cost minimization is the presumed motivation behind a firm's search for facility and plant location (Herzog and Schlottman, 1991). The factors in the location calculation include local wage rates, utility costs, transportation access, labor supply and quality, as well as others. Traditionally, wages have been considered one of the major factors due to their large role in determining firm's costs and profitability. The general perception is that firms move towards low wage regions in an attempt to compete with lower cost producers particularly in other countries. Within a regional economy, firm decisions may be motivated less by wages and more by government attempts to lower the cost of infrastructure or taxes.

A debate continues to rage over the ability of local and state governments to actually generate change in population and employment distributions through the use of fiscal incentives. Some authors claim that evidence suggests that local government fiscal policies, such as tax incentives, can generate employment and income creation for communities (Bartik, 1991). Others suggest that labor costs and other factors are far more important than the impact of tax rates on business decisions (Wasylenko, 1997).

The evidence regarding government expenditures is even more mixed (Fisher, 1997). Transportation services have shown the greatest magnitude of influence on economic location decisions, while educational spending and quality also appear to influence household location. Otherwise, evidence regarding the effect of government expenditures and taxes on economic location decisions is mixed, presumably due to different datasets, analytical methods and controls used in studies.

Research Objectives and Hypotheses

The purpose of this research project is to develop a model and test alternative theories as to the determinants of population and employment location within a labor market area. Fiscal amenities or public services are believed to play a role relative to other factors in that process. The word relative reflects the fact that amenities are only one of the forces that drives regional change. In particular, the role of fiscal amenities must be measured relative to the role of employment opportunities or wages.

Traditionally, employment and wage differentials between labor market areas have been considered the most important force behind population and employment movement. However, we believe that a case can be made for the importance of fiscal amenities in the context of a single labor market area. This is due to the fact that employment differentials within a single region may be more closely related, such as wages or other business cost factors. Further, one does not have to live and work in the same county. The place of residence can be where a household enjoys amenities, while the place of work can be made based on employment opportunities. Thus, unlike studies of interregional population movement, fiscal amenities can play a stronger role in a labor market analysis.

The research objective is expressed as two specific hypotheses in an econometric analysis. The first hypothesis relates to the influence of fiscal amenities on population. It is expected that general government spending on local fiscal amenities will have a positive influence on the degree of population growth. In particular, the share of government spending on categories such as public safety, parks and recreation and schools will have an economically significant and positive effect on population change in a county. It is possible, and perhaps likely, that government spending on categories such as welfare and public health will have a negative influence on population growth in a community. These amenity variables must be weighted against the influence of the employment and wage variables. It is possible that both types of variables, employment and amenities, will have an influence on population growth and the answer may depend on relative influence. A secondary hypothesis is that population will be driven by regional employment and employment by regional population, thereby reflecting commuting linkages.

For employment, fiscal amenities are not expected to play a significant or even positive role based on previous research. Business may be repelled by high spending on categories such as parks or welfare, which signal higher tax burdens and few benefits to business directly. The very nature of a single labor market area implies a stronger role for fiscal amenities in population location and implies a weaker role for fiscal amenities in business location. Especially in a single labor market area, businesses realize that employees can live in a set of surrounding counties and do not have to locate in the one county with the highest degree of amenities for employees. Still, market related variables, such as roads and transportation, are expected to have a positive impact on the

degree of employment change in a county. Other variables, like parks and schools, are likely to have no significant or even a negative relationship to business growth. In short, economic factors such as wages are expected to have the strongest influence on business location.

The simultaneous nature of this estimation implies that population and employment are jointly determined. Generally, research has found that population exerts a stronger influence on employment than employment on population in single and multiple labor market areas. The hypothesized population-employment linkage leads to the potential implication that, in general terms, employment change follows population change. Thus, adding further evidence to the debate surrounding the question first posed by Richard Muth as the chicken and egg problem- "Do jobs follow people or people follow jobs"? In this regard, population growth represents both labor supply and consumer demand for firms for certain sectors. The implications of this evidence is that economic development strategies should focus on attracting residents through quality of life concerns and employment growth will follow afterwards. This is in general opposition to the strategy that assumes that jobs should be enticed to a region based on capital oriented tax incentives so that population will follow these jobs.

Study Contribution

This study makes a contribution of methodology, policy analysis and outlining new conceptual areas of the regional development field. Very few regional econometric models have utilized a sub-regional examination of population and employment change. Further, few models have examined the direct link between local areas, preferring to focus on intermetropolitan regional distribution. However, many labor market areas,

including rural and urban areas, will benefit from this initial assessment of the relative forces of population and employment change. The analysis will also provide a method to test whether various factors (fiscal policy, net regional commuting, own county employment or wages) differentially influence sub-regions within a broader area of analysis. Hopefully, the model presented here can serve as a benchmark for further intraregional studies of labor market areas.

In particular, the contribution here focuses on the specification of simultaneous equation models that are used to determine the relative determinants of growth in a region. Previous studies have either ignored the issue of the role of amenities on regional growth or misspecificed their models by ignoring the capitalization effects of amenities through wages and rents. In contrast, other studies have focused exclusively on amenities, while ignoring the importance of jobs and real wages on the movement of households and firms. A properly specified model should account for employment conditions, regional amenities and the fact that these two factors simultaneously affect one another.

Beyond academia, this research should be of interest to regional policymaking bodies such as the Denver Regional Council of Governments and other local government agencies. It is critical for these agencies to consider the effects of fiscal amenities on employment and population growth. Economic development policies depend on a strong and positive relationship between government programs and population and employment growth. Indirectly, other government programs such as infrastructure projects should also consider their economic effects.

Chapter 2 Literature Review

This literature review covers six related but distinct areas. First, the original hedonic literature established the importance of amenities on household location and the use of wages and housing price capitalization as a method to undertake empirical analysis. Second, the disequilibrium literature based on the idea that households and business respond to regional differentials such as wages and employment. The third area is a survey of an integrated equilibrium-disequilibrium approach. The fourth section covers the population-employment simultaneous equations literature. The fifth section covers the partial equilibrium literature on the effects of state and local taxes and expenditures on business location decisions and the effects of local economic growth (population and employment) on wages and housing prices. The final section reviews concepts and research behind commuting, generally, or the balancing of labor supply and demand across jurisdictional boundaries. The objective of these surveys was to identify the key variables that determine business and household location decisions and their empirical influence in previous studies.

Equilibrium Theory of Migration and Amenities

The traditional Alonso-Muth-Mills urban economics model developed in the 1950's and 1960's envisioned distance as the major amenity difference between areas in a metropolitan setting. The major tradeoff was between living close to the center and paying higher rents or living farther away from the central city and paying lower rents. The same was true for rural areas. Distance from amenities was considered the major

factor driving lower growth in distant rural regions. Despite these theoretical advances, amenities still were rarely included in empirical analysis. In the 1970's, the development of hedonic methods and the theory of product characteristics led to new tools in examining and valuing fixed location specific differences between regions. Sherwin Rosen's pioneering work was expanded by Roback (1980) to become the standard for amenity and regional growth analysis. The original theory stated that wages would be discounted and rents would rise as people attempted to access the limited areas that were amenity-rich. This was due to the fact that as population (labor supply) grew, firms could offer lower wages. Further, higher population growth would raise housing prices due to the relative inelasticity of housing supply. Therefore, an implicit price (lower wages or higher housing prices) exists in areas that are amenity-rich. Past researchers (Hoehn et. al, 1986; Voith, 1991; Roback, 1981) used hedonic price models to estimate the level of implicit prices in various markets and then construct quality of life indexes based on relative implicit prices.

In fact, the amenity-based theory postulated that migration would be strongest towards areas of relatively high rent and low wages. This was exactly the result uncovered by earlier employment-based migration research. However, it became obvious that this simple statement did not completely account for all possible outcomes in these environments. Further research indicated that the relationship between wages (employment), amenities and population growth was mixed and inconsistent. At times, amenities seem to drive population, while at other times employment opportunities and wages were more important. A key issue turns on the relationship between amenities and firm productivity.

The hedonic approach is based on a number of key assumptions. First, a foundation of this approach is the assumption that households and firms move costlessly and instantly based on any exogenous shocks in supply or demand conditions. In this manner, the regional economy is generally in a constant equilibrium. Graves introduced a notion of moving equilibrium. Under moving equilibrium, the system is dynamic due to continuous exogenous changes, but remains near to the equilibrium position. The argument is that the system remains close enough to equilibrium for the assumption to work. The example used is that amenities should be valued as normal or superior goods. As incomes gradually rise in an economy, the demand for amenities will gradually shift out.

Some other key assumptions for the equilibrium approach include utility maximization based on a composite good, residential land and an index of amenities.

(1) Household Utility Function: Max U ($x, L^c, ; s$) subject to $w + I = L^c + r$

Where

w = wage, I = nonlabor income, L^c = residential land price, r = rent, x = composite commodity quantity, s = amenity index

(2) Production function $X = f(L^p, N; s)$

Where

L^p = commercial land, N = workers in region

and

Cost Function $C(w, r ; s) = 1$ "Equilibrium condition"

Households are assumed to move based on regional differentials in utility. Utility is based on wages, rents and amenities. Firms are assumed to produce the composite good

through the use of constant returns to scale technology, perfect competition and the zero profit condition. In equilibrium, unit cost equals product price and firms would have no incentive to move sites. A critical issue is whether or not the amenity in question is productive or not. If $C_s > 0$, the amenity raises unit costs and is unproductive to the firm.

The empirical manifestation of the hedonic-equilibrium approach was an attempt to estimate the implicit prices of amenities based on existing wage and housing price differentials. These estimates could be used to compute the value of an exogenous change in amenities. In addition to business location and production, household location will be affected directly or indirectly by changes in the policy environment. The relationship between housing prices, wages and local amenities is important for linking changes in population to changes in local prices. Evidence from a number of research studies indicates that housing and wages do capture differences in local amenities (Robak, 1982; Hoehn et al., 1987, Voith). Robak (1982) was the first to establish a theoretical and empirical link between local amenities and housing prices and wages. Previous research had focused on the implications for only a single market. Hoehn et al. (1987) extended this model by incorporating intraurban amenities. Based on their results, the evidence supports the conclusion that rents and wages do capture such differences in amenities. Finally, Voith (1991) found that incorporating different land use types (residential, mixed, commercial) did not alter previous results.

Gyourko and Tracy (1991) relaxed a number of standard hedonic assumptions to ascertain whether or not fiscal amenities or public services are capitalized into wages and rents. First, they introduce the concept of pure versus produced amenities. Produced amenities have an explicit tax cost associated with them. However, if that tax cost does

not cover the entire true cost of the service, implicit capitalization into wages and rents may occur. Their empirical findings suggest that produced amenities are partly capitalized into local wages and land rents similar to pure amenities.

Dalenberg and Partridge (1997) considered the potential dual roles of public capital in affecting the economy. These dual roles are that public capital acts as an unpaid input into the production process and as a possible household amenity. If public capital primarily acts as a household amenity, labor supply will increase and shift the labor supply curve. The effect of this curve shift will be to lower wages. However, if public capital acts more as an unpaid input to production, labor demand will shift out and cause wages to rise. Empirical estimates suggest that public capital, in the form of highway investment, act primarily as a household amenity leading to lower wages. Manufacturing was the exception where highway investment led to higher wages.

All of these studies were valid in their own right. Empirical estimates could be calculated based on existing differentials between regions. Econometric work established significant coefficients for amenities in wage and housing price equations. However, these authors did not consider the potential ramifications if labor and housing markets did not instantly adjust to any exogenous changes.

Disequilibrium Theory of Migration and Location: Jobs and Wages

A number of economists have challenged the equilibrium assumption. Many would argue that the assumption of costless movement, perfect information and instantaneous adjustment are too strong. The empirical results are mixed in this regard. Greenwood et al. (1991) found that the assumption of equilibrium does not lead to serious quantitative or qualitative errors in classifying amenity rich or poor areas and in

computing amenity implicit prices. Herzog and Schlottman (1993) did find that the assumption of instantaneous adjustment leads to biased estimates.

Mathur and Stein (1993) put a different type of criticism forth. They argue that the instantaneous adjustment assumption masks the feedback effects of population and firm movement on the regional economy. As firms or households move, they engender change in the relative wage and rent factors in both the entrance and exit regions. These relative wage and rent changes then result in secondary changes in household and firm location. Further, they argue that firm and population movement affect endogenous or induced amenities. Graves and other equilibrium theorists have often mentioned endogenous amenities as a reason why everyone does not move to amenity rich areas. They also model the impact of firms and population on wages and rents. These effects are only implicitly mentioned as adjustment forces in the equilibrium approach.

The disequilibrium approach is based on the notion that regional economies are not in balance if a wage or rent differential exists. Households and firms will move until the differential is arbitraged away. This approach assumes that movement between regions is costly, and often, response to differentials is delayed due to information failure or other impediments. Also, the disequilibrium approach is based on migration that occurs due to economic opportunity or income differentials. It is hypothesized that households will move to regions that have higher incomes or lower unemployment rates with rents used as cost of living deflators.

The disequilibrium literature hypothesized that these wage and rent differentials were the primary factors behind household and firm movement. This literature specified

simultaneous equation models involving the dependent variables population and employment.

(3) $P = P\text{-}1 + E + \text{wages} + \text{external forces}$

(4) $E = E - 1 + P + \text{external forces}$

Population growth is a function of past population growth, current employment growth, wages and other external forcoes. Employment growth is a function of past employment growth, current population growth and external forces. However, the disequilibrium literature failed to take account of the fact that part of the wage and rent differential reflected the capitalization of amenity values due to previous population and employment movement.

An Integrated Approach: Amenities and Employment

Only a few authors have attempted to empirically address the question of equilibrium versus disequilibrium flows in a regional economy. In 1995, Mueser and Graves, two principal proponents of the equilibrium approach, presented an integrated model. Mueser and Graves (1995), in their own words, are concerned about "the failure to integrate migration flows (representing the response to disequilibrium) into an equilibrium framework has left migration to be studied in terms of a variety of ad hoc structures". They start with a familiar representation of households and firms:

(5) $U(w_i, r_i\ a_i) = U^*$

(6) $C(w_i\ r_i\ b_i) = P^*$

Where

U = utility

C = cost

P = product price

w= wages received by the i^{th} household

r = land rent

a = household amenity (mountains, ocean view...)

b= firm amenity

i = 1 to n.....households

This model specifies that households and firms respond to relative wages, relative rents and fixed location amenities. In equilibrium, firm costs are equal to product price across all regions and household utility is equal across all locations. The authors acknowledge that household migration is "properly viewed as an indication of disequilibrium" (Mueser and Graves, 1995). They specify a dynamic version of the above model household agents with rational expectations compare net utility across regions.

Unfortunately, the Museur and Graves model strictly deals with population change and ultimately holds employment change in the background. Thus, it is an incomplete merger of the disequilibrium and equilibrium literature. The potential integration of these two separate literatures represents a major step forward in regional economics.

Greenwood et al. (1991) estimated a migration model that regressed net migration rates for each state against relative real expected income (RY) and fixed effects. The fixed effects are purported to represent relative state natural amenities. The equilibrium value of RY is the value that equals no net migration. It just offsets the value of amenities or disamenities for a state. Areas with higher than unity for RY have less attractive or net disamenities and imply that higher wages or lower housing costs will be

required to reestablish equilibrium. Areas with less than unity for RY should experience net migration leading to higher housing costs and lower wages (labor supply effect). The authors find that the assumption of equilibrium does produce errors due to "disequilibrium gaps" but that in many cases these gaps are of low economic significance.

Herzog and Schlottman (1993) attempt to determine if changes in population growth and population density act as a net amenity or disamenity. This question also asks whether or not regional labor markets adjust quickly and efficiently. They regress the likelihood of migration against prospective wages. Prospective wages are wage differentials regressed against amenities and worker characteristics. The final result is that population growth appears to be a net amenity and population density appears to be a net disamenity. The interpretation of these results indicates that disequilibrium exists in urban labor markets, particularly in cities below 4.5 million. Population growth acts to create endogenous amenities such as cultural activities, restaurants and others. This is clearly in evidence in the Denver region where population growth in the 1990's has led to the construction of an Ocenarium, new football and baseball stadiums, a revitalized art and cultural district and other neighborhood renovations. The downside of growth has been endogenous disamenities such as traffic congestion, higher local prices and increased pollution. However, at this point, the amenity factors seemingly outweigh the disamenities as evidenced by continuing net migration into Denver county.

All of these empirically based studies attempt to disentangle the relationship between equilibrium and disequilibrium differentials between regions. The lessons are that income, wages, cost of living, employment and amenity differentials only stimulate

changes in household or business migration when a wedge exists between housing prices/wages (implicit prices) and the value placed on these amenities. Population migration may respond to both employment opportunities and amenities. Business migration will likely respond to differentials in cost factors such as labor, energy, transportation and materials. However, these authors only considered population change and did not consider the effects of population and employment change in a simultaneous framework.

Simultaneous Models of Population and Employment Location.

The regional simultaneous equation model, first introduced by Richard Muth in 1971, addresses the question of intraregional employment and population distribution. These models posit that employment and population interact and respond to one another in the process of regional growth and decline. Other studies have focused on the distribution of population and employment in metro and nonmetro areas in non-simultaneous frameworks holding one or the other exogenous. For this review, I focus on those studies that have utilized simultaneous frameworks to analyze this issue, where other studies, which hold employment or population exogenous, will not be reviewed.

The Steinnes-Fisher model was one of the pioneering models in this area. It posited that population was a function of employment change plus other exogenous factors. The employment location equation is regressed against variables explaining the level of labor demand in the area and those affecting residential housing supply and demand (Steinnes and Fisher, 1974). These include median income, racial shares, lake access and subway access. Although a simultaneous model, it lacked any dynamic features and only accounted for cross sectional differences.

In further studies, Steinnes attempted to expand upon this original model. In particular, he was interested in whether employment drives population change or vice versa. His basic conclusion, using a pooled cross section-time series approach and U.S. metropolitan areas, was that causality runs from population (residences) to employment. One interesting finding is that manufacturing and service sector jobs follow people, but people follow retail jobs. This is certainly counter to the generally accepted notion that "retail follows rooftops".

Grubb (1982) estimated a fairly simple pooled cross sectional-time series model. In his study, public expenditures and taxes were determined to have no real effect on location decisions in general. Transportation access and crime rates also had no effect on location decisions. It does appear that employment tends to follow population. However, in general, the study uses very crude variable measures and the results do not appear to be reflective of findings from other studies.

Greenwood (1980, 1990) has estimated two population-employment models. In both studies, he estimated a housing supply equation, employment location equation, resident location equation and income equation. Similar to other studies, Greenwood (1980) uses the US metro areas and divides them into suburban and urban areas. Rather than using only one census year, he uses 4 census periods to capture dynamic effects. His findings indicated that as people move to the suburbs, housing supply responds to growth. Housing responsiveness is much greater than employment growth. Suburban retail employment is driven by suburban population growth unlike in the Steinnes model. Suburban manufacturing and other base industries appear to be largely exogenous to the population and employment dynamics in the metro area.

In the second Greenwood study (1990), population is broken into income classes, employment is broken into type of industry and housing is broken down into type of unit. Again, the study uses US metro areas and three census periods. In the central city, low income and high-income residents' migration encouraged rental property development, whereas in the suburbs, high-income migration led to the development of single family structures and low-income migrants led to rental units. Employment location in central cities did not encourage residential migration to central cities.

Luce (1994) focused his research efforts on the role of taxes and public services in population and employment regional changes. Using 340 municipalities in the Philadelphia metro area, employment is broken down into five one digit SIC sectors. Taxes are measured as school district property tax rates and local income tax rates. Public services are divided into public safety spending, public works spending per household and spending per pupil. Finally, transportation access is measured as access to major highway exit points in the city. Property and wage tax rates are significant in the employment equation. However, public spending shows no significant effects on employment location. For residential location, taxes appear to have little effect but school spending does have an important effect on location. Public safety and public works spending do not have significant effects on residential location. Similar to findings by Wasylenko and Bartik, local taxes and spending do have effects on residential and employment location within labor market areas.

Levernier and Cushing (1994) attempt a slightly different version of the population-employment model. They use county level variables rather than urban-suburban splits of the data. Population is assumed to be a function of employment

growth (manufacturing and nonmanufacturing), racial groups, land area, land rent, house age (quality), fiscal spending per capita and property taxes. Employment is a function of wages, education levels, racial groups, size, highway and road access and land rents. A two stage least squares model is used for 1980 US metro areas. They find that highway and port access significantly influence employment location. Also, population is the driving force behind nonmanufacturing employment location. Labor and land costs have insignificant effects on employment distribution. Land rent appears to have an important effect on residential location, but public services and taxes have mixed effects on residential location.

Recently, Richard Deitz (1998) has contributed to the literature by disaggregating households by occupational groups. The goal is to determine if previous inconclusive results concerning "people follow jobs" or "jobs follow people" can be cleared up with this use of further disaggregation. The study setting was census tracts in the Boston metro area using 1990 census data. A two stage least squares approach was used with lagged dependent variables and tax revenues per capita, standardized school test scores, crime per capita, local tax rates, access to jobs and households, distance to center and highway access as variables. The results provide evidence that firms wish to locate near employees who work in their industry. Tax rates, public services and highway access are of the wrong sign (negative) and nearly always insignificant. The residential equation appears to suggest that wealthy households outbid others in terms of neighborhood quality variables (crime, education), distance to work does not affect location decisions, and there are substantial lags in household movement.

Thurston and Yezer (1994) attempt to use density functions to explain population and employment distributions. Employment is broken down into two-digit SIC sectors. As with other studies, they find that suburbanization of population leads to decentralization of retail and service employment. Otherwise, other types of employment are not affected by population change. Overall, they argue that aggregation is responsible for many of the insignificant or wrong sign findings in previous studies.

Mark et al. (2000) recently examined the forces that drive population and employment change in the Washington DC area. They placed special emphasis on the role of fiscal incentives, especially business and sales tax. Their findings indicate that, after controlling for jurisdiction fixed effects and time, higher tax rates do reduce the level of employment growth. Higher levels of non-welfare expenditures were estimated to have a positive effect on employment, but property taxes do not appear to negatively influence employment growth. For population, tax rates negatively influence population growth, while higher welfare spending also discourages population growth. In general, this study finds evidence that fiscal incentives do have an impact on population and employment growth. However, one could criticize the study for omitted variable bias. Natural amenities and other economic factors appear to be missing from the population and employment equations. Much of the differences between regions end up being captured in the fixed-effects specification.

Barkley et al. (1999) attempt to determine the effect of rural schooling on population and employment growth in South Carolina. The study estimates an empirical model using changes between 1980 and 1990 for rural South Carolina counties. School quality is defined as per pupil expenditures and teachers per pupil. Results indicate that

improvements in rural schooling lead to higher residential or population growth in a county. Per capita income, 1980 employment levels and housing quality (defined as housing age) all indicate statistical significance in determining population growth. The effect of schooling on employment growth are ambiguous in the study. Employment growth is mainly determined by 1980 employment levels and distance to a nearby metro area.

Clark, along with fellow authors Cosgrove (1991) and Hunter (1992), introduce a different version of the effects of amenities and economic opportunity on migration. Specifically, they focus on the likelihood of migration relative to age categories. Clark and Cosgrove (1991) find that both employment opportunities and amenities have an impact on intermetropolitan migration. Clark and Hunter (1992), using a life-cycle focus, discover that younger workers are more attracted by economic opportunity while older workers tend to be attracted by natural amenities. Fiscal amenities appear to have little influence on any age group, however, taxes appear to be a deterrent for both young and old individuals. Despite their specific focus, they make statements with regard to equilibrium and disequilibrium similar to other authors, "labor movement eliminates only wage differentials that result from spatial equilibrium, while differentials resulting from the relative amenity mix are capitalized into the local wage and land rent" (Clark and Cosgrove, 1991).

Overall, conclusions are difficult to make given the variety of data time periods and levels of disaggregation. However, one clear finding is that, in general, retail and some service employment follows population change. Other types of employment appear to follow exogenous trends, although the findings of Deitz using occupational groups,

suggests that access to occupational groups is important for industries. In general, taxes and public services do not appear to have a significant or important role in explaining population or employment distribution with a few exceptions. This may be due to improper measurements or the lack of dynamics in most models. Given the degree of persistence effects that have been revealed, cross sectional studies are suspect on the grounds of ignoring the substantial lags in household and firm location changes.

Econometric Analysis of Regional Effects of Local Taxes and Expenditures.

Many studies have been conducted to measure the effectiveness and impact of taxes on business location and economic growth. This literature provides a benchmark of the elasticity estimates for business response to tax changes and comparing the results of econometric-based analysis of tax cuts and the impact on overall economic growth.

Bartik (1991,1992) and Wasylenko (1997) have provided comprehensive reviews of the literature. According to these authors, over 75 academic studies have been completed on this subject since the 1970's. Conventional wisdom was that state and local taxes did not have a material impact on business location. Business taxes were imagined to be too small of a percentage of total costs to have a large impact. Also, surveys of business leaders found that taxes were at the bottom of the list among location concerns. Finally, empirical evidence in the 1960's and 1970's did not discover any statistically significant relationships between location and taxes.

However, Bartik claims that the studies he surveyed did find a statistically significant relationship between growth and taxes. There are number of reasons to believe the more recent results as opposed to the older research. 48 of the 57 studies surveyed found a negatively correlated relationship between state and local taxes and

some measure of economic growth. The measure of economic growth ranged from employment growth and gross regional output to business capital stock. He calculated that the mean long run elasticity of local employment growth with respect to local taxes was -.25. This finding is strengthened when local public services are taken into account. This is due to the correlation between tax levels and the provision and quality of public services. Transportation infrastructure and education spending appear to have a positive impact on long run economic growth, while welfare spending exhibits a negative impact on growth.

Wasylenko (1997) reviews the same studies as Bartik plus any new additions since 1992. He challenges the view that state and local taxes do have a significant impact on local economic growth. The argument is put forward that estimates in the literature vary widely and do not provide a reliable guide to the potential impact of taxes on growth. Researchers often use an average cost as a measure of labor or energy costs to a firm. This is criticized because many firms may face a different cost structure than the local average. Tax burden measures are also argued to be flawed. Using nominal tax rates ignores the tax base. The tax base is usually not equal to income but to some form of adjusted income with deductions and credits. A second approach used is dividing revenue collected by personal income or population. Neither approach deals with variations in the tax code for certain industries or economic incentives. Basically, Wasylenko has argued that misspecification is a major problem for empirical research linking local growth and local taxes. The final question is whether this misspecification is so serious as to bring into doubt the entire body of research.

Housing Prices and Local Economic Growth.

Local economic growth, usually defined as changes in employment, may respond to changes in state and local taxes. The magnitude of this response is in question, and appears to depend on data, specification and time frame. Provided that some degree of local growth does occur, econometric evidence suggests that other markets in the region will experience change as well.

Housing is a key regional, non-tradable asset. As such, the impact of local growth will influence housing prices and quantities. A number of studies have addressed this issue. Local job growth has been the most common independent variable and housing or rental price the most common dependent variable. The production function of the housing sector along with the government's institutional structure dictates certain lags in the planning, development and construction process. Empirical research indicates that, despite builders response to higher prices and added supply to the market in the medium run, housing prices still rise. This is because land and labor construction costs are permanently higher after the economic shock. The estimated elasticity (employment growth shock affect on housing price) ranges between .25 and .70 based on Bartik's (1991) review of 10 studies done between 1975 and 1991 as well as a study by Voith (1997).

Besides being affected by local job growth, housing prices have been identified as a key measure of interregional locational differences. Locational attributes include distance to work, distance to recreation and entertainment, neighborhood characteristics and others. Differences between local regions are capitalized or bid into housing prices as households move in response to differentials in price and attribute availability. Voith

(1991) and Hoehn et al. (1987) indicate that regional differences are bid into housing prices. These measures are determined using hedonic analysis.

Wages and Local Economic Growth.

The literature about the effect of wages on local employment and population growth, and the subsequent effect of population/employment growth on wages is mixed based on a survey of past studies. Bartik (1991) claims that population and employment growth does not lead to changes in the nominal or real wage. However, other authors claim that regional growth leads to positive feedback effects on wages. The mechanism is based on agglomeration and productivity effects. Employment growth stimulates further growth and higher wages. These findings indicate that wages may potentially be simultaneously related to population and/or employment.

The Role of Commuting in Empirical Modeling

Much of the previous research ignored the issue of commuting and focused on interregional movement. However, within a labor market area, households can chose to live and work in different counties. These types of choices help determine the nature of the relationship between population and employment. Within a labor market area, commuting allows labor supply and demand to be out of balance in any particular local area or jurisdiction. The equilibrium framework assumes that demand and supply in each market is in balance. Thus,

(7) $L_D = L_S$.

However, within a labor market area, commuters may travel across jurisdiction boundaries. The place of residence and place of work may not be the same. In this case, labor supply may be provided to one county from another county. Other counties may

actually experience a net reduction in workforce as people leave the county to work somewhere else. Under these circumstances,

(8) $L_D = L_S$ (internal) + L_S (external).

A final situation is also possible where commuters cross county lines in both directions. The net commuting figure may disguise the fact that commuters cross each in the morning and evening.

(9) $L_D = L_S$ (internal) + L_S (external) – L_S (internal, out-commuting).

Empirically, the real difficulty is that gross commuting flow data is only available from the decenial census. In between census years, the only available commuting is based on net commuting flows. Net commuting is calculated as the difference between available labor supply (proxied by population) and employment. Commuting flows can also be proxied by the difference between a county's population (employment) and employment or population in other counties of the region.

(10) $L_{D\ (county\ x)} = L_{\ s\ (commuting\ region\ counties)}$

(11) $L_{s\ (county\ x)} = L_{d\ (commuting\ region\ counties)}$

In terms of empirical specification, employment opportunities and wages will induce population growth to counties with a labor market area. Households will not necessarily move to the same county as the job is located. Further, distance to employment may not be a major factor up to a certain threshold (see above). The net result is that, as opposed to previous studies, both own-county employment and regional or external employment and wages will be explanatory variables for population growth. Conversely, employers will take an entire labor market area into consideration, not just the county where they are located, as the pool of potential workers.

Chapter 3 Model Development

In undertaking an analysis of regional employment and population change, one is faced with two divergent explanatory theories. The equilibrium theory posits that regional amenity differences are the determinants of migration. As expressed through hedonic models, the theory assumes that wage and rent differentials that exist between regions are not the subject of population or employment movement. These differentials simply represent the capitalization of previous household and business movement. This theory assumes that perfect information exists about cross-regional differentials and spatial adjustment costs are negligible.

The disequilibrium literature states that cross-regional differentials are the subject of spatial arbitrage by households and firms. Due to imperfect information and potentially high adjustment costs, firms and households take time to switch places in response to differences in profit maximizing opportunities and spatial utility differences. The movement of economic agents eventually reduces and eliminates regional variation in utility and cost differentials. This is the concept behind regional convergence where all regions experience equal per capita real income levels.

More recently, an attempt has been made to bridge the gap between disequilibrium and equilibrium theories. Economists now recognize that household and firm migration, whether into or out of a region, is a logical response to disequilibrium forces or shocks. It has also been recognized that population and employment migration

influence each other. At the point of zero net migration (firms or households), a regional economy will be in equilibrium. A variety of approaches have been developed to integrate these theories.

It is informative to examine the differences in hypothesized outcomes between the two literatures when they are separate versus combined.

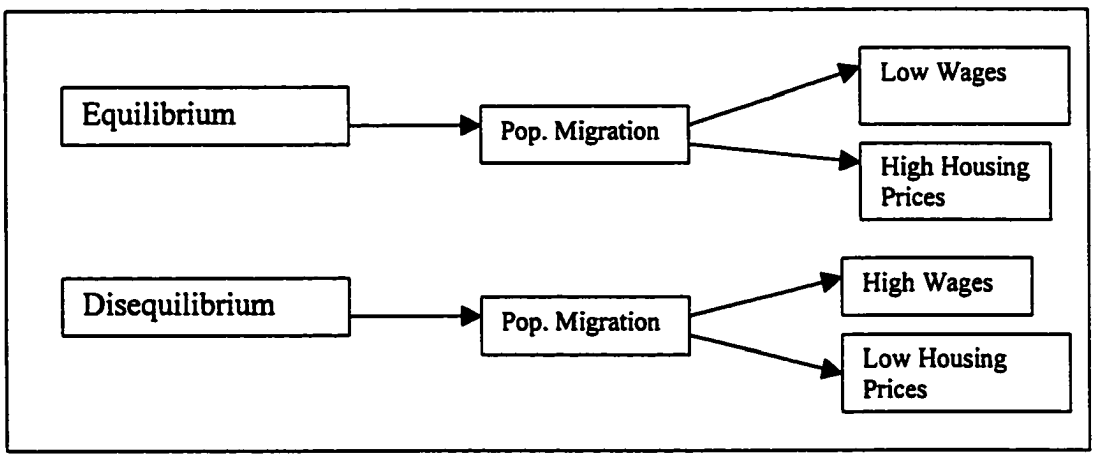

Figure 1: Equilibrium and Disequilibirum Theories

In the equilibrium world, it is hypothesized that, if amenities are unproductive or raise firm costs, the effect on market area economies will be lower wages and higher rents. This is due to an increase in labor supply driving wages down in equilibrium, while higher population growth leads to higher land and housing prices. In the disequilibrium world, the hypothesis is that population will move towards regions with higher real wages and better employment opportunities (i.e. lower unemployment rates). As they move, wages are bid down in the in-migration region and up in the out-migration region, ultimately leading to convergence. The two approaches agree on the adjustment mechanism, but not the direction or cause of movement. Both theories also share the characteristic that they often leave employment location decisions in the background.

However, in the combined model, wages in high amenity areas may be higher or lower depending on the role of agglomeration economies of scale relative to labor supply effects. Higher population growth induces a shift in the labor supply curve and lower wages. On the other hand, higher population growth has been shown to be a good proxy for agglomeration economies which translates to higher wages. Workers entering a region produce productivity advances for firms, which in turn leads to higher wages, partially due to efficiency wages. In short, empirical evidence suggests that the agglomeration effect is likely to outweigh the labor supply effect.

Land and structure rents are likely to rise due to an influx of firms and/or households. This hypothesis is supported by available empirical evidence that land and structure supply is inelastic and responds to increasing demand through higher prices.

Based on a combined model approach, the effect of exogenous amenity changes on population and employment change depends on the relative magnitude and direction of cost and benefit effects. If firms are amenity adverse, the hypothesized relationship is that employment growth will slow or decline. Under these circumstances, the change in population depends on the marginal benefit of the amenity to households versus the higher marginal costs to firms. If increasing amenities leads to fewer firms and jobs, household welfare will be reduced due to fewer employment opportunities and potentially lower outcomes. The new economic geography would also suggest that fewer firms imply fewer varieties of products (monopolistic competition) which also reduces household utility. Higher amenities, depending on their type and variety, leads to higher welfare for households. The empirical question is which of these forces is stronger. The

coefficient on the amenity variable in the population equation, controlling for employment effects, will determine the answer to this question.

These ideas were most clearly specified in the theoretical model of Mathur and Stein (1993). These authors directly tackle the issue of employment and population change simultaneously, whereas other authors hold employment exogenous. The full model is presented and its connection to the research hypotheses and empirical results of this paper are compared and contrasted.

Closely following the work of Rosen (1974), Roback (1980) and Mathur and Stein (1989, 1991), the theoretical model specified here examines the workings of a regional economy and suggests appropriate empirical hypotheses. The hypothetical regional economy is made up of representative households and representative firms. Households and firms are assumed to respond to regional differentials (disequilibrium literature) in an attempt to arbitrage differences between regional utility and costs.

The Mathur-Stein model is based on a Robackian economy with endogenous population and employment movement.

(12) $P = \lambda_p[V(W, R, S, G) - k]$

(13) $N = \lambda_n[1-C(W, R, S, H)]$

(14) $W = W(P, N, S, I)$

(15) $R = R(P, N, S, J, \delta)$

Where:

P = change in population in a given region

N = change in employment in a given region

λ = Adjustment factor due to imperfect information, moving costs

W = regional wages

R = regional land and structure prices

S = amenities

G, H, I, J = predetermined and excluded variables for population, employment, wages and housing prices

K = constant utility factor

V = indirect utility

C = constant cost factor

Household utility is dependent on wages, rents and amenities. The k factor represents the equalization of utility across regions necessary to establish equilibrium. Firm or employment equilibrium is established in the second equation based on cost differentials. The (1) one factor represents equal costs across all regions. Otherwise, firm movement is based on wages, rents and amenities relative to other areas. The excluded variables, important for empirical work, represent factors such as industrial composition that affect only employment and not population. Both population and employment are affected by an adjustment factor (λ) that represents the disequilibrium notion that it requires time and resources to alter household and firm location.

However, wages and rents are also endogenous in this model to reflect the fact that capitalization occurs between amenities, wages and rents (equilibrium literature). This endogenity also reflects the fact that firm and household movement has a direct effect on wages and rents separate of the amenity effect. Wages are a function of population change (agglomeration economies), employment change and amenities. The wage-amenity effect is similar to a traditional hedonic model with the further recognition

that population and employment movement are part of this process. Wages are expected to be positively related to population and employment growth and negatively related to amenities. Land rents are a function of the same variables with different directional expectations. Rents are expected to be positively related to employment and population change as well as changes in amenities.

Following Mathur and Stein (1993), a comparative static approach is specified using a baseline steady-state model. The comparative static examination is designed to test the effect of an exogenous change in amenities on population and employment change. In the steady-state model, population and employment change are set equal to zero. Substituting the wage and rent equations into the population and employment equations reveals:

$$(16)\quad P = \lambda_p\{V[W(P,N,S), R(P,N,S)]-k\} = 0$$

$$(17)\quad N = \lambda_n\{1-C[W(P,N,S), R(P,N,S)]\} = 0$$

With these steady-state conditions, we can solve for the effect of an exogenous amenity change on population and employment changes:

$$(18)\quad dP/dE = (V_E C_N - V_N C_E) / J$$

$$(19)\quad dN/dE = (C_E V_p - C_p V_E) / J$$

The variables V_P and V_N represent the direct and indirect effects of population and employment on household utility. The utility-population relationship is based on the fact that increased population leads to higher housing prices while at the same time leading to higher wages due to agglomeration effects. Generally, we expect the housing price factor to outweigh the wage effect. If these conditions hold, the V_P variable will be negative.

The V_N variable indicates the relationship between utility and employment growth. Similar to the utility-population relationship, higher employment growth will lead to higher wages and higher housing prices. In this case, however, we expect wage growth to outpace housing price growth. Therefore, the utility-employment relationship will be positive.

The C_P and C_N variables are based on the relationship between firm costs and population and employment growth. It is likely that both of these factors will lead to higher firm costs. Higher population growth raises firm costs by raising housing prices. Higher employment growth shifts the labor demand curve and leads to higher wages and higher firm costs.

The V_E and C_E variables are based on the relationship between an exogenous change in amenities and household utility and firm costs. Under their theory, a change in amenities has a positive effect on household utility. The relationship between firms and exogenous amenities is the key to the ultimate impact on population and employment.

This framework provides the basis for interpreting empirical results with respect to the effect of an amenity shock on regional population and employment change. Rather than stating specific hypotheses, the authors provide a variety of scenarios based on parameter values. As stated previously, a key parameter is whether or not amenities act to raise or lower firm costs (see appendix 3). If amenities act to raise costs, an amenity improvement will lead to lower employment growth. Changes in population growth depend on the tradeoff between the benefits of greater amenity consumption and the costs of lower employment growth. If amenities lower costs, the situation becomes more complex. Population growth will be stronger in this situation. Firms must weigh the

benefits of lower costs due to amenities versus higher population growth which in turn raises costs.

A previous paper by Mathur and Stein (1991) examined similar issues in the context of population growth only, holding employment growth exogenous. The previous paper stated that" in disequilibrium...there is a wedge between amenity differentials and the corresponding earnings and housing price differential....It is this wedge that causes migration and ultimately, results in migration" (Mathur and Stein, 1989). This result was similar to findings from both equilibrium and disequilibrium authors. However, in the more recent paper, it was further acknowledged that households must not only tradeoff amenities for local prices and wages, but in fact, for general employment opportunities. Previous literature did not acknowledge this link.

The empirical models, mentioned in the previous chapter, have attempted to integrate these two approaches with a variety of data and methods. Ultimately, the question revolves around the efficiency of adjustment among local labor and land markets. These market adjustments determine the degree to which a change in amenities or public goods lies in capitalized assets or as a residual subject to spatial profit and utility arbitrage. In the empirical literature, the definition of equilibrium and disequilibrium revolves around the idea that population and employment growth is zero in equilibrium. Thus, authors often attempt to determine the value of variables where the stationary-state (zero migration) exists and compare that world to the one that actually exists. The difference between the stationary-state equilibrium world and the world of non-zero population and employment change is a measure of disequilibrium.

The theoretical and empirical literature appears to be moving towards agreement around the issue of disequilibrium versus equilibrium components of firm and household migration. The first lesson is that part of the regional differentials in housing prices and wages reflects the capitalization of amenities or local factors. The second lesson is that this capitalization process is dynamic and occurs through the movement of households and firms. At any point in time, however, land and labor markets may be in disequilibrium due to slower than expected adjustment by population and employment. The third lesson is that when one considers general equilibrium effects, the net result on household and firm movement depends critically on the direct effect of amenities on these agents.

The empirical question is how to measure the degree of equilibrium versus disequilibrium in local factor and housing prices. In this research, we propose that the instrumental variables of housing prices and wages represent the capitalized portion of amenities during a particular time period. To the extent that changes in housing prices and wages vary with changes in amenities, this is a reflection of the capitalization process. The non-capitalized portion of amenities on housing prices and wages, the equation residual, reflects the so-called disequilibrium gap. To the extent that county labor market conditions influence county population growth, disequilibrium-adjusted wages represent market signals that may attract households. Disequilibrium-adjusted housing prices also represent market signals that may effect household utility differences. With this adjusted specification, the most accurate analysis can be conducted measuring the relative effects of labor market conditions and amenities.

Model Specification and Variable Relationships

As discussed earlier, theory suggests that a four-equation system is appropriate for examining the determinants of population and employment distribution. The equations estimated are derived directly from the theoretical model of Mathur and Stein (1993). Population, employment, wages and housing prices will serve as the critical dependent variables. Each independent variable will be hypothesized to be partly dependent on the others. The wage and housing price equations are specified as traditional hedonic models. An attempt is being made to determine the level and value of attributes related to those primary local prices. The population and employment equations are specified in a fashion similar to the simultaneous equation models discussed in Chapter Two. All equations are specified in the form of annual change versus the level approach.

Within the system of equations, a number of independent variables were selected based on economic theory and previous research. These variables can be classified into categories. These categories include fiscal amenities, natural amenities, employment conditions, housing market conditions and population conditions. Fiscal amenities are classified into two groups: total per capita spending (local govt. only) and the shares of spending in different categories, including parks and recreation, welfare, public health, public safety, roads-transportation, other infrastructure and general government. State and federal spending is held exogenous in this model and not included as an independent variable. Employment conditions (specified as the number of jobs in a county) are represented as own-county employment, total regional employment and wage differentials between counties. The housing market is measured as own-county vacancy rates, own-county housing permits and average annual housing prices. Finally, regional

population and regional employment represent the effects of commuting and labor pools across county lines. Each equation and its specification relative to these independent variable categories will be discussed.

The employment equation is specified to include those factors that explain the annual absolute change in employment, by county, in the Denver labor market area.

(20) EMP = F[industry shares (I), income(+), wages(I), amenity(-), hpindex(-), pop(+), road(+), health(-), safety(+), welfare(-), parks(-), metropop(+), tax(-)]

It reflects the changes in own-county employment due to a variety of exogenous factors. Industry composition has often been cited as a major factor behind varying employment growth. This variable controls for differences between counties in their economic makeup. The major two digit Standard Industrial Code (SIC) categories were used for this analysis, including extraction (agriculture and mining), construction, manufacturing, transportation and communications, wholesale trade, retail trade, finance and insurance and services. The share of government workers was excluded to serve as a reference group. The signs in the employment equation and other equations reflect consensus based on past research.

Fiscal amenities were also included in the employment equation. The belief was that these types of amenities would generally be categorized as having a negative effect on firms costs, and therefore, reduce relative employment growth in the local area. The amenities were specified in the same manner as they are for the population equation. We believe that fiscal amenities, similar to natural amenities, will raise firm costs and reduce employment growth.

The relationship between local employment growth and government spending and services is mixed. Evidence of a positive and negative effect appears in many studies. Transportation and highway spending and access are the most widely supported government services that play a positive role in the economy. According to Bartik (1991), there are three possible ways through which public services affect employment or capital location: 1) as an unpriced input; 2) to reduce cost of public capital paid by business; and 3) to reduce the cost of private inputs for business. On the other hand, infrastructure may be costly to businesses and reduce productivity and employment growth in a region. However, controlling for tax burdens and labor costs helps to isolate the specific effect.

Infrastructure investments have traditionally been believed to play a major role in local economic development. Both urban and rural related studies have confirmed this theory that aggregate highway investment promotes economic growth (higher income and more jobs) with some caveats, especially regarding the distribution of benefits and costs. Highway spending appears to be negatively related to employment location while highway access or density is positively related to employment location. In this study, highway investment in the form of the share of road and highway per capita spending across public expenditure categories is an amenity share independent variable.

Public safety, including fire and police protection, has also been considered a potential force driving employment change. One difficulty here is that high spending may indicate the need for higher levels of protection, for example higher crime rates and the need for more police officers, as much as the existence a greater supply of protection. Again, one sees the importance of distinguishing between outcome and output

(expenditures). In this case, the change in per capita spending was used as a proxy for the level of protection in a given county. It is expected that there will be a positive relationship between public safety per capita spending and employment location. However, this effect is not expected to be large or of much importance in the employment equation since previous research has found a positive, but small relationship.

The change in local general government (excluding schools) per capita public spending is another variable included in this analysis. Evidence on the influence of this variable in employment location is mixed at best, and overall not very strong in supporting a positive or negative effect. In theory, if public spending acts as a latent input for firms, it reduces firm costs and may lead to more employment growth. On the other hand, higher public spending may be accompanied by higher taxes and may be response to serious socio-economic problems or bureaucratic inefficiency. In this case, public spending raises the costs of firms or proxies for other problems such as safety concerns that raise firm costs. Due to the lack of a definite theoretical expectation and weak empirical evidence, it is uncertain as to the influence of overall government spending on employment location. It is more likely that spending shares for the other categories will have more influence.

The relationship between wages and employment growth is particularly important. Traditional economic theory specifies a negative or inverse relationship between wages and employment growth. As wages rise, firms will slow job growth or relocate due to higher cost conditions. However, newer theories, such as efficiency wage arguments, specify a positive relationship between the two, at least over some range of wage growth. The relationship suggested by this literature hinges on wages being a

factor that employers use to induce greater productivity or loyalty to a company. The urban economic literature provides further support for this positive relationship where it is contended that agglomeration economies and productivity led to higher wages in high employment growth regions.

Finally, as discussed in the literature review, population has proven to be one of the critical factors in determining regional employment growth. Because we are examining a commuting region, population takes the form of own-county population, along with the wider regional population growth. It is expected that regional population growth will be more important than own-county population change, due to the general patterns of population and employment dispersion.

The population equation specifies a relationship between changes in population (population growth) and exogenous factors such as wages, local and regional employment opportunities, housing prices and amenities.

(21) Pop = F[emp(+), hpindexf(-), reshp(+), wagesf(+), wageres(+), amenity(+), road(I), parks(+), health(I), safety(I), tax(-),]

Population and employment have been found to be simultaneously determined with population typically the stronger effect on employment. Of all research findings, the effect of population on employment has been the most consistent and economically important finding in both rural and urban settings. This finding appears to be consistent with research in economic development that shows most regional employment opportunities are taken by migrants rather than local residents.

If taxes and public services are perfectly capitalized into wages and rents, no effect would be expected on their coefficient signs with respect to population. This

statement holds true if perfect labor and capital mobility exist. It is factor mobility that serves as a mechanism that to transmit fiscal service changes into price changes. However, if the economy is in disequilibrium at any point at any point in time, then this statement will not hold true. Disequilibrium implies that labor or capital mobility has not occurred fast enough to erase or eliminate the benefits of an amenity shock. A wedge exists between wage/rent prices and amenities that is the catalyst for a continued movement of households.

The most likely amenities that affect household location are parks and recreation and school spending. Households are expected to place a positive value on local access to open space and parks and education spending is at least partially correlated with student achievement. According to previous research, general government spending, highway and road spending and public safety spending may have a positive or negative effect on population location. Public health and welfare spending are likely to negatively influence household location since these characteristics are usually correlated with low-income and minority groups. Although not directly measured here, it must be acknowledged that race and income often serve as negative deterrents to the location of high and middle income households. This effect may or may not appear in this model since we are using data aggregated across all income levels.

Traditionally, economic factors (wages and employment opportunities) were considered to be the most important determinants of population change. Households responded to regional differentials by moving to a new location or changing commuting patterns. The combination of wage differential and new jobs creates incentives for households to switch from current employment choices. Given the high degree of labor

market integration, we expect that households will respond to both their home county and regional employment opportunities. Households may not respond to wage differentials in their county of residence if the type of occupations or industries is not appropriate for the resident population. Ultimately, we believe household location will be relatively more driven by fixed amenities then employment opportunities. People will be attracted to the region based on employment opportunities, but will choose their county of residence based on amenities.

The wage and housing price equations were included because of widespread support for the notion that regional population and employment growth are not inframarginal changes with respect to locally derived prices such as wages and housing.

(22) Wage = F[amenity(-),road(-), parks(-), welfare(-), health(-),safety(-), Empf (-), industry shares(I), hpindexf(+), popf(+)]

(23) Hpindex = F[amenity(+), road(+), parks(+), welfare(-), health(I), safety (I), school(+), popf(+), permits(-), vacancy(-), metropop(+), income(+)]

In fact, quantity changes are very much part of the story in determining local price changes and vice versa. However, the story does not end there. Due to the dynamic and open nature of regional economies, changes in relative price differences reflect population and employment change and part of the difference does not. As explained before, households are postulated to only respond to the non-capitalized or residual portion of housing prices and wages. Therefore, we have defined two variables for each factor in the population equation; nominal wages, residual wages, nominal housing prices and residual housing prices.

The wage equation represents an attempt to uncover the implicit prices or values that make up average annual wages in these Colorado counties. It is expressed in classic hedonic form with average annual wage as the dependent variable and attributes or characteristics as independent variables. The likely candidates for independent variables are general amenities, amenity shares, industrial shares, employment, as well as, the consumer price index as a measure of other local prices.

The housing price equation is also expressed as a classic hedonic function. The independent variables include general amenities, amenity shares, income, population, population squared (to proxy for population density and congestion), vacancy rates and housing permits. Housing prices, based on previous literature, are expected to vary positively with general amenities and amenity shares such as parks and recreation. However, the relationship between housing prices and other amenity are likely to be zero or negative.

Econometric Data

The following table (table 1) presents each of the dependent and independent variables in the model. Information provided includes the name of the variable, description of the variable, units and mean value. The text following the table describes each variable in more detail including source.

Table 1: Data Descriptive Statistics

Employment (empp)	Percentage change in own-county employment	%	4.63
Population (popp)	Percentage change in own-county population	%	3.36
Amenity	Change in own-county per capita total local government expenditures	$/capita	$22.3
Roads	Level of own-county share of government spending on roads	%	.198
Parks	Level of own-county share of government spending on parks, recreation and arts	%	.078
Judical	Level of own-county share of government spending on court and Judical services	%	.003
Health	Level of own-county share of government spending on public health services	%	.026
Welfare	Level of own-county share of government spending on federal welfare programs	%	.124
Safety	Level of own-county share of government spending on public safety- police and fire	%	.236
Government	Level of own-county share of government spending on general administration (excluded variable)	%	.335
Wages	Change in county's regionally indexed average wage.		-.0016
Wagef	Predicted Value from wage instrument equation		-.0019
Reswage	Residual from wage instrument equation		-.0006
Hpindexf	Predicted value from housing price instrument equation		.011
Housing prices (hpindex)	Change in county's regionally indexed average single family housing price.		.010
Reshp	Residual from housing price instrument equation		-12257.72
Extract	Change in share of own-county employment in agriculture and mining	%	.149
Cnstshare	Change in share of own-county employment in construction	%	-.247
Manshare	Change in share of own-county employment in manufacturing	%	-.007
Tcpushare	Change in share of own-county employment in transportation, communications and utilities	%	-.005
Whleshare	Change in share of own-county employment in wholesale	%	-.007
Retshare	Change in share of own-county employment in retail	%	.061
Fireshare	Change in share of own-county employment in finance	%	-.017
Sershare	Change in share of own-county employment in services	%	.013
Permits	Change in own-county residential housing permits	#	145.04
Vacancy	Change in own-county residential vacancy rate	%	-.014
Tax	Change in own-county per capita local government taxes	$/capita	35.77
CPI	Change in Denver-Boulder-Greely consumer price index relative to national consumer price index	index	1.033
School	Change in own-county per pupil education expenditures	$/pupil	352.39
Metroemp	Percentage change in regional employment	%	2.9
Metropop	Percentage change in regional population change	%	1.5
Income	Change in own-county per capita personal income	Thousands	-.004

The data for the wage variable is derived from the Colorado Department of Labor's ES-202 unemployment insurance file. This file provides average annual wage

data by county and by 2-digit SIC breakdown. In order to provide a measure of relative wages, each county's average annual wage was divided by a Denver metropolitan average annual wage. The index was based on a scale where a value of one indicated that the county had the same average annual wage as the metro area. This index was further altered by looking at changes in the index from one year to the next versus the index value itself. The average annual wage for the counties and the metro area represent a composite of all industry groups.

Income is another variable that has been used to measure local product demand in a region. Typically, it is assumed that a positive relationship will be found between employment location and income, particularly in non-basic industries that rely on local demand. The income effect is also related to the market pull of the particular industry. Almost every study surveyed here found the expected positive relationship between income and employment. This finding is one the strongest and most consistent across studies. The income variable was measured in a similar fashion to the wage variable. This data was derived from the Regional Economic Information System (REIS) created by the US Department of Commerce. The REIS database includes wage income from the State Department of Labor along with calculations for non-wage income, such as interest, dividends, rent, transfer payments and other income computed from a variety of sources. This variable was also indexed to the metro average and calculated as annual changes in per capita income.

Amenities, both natural and produced, are the other major factor driving population and employment change. These location specific factors determine the character of a specific place whether it be a neighborhood, city, county or state. In this

study, amenities are analyzed at the county level. County level amenities are the sum of county provided, municipal provided, special district provided and school district provided amenities. They are measured as per capita expenditures by each of these jurisdictions under a few general categories. Special district, municipal and county spending is divided into two variables, total per capita expenditures and a measure of shares of spending in a number of categories. These categories are general administration, public safety (fire and police), judicial (court and jail), recreation and culture, health (hospital and clinic), transportation and welfare. These categories are represented as shares of total spending by a jurisdiction. In this case, general government was excluded in estimation as the reference group.

The general amenity variable is measured as changes in per capita local government general fund expenditures. The first challenge was to reconcile all possible jurisdictions that lie within a county. In general, county government, municipal governments and special districts are the three major governments that overlay a county. Border problems, for example a city that covers more than one county, were handled by dividing the portion of the population in each county covered by the city by the total city population. These proportions were then used to divide up total government expenditures by county. Once this step was completed, each level of government was added up to provide the total amount of non-school local government spending. This was then calculated as annual changes in total local government spending

Industry shares may represent a key determinant of employment growth in a county. These shares are likely to capture important market structure differences across counties that account for differences in employment growth. Industry shares may proxy

for technological differences, "new economy" versus "old economy" counties, occupational makeup and other cross county differences. It is expected that counties with growing dependence on services and FIRE will experience higher employment growth as these industries have led national and state employment growth trends. Manufacturing, wholesale and other industries may be a drag on economies and represent slower job growth.

The data for industry shares comes from the Colorado Department of Labor's ES-202 unemployment insurance file. It is calculated by dividing the number of full time equivalent employees in a given industry group by the total employment for that county. This provides the ratio or proportion of employees in that industry versus all others. Again, this variable is calculated as the annual change in industry shares. The 2-digit SIC industries are used, including extractive (agriculture + mining), manufacturing, construction, transportation and communications, wholesale, retail, finance and insurance, services and government. Government employment is the excluded variable and represents the baseline for the other categories.

School spending is separate from other government spending. School governments are separate entities from county, city and special district governments and targeted towards a specific group of people, students. School spending in a county is the aggregate measure of revenues collected and expenditures undertaken by the responsible government agency. This number is then divided by total students in the county to give us per pupil spending in a given county. The variable was constructed this way because research has revealed that this is one of the indicators that households examine when

choosing where to reside. This is in contrast to the other fiscal amenities that are measured on a per capita basis.

The population variable was calculated using data from the State Demographers Office. As with the other variables, population represents the annual change in county population. It should be noted that for most Colorado counties, certainly the ones in this study, migration represents the bulk of population growth, and is a better of measure of economic forces, versus net births.

The metropolitan population and metropolitan employment variables are based on a composite number from all counties in the study region so it takes on the same value for all counties. Metro population is measured as the annual change in regional population; metro employment is measured as the annual change in regional employment. Both of these variables will be used to indicate the influence of the regional labor market on the county labor market. Metro population will appear in the employment equation and metro employment will appear in the population equation.

The housing variables, new permits and vacancy rates are used to reflect the supply side of the housing market. New permits represent the addition of housing stock on the market by builders and it is depicted as the annual change in single family housing permits by county. Vacancy rate is a measure of the amount of available supply from existing housing and it is measured as the annual change in the percent of the total housing stock that is available.

The consumer price index variable is used to control for non-housing inflation. It is calculated as an index number from one to zero. At one, the index is at a level where local and national prices are identical. Less than one, local prices are lower than national

prices. The index is also tracked as the annual change in the index value by county. For this particular variable, there is only one measure of local price inflation, the Denver-Boulder-Greeley consumer price index, and therefore the number is the same for all counties.

The housing price variable was computed as an index variable. The metro average annual single family housing price was the base of the index. Each county's average annual single family housing price change was found and divided by the metro single family housing price average change to produce the index. An index value of one indicated that the county's housing price changes were the same as the metro average change. As expected, Boulder, Douglas and Jefferson counties had higher than metro average home price changes, while Adams, Denver, Weld and the rural county housing price changes were lower than the metro average change.

Study Region Description

The Denver labor market area presents an ideal case study for these hypotheses. Traditionally, the assumption has been that migration into this region was based on natural amenities such as mountain views and access to skiing and other recreational activities. Besides natural amenities, fiscal amenities are also an important potential driver in the region. Taxes and government spending vary across the region. In particular, the combination of fiscal spending and natural amenities may drive population growth. For example, Jefferson county and Boulder county have a dedicated sales tax that funds open space purchases and park maintenance.

However, the 1990's have witnessed an extraordinary period of economic expansion in Colorado. Most analysts believe that the current migration boom (almost

500,000 people since 1990 in metro Denver) is based on employment conditions and wages, rather than amenities. The region has generated an enormous amount of new, high paying jobs in sectors such as telecommunications, biotechnology and financial services. These base industries have contributed to even further growth in non-base industries like construction and retail services. Even in this environment, fiscal amenities may play a role in distributing growth across the region.

The study region is composed of the ten county Denver Labor Market Area: Jefferson, Arapahoe, Adams, Denver, Boulder, Elbert, Clear Creek, Park, Weld and Douglas. The labor market area population is 2.3 million with a personal income base of $66 billion (1997) and per capita income of $ 34,000. This region was selected because it represents a coherent economic area. Labor market flows based on commuting data show that these counties have significant, interdependent labor flows among them. Moreover, the federal and state government recognizes this region as an economic entity for expenditure purposes. Finally, these counties have a wide range of economic activity between them including agriculture, natural resources, industrial, services and retail and wholesale trade.

The state and Denver region have been experiencing rapid economic and population growth, which has strained both public and private resources. Although the most apparent contrasts of economic status are between the rural and urban areas of the state, there are even significant differences in employment, income and industrial structure among the ten counties of the Denver labor market area (Tables 2 and 3).

Table 2: 1997 Denver Labor Market Area Economic and Demographic Data

	315,944	462,958	261,584	8,868	499,229
	172,872	270,719	167,202	5,108	278,556
	146,254	301,602	186,464	3,889	518,754
	6,779,158	15,848,582	8,211,877	206,034	16,854,836
	21,457	34,233	31,393	23,829	33,727
	126,760	17,487	496,515	12,583	162,975
	66,824	9,837	299,004	7,456	80,037
	45,305	4,545	240,368	3,354	78,941
	4,343,334	365,126	14,645,526	239,572	2,930,552
	34,264	22,695	29,497	20,885	19,393

Table 3: 1997 Denver Labor Market Area Industrial Shares

	0.2%	1.0%	1.1%	0.6%	0.3%
	0.3%	0.3%	0.1%	13.3%	1.0%
	11.4%	6.8%	4.5%	5.8%	4.2%
	12.6%	5.4%	20.3%	2.2%	7.8%
	12.2%	8.3%	2.4%	1.8%	9.4%
	29.1%	23.7%	22.1%	29.3%	20.8%
	2.9%	10.6%	3.5%	2.8%	9.0%
	17.9%	33.4%	32.3%	26.1%	33.4%
	13.5%	10.5%	13.7%	15.6%	14.1%
	2.6%	26.0%	1.2%	8.3%	10.1%
	0.1%	0.0%	0.2%	0.4%	1.8%
	11.5%	17.9%	7.0%	17.9%	6.6%
	5.5%	3.4%	13.0%	2.2%	15.0%
	4.6%	1.3%	4.1%	5.6%	3.0%
	36.5%	11.1%	26.1%	17.8%	20.9%
	5.9%	3.6%	6.1%	3.6%	4.4%
	20.3%	17.8%	26.9%	22.7%	23.7%
	13.0%	18.9%	15.4%	21.7%	14.5%

An important question facing regional policymakers is the relative role of amenities, fiscal and natural, versus employment conditions in driving population and employment change. Given limited government resources, policymakers want to know the effects of different tax and spending policies on population and employment. One issue that continues to be debated is the role of the jobs-housing balance in creating

congestion conditions on area roads and leading to imbalanced counties. In one scenario, they may wish to prevent further population or employment growth. A second scenario is that communities may wish to encourage population or employment growth. Finally, a third scenario may involve a community trying to balance population and employment growth. For example, the City of Aurora is attempting to induce employment growth, while slowing further population growth. To what degree can a fiscal management strategy, for growth expansion or control, be effective?

Economic Linkages and Commuting

Theories about household and employment location decisions have often focused on issues surrounding interregional movement. Analysts examined the relative impact of employment opportunities and amenities on movement between rural-urban settings and between metropolitan areas. These types of location decisions are of an all-or-nothing nature. The household or firm must completely locate in one region or another. However, within labor market areas or commuting zones, households in particular can decide to live in one region and work in another. The ability to make these separate but related intraregional decisions implies a different type of outcome than the interregional models. These linkages between regions also imply that the economic fortunes of different cities, counties or other local areas will be tied together. This was one of the basic insights from the Alonso-Muth-Mills model.

Commuting represents the clearest labor market linkage among metro counties, and the degree of such flows is often much stronger than external flows such as goods and services trade. Employment growth in a local area may result in housing development in another area due to local price, amenity or availability differences. This

type of dispersed growth results in the need for commuting between local areas to balance labor supply and demand. Commuting is the adjustment mechanism that achieves this balance. Table 4 presents the Denver region's gross commuting flows.

Table 4: Denver Labor Market Area Commuting (1995)

	Adams	Arapahoe	Boulder	Denver	Douglas	Jefferson
Adams		15,083	10,507	46,477	1,121	16,883
Arapahoe	16,036		2,309	81,262	7,621	13,235
Boulder	6,774	3,160		11,228	102	7,176
Denver	11,436	41,834	3,276		2,105	18,554
Douglas	1,945	28,281	201	12,224		4,078
Jefferson	18,740	32,128	8,756	72,355	3,009	

Table 4 has to do with gross commuting flows based on the 1990 census and a survey by the Denver Regional Council of Governments (DRCOG). The table reveals that Denver County has many more jobs than people available to fill them. Arapahoe, with an edge city, and Boulder, with a university presence, are fairly balanced, while the suburban counties of Jefferson, Adams and Douglas face gross commuting leakages.

A different perspective on the degree of commuting or labor market linkages between counties is net commuting. This data is more readily available, but hides the fact that counties experiencing net in-commuting still potentially have significant gross out-migration flows. The same is true of net out-commuting counties that may have significant numbers of gross in-commuters. Nevertheless, net commuting figures are still

important from an overall perspective. Table 5 provides the net commuting figures for counties in the Denver labor market area.

Table 5: Net Commuting by County for Denver Labor Market Area

	1987	1997	1987	1997	1987	1997	1987	1997
	102,199	151,953	149,556	172,067	268,485	314,191	47,357	20,114
	195,807	313,744	209,902	268,939	382,074	464,320	14,095	-44,805
	129,688	190,556	127,738	165,686	218,024	264,975	-1,950	-24,870
	2,810	3,889	2,865	5,108	7,741	8,868	55	1,219
	477,124	525,652	267,510	273,178	492,049	517,194	-209,614	-252,474
	13,000	48,025	21,475	73,952	46,882	130,683	8,475	25,927
	3,536	4,545	4,138	9,837	8,817	17,487	602	5,292
	190,006	247,588	233,600	294,395	428,667	503,915	43,594	46,807
	1,860	3,354	3,278	7,456	6,823	12,583	1,418	4,102
	57,050	78,941	66,263	80,037	131,713	162,975	9,213	1,096

These commuting linkages that define the Denver labor market area imply that one county's fiscal policies may have an effect on another county's economy. For example, employment centers such as Arapahoe, Boulder or Denver may continue to encourage business growth at the expense of residential growth. Given the extremely tight status of local labor markets, new migrants will be required to fill these jobs. Counties such as Jefferson, Elbert, Park, Adams and Douglas are likely recipients of these households. In developing an empirical model, these regional linkages will need to be specified and tested.

Econometric Estimation and Specification Issues

Population and employment equations were the main focus of this research. Further, the theoretical expectation was that both wages and housing prices would be endogenous in this system and require separate equations. The general estimation strategy was a pooled cross sectional-time series simultaneous equations model using the

four dependent variables described in the last chapter. All variables were first-differenced to examine changes, except for the amenity share variables, since levels were expected to be more relevant for those factors.

There are four main issues regarding this type of estimation structure: 1) variables in changes or levels; 2) fixed or random effects; 3) choice of specific or common coefficients; and, 4) Hausman tests.

One major discussion revolves around the changes versus level argument. Some analysts have argued that the level model is more appropriate. When corporations or businesses decide to locate employment and facilities, they are looking at the general differences between regions not changes in those differences. However, others have suggested that particularly, in the case of non-base employment, such as retail trade, financial services and other services there is now more interest in changes in community differences. For this research, the changes approach was used for most variables, while the amenity share variables were specified in levels. This choice was made because we wanted to examine the reasons for changes in differences across counties.

The second major issue is the use of fixed or random effects. In specifying a panel data model, the analyst must typically choose between fixed effects and random effects (random variables). There are two types of characteristics that will vary across counties: county effects and time effects. To argue that these are fixed effects is to argue that the estimates are conditional based on the chosen sample. However, while random effects models may provide more efficient estimators, there are number of underlying assumptions that characterize the difference between fixed and random effect models.

The random effects model assumes that these variables are independently and identically distributed. Further, this specification assumes that the random effects are independent of the error term. Given the differences between counties over time periods, it seems unlikely that they are drawn from the same distribution (independent). Over this time period, major industrial restructuring, population growth and demographic changes occurred at various rates and conditions to different counties.

Finally, even if the stochastic requirements were met, the question of fixed versus random effects ultimately is a question of the generalizability of results. Because fixed effects model are conditional on the sample, they are useful for generating estimates about the particular area or group of people. Random effect models, with their unconditional results, are more appropriate for generalized results. It should be noted that as the number of time periods in the sample rises, random effects models converge to fixed effects models. Our time period covers thirteen years which is considered relatively large. Further, we are interested in developing the specification principles for this type regional growth model. Our concern is not with generalizing results to other metro or nonmetro areas and we do not believe, that results would be generalizable to other areas.

The first and second econometric estimation issues are interrelated. Despite the arguments for fixed effects, in fact, it is somewhat of a moot point. Since the variables in the model were first-differenced, there is no need for fixed effects specification and random effects was ignored for this study. This implication can be derived from a standard generic representation of a panel data model.

$$(24) Y_{it} = B_0 + B_1X_{1it} + \ldots\ldots + B_kX_{kit} + V_{it}$$

where:

$$V_{it} = \alpha_{it} + \mu_{it}$$

$$i = 1\ldots\ldots n$$

$$t = 1\ldots\ldots T$$

$$(25) \text{First Difference: } Y_{it} - Y_{it-1} = (B_0 - B_0) + (B_1X_{1it} - B_1X_{1it-1}) + (V_{it} - V_{it-1})$$

where:

$$(V_{it} - V_{it-1}) = a_i + \alpha_{it} - a_i + \alpha_{it-1}$$

$$(V_{it} - V_{it-1}) = \alpha_{it} - \alpha_{it-1}$$

With the first-difference specification, the fixed effect (a_i) falls out or becomes unnecessary. If fixed effects are used in a first difference model, they represent unit-specific (county) time trends. The equations were first estimated using fixed effects to determine if unit-specific time trends existed in the data. In cases where these existed, a unit-specific dummy variable was included to account for the time trend.

The choice of common or specific coefficients relates to the degree of detail desired in the results. With county specific coefficients, one can determine the results for a particular county for a particular variable. Otherwise, with common coefficients, the results are a mix of cross-county effects. For this research, the common coefficient approach was used. One problem is the use of county specific coefficients quickly uses up many degrees of freedom. Further research could be conducted on individual county effects.

First differencing removes the problem of bias between independent variables and fixed effects in the error term, but it does not completely eliminate the contemporaneous

correlation problem with the error term. Given the potential simultaneous structure of the equations, Hausman tests were performed to determine where appropriate instrument variables were needed to avoid statistical bias. The results of Hausman simultaneity test results in light of the type of model being proposed will be examined (see appendix 2 for Hausman results).

Besides these econometric issues, a number of other specification issues have been raised in the literature. The following list is a compilation and summary of the key empirical issues surrounding the role of government taxes and spending in regional economies:

(1) **Govt. Budget Constraint.** Changes in taxes or expenditures must be met by corresponding changes in the other category. Studies that have incorporated both sides of the government budget equation result find different results than those that only include one side of the equation.

(2) **Average versus Marginal Effect.** Many studies only examine the average effect of taxes or expenditures on business activity. However, households or businesses moving into a region will face the marginal not average government rates.

(3) **Endogenity of Taxes and Expenditures.** Government taxes and expenditures not only affect the economy, but may in turn be affected by economic performance. Treating government as exogenous may lead to specification bias.

(4) **Service quality vs. spending.** Government spending may not capture the actual effectiveness of government programs and services. Spending may be

high due to low productivity or to offset a rising problem. For example, high crime may force a government to spend more on public safety in an attempt to simply keep pace with the problem rather than actually reducing crime levels.

(5) **Amenity Capitalization into Wages and Rents.** In theory, government services are explicitly priced via taxes or fees. Therefore, no implicit pricing should exist in the form of higher rents or lower wages, as would be the case with natural amenities. However, empirical research has revealed that government services are capitalized into wages and rents. This is most likely due to the fact that local governments do not use marginal tax rates , but rather average tax rates.

(6) **Spatial Spillover.** Due to the fluidity of borders in the US, people are able to live in one locality and consume resources in another locality including jobs and location based amenities. A government in one region may expend resources that will have a positive (spread) or negative (backwash) effect on another community.

(7) **Public Services as Consumer Amenity and Business Input.** Pure and produced amenities may act both as an unpaid input to businesses and/or consumer amenities. The relative strength of these two effects may determine the outcome of higher or lower wages in a region when a positive amenity shock occurs.

(8) **Policy time lags.** Given the often long delay between fiscal changes and changes in business or residential activity, the econometric equations should take delays into account.

The system of equations specified for this project will address some, although not all of these issues. The strengths and weaknesses of our system will be illustrated relative to these principles. The government budget constraint is accounted for in this system while both taxes and public spending are included as independent variables in the population and employment equations.

In this study, we use average taxes versus marginal taxes. Due to the aggregate nature of the data collected here, the average tax rate is more appropriate as we are not analyzing the decisions of a single firm or representative firm. One can argue that existing firms facing average tax rates, rather than the location of entirely new firms facing the marginal tax rate, often generate employment growth.

Taxes and local public spending are held exogenous in this system of equations. This specification was based on a Hausman exogenity test for public services and taxes. This test found that these variables are exogenous relative to population and employment change. A note should be made here that we are using tax revenues rather than tax rates.

Service spending is used instead of service quality. The quality of public services is often difficult to measure and data collection in this area remains scant, particularly for a study involving time series data. Public safety is a key area where spending and quality are often at odds with one another. As mentioned previously, a community may expend resources when crime is high in an attempt to combat it.

The issue of amenities as productive business services rather than consumer amenities is directly addressed in this study. As acknowledged in the Mathur and Stein work, it is critical to assess the nature and relative strength of these relationships. If the business service effect dominates, wages will tend to be higher in the face of an amenity

improvement. On the other hand, if the consumer amenity effect dominates, wages will be lower as households are attracted to the region and the labor supply curve shifts out. The wage-amenity coefficient in the hedonic wage equation will help determine which of these hypotheses holds true. A positive coefficient would indicate that the business service effect dominates while a negative coefficient would indicate that the consumer amenity effect dominates. This relationship will be important in determining the ultimate relationship between amenities and population and employment change.

Gyorko and Tracy (1989, 1991) were the first to empirically verify fiscal amenity capitalization. They discovered that similar to natural amenities, fiscal amenities also led to wage and rent capitalization. This was contrary to popular belief that taxes accounted for the full price of fiscal amenities and no wage and rent capitalization would occur. Wage and rent equations are specified in this system and will measure the degree of capitalization.

Spatial spillover from fiscal amenities involves the fact that people in labor market areas or metropolitan areas are often willing to reside in one area close to amenities but not in the same county. This has been one of the major factors behind the suburbanization of America since World War II. People recognized that they could live in one part of the metropolitan and consume amenities in the central city such as museums, theatre, sports stadiums and others. These types of amenities are often based on public financing. However, suburban residents could avoid the high taxes and negative fiscal amenities such as welfare spending, public health spending and public safety. In some cases, such as Detroit, MI, many of the fiscal and cultural amenities left the city and moved to the more affluent suburbs.

In econometric terms, these spillovers are difficult to measure and estimate. Some progress has been made in spatial econometrics and the author recognizes that these may be more important longer-term next steps in this research project. The regional population change and regional employment change are independent variables in the county employment equation and the county population equation. Using this specification, amenity spillovers are ignored, but employment and population spillovers are taken into account.

Chapter 4 Results and Discussion

An attempt will be made to provide context and explanation behind the econometric results as well as their relationship to the Mathur and Stein (1993) framework presented earlier. The research hypotheses were: 1) fiscal amenities will have a positive effect on population growth 2) fiscal amenities will have an insignificant and/or negative effect on employment growth. The secondary hypothesis was that households and businesses are more concerned with regional employment and population than own-county employment and population from the Mathur and Stein framework. If the propositions from the Mathur and Stein framework are supported by empirical evidence, the implication is that households value amenity gain more than employment losses. In general, the results provide some evidence in favor of these research hypotheses. Also, some interesting and unexpected results appeared in the model which will be discussed in this chapter.

Our original objective was to determine the factors driving population and employment growth for counties in the Denver labor market area. This region includes core urban, suburban and rural counties. In determining the factors behind regional growth, it was recognized that growth could occur due to internal redistribution of population and employment between counties in the labor market area, as well as, counties outside of the labor market area. Given the Mathur and Stein model, it was also recognized that wages and housing prices might be simultaneously related and

endogenous with population and employment growth. In fact, the Hausman specification test provided evidence for this type of relationship. Accordingly, wage and housing price equations were specified. As growth occurs, there is a direct and indirect effect on wages and housing prices, which in turn leads to further changes in population and employment growth.[1]

Relative Housing Price Change Equation

The results discussion will begin with the housing price equation. The housing price equation has an R-squared of .51 and the F-statistic indicates overall significance at the .01 level. The Hausman tests indicated that population was simultaneously related to housing prices, so it was inserted into the housing price equation using an instrumental variable approach. All exogenous variables in the system were regressed against population. This instrument was then used in the housing price equation, which is analogous to the two-stage least squares approach. Based on the Durbin-Watson test, an AR(1) term was added. The term was negative and significant at the .01 level.

As expected, population growth leads to higher housing prices since it represents a demand shift factor for the housing demand schedule. Due to the inelastic nature of housing supply (especially in the short run), demand is likely to outstrip supply especially in periods of economic expansion. Specifically, Colorado has experienced a very strong economy in the 1990's, so experts have recognized that housing prices have risen as demand outperforms supply. Table 6 provides the results for the housing price equation.

Table 6: Housing Price Equation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.053365	0.053348	1.000317	0.3197
ROADS1?	-0.030474	0.080537	-0.378380	0.7060
PARKS1?	0.373276	0.100755	3.704793	0.0004
WELFARE1?	-0.320137	0.088354	-3.623356	0.0005
HEALTH1?	-0.492481	0.223526	-2.203243	0.0300
SAFETY1?	-0.029581	0.116224	-0.254517	0.7996
SCHOOL?	7.98E-06	5.84E-06	1.365203	0.1754
TAX?	6.90E-05	8.41E-05	0.819985	0.4143
JUDICAL1?	-0.762310	0.522451	-1.459104	0.1478
VACANCY?	0.006187	0.033648	0.183886	0.8545
PERMITS?	1.26E-06	6.19E-06	0.203457	0.8392
POPPF?	0.001402	0.002733	0.513060	0.6091
AMENITY?	0.000236	0.000105	2.257499	0.0262
AR(1)	-0.339808	0.105655	-3.216220	0.0018

A critical question is the degree to which housing prices represent the implicit valuation of local amenities for households. The amenity share variables reveal the degree to which different types of spending affect housing prices. Parks spending is the one category that raises housing prices, which is not an unexpected result given the expected value people place on green and open spaces near their homes. Yet, welfare and health spending reduce housing price growth. Since these variables may serve as an indicator of sociodemograhpic challenges for a county. Also, the results may represent the spillover effect as households in one county can easily travel to and consume necessary services in another county. It should be noted that welfare, safety and road spending have all been found in the past to potentially reduce housing prices.

This study found that per pupil school funding is positively correlated with housing price growth. Many studies have attempted to use differences in housing prices as a reflection of school quality. Not suprisingly, higher income districts can afford to spend more on schools, since spending is at least partially correlated with student achievement and people are willing to pay the costs for better schools.

Vacancy rates and housing permits are supply curve shift factors that should be negatively correlated with housing prices, since they indicate supply is increasing on the market. In this case, the permit and vacancy coefficients are positive, but statistically insignificant.

Taxes potentially raise the cost of building homes, and are part of the home payments made by households, thus they shift the housing demand and supply curves by reducing both demand and supply of housing. The empirical results indicate that taxes actually do have a positive effect on housing prices although the result is not significant. This finding, together with positive findings on amenities, may suggest households are willing to pay taxes if spent on ways important to them.

Relative Wage Change Equation

The wage equation was the weakest in explanatory power of the four equations. The R-squared was .33 and the F-statistic indicated overall significance at the .01 level. The Hausman test was used to determine that population and employment were simultaneously related to wages. As with the housing price equation, instrumental variables were used to correct this bias. A lagged version of the wage variable was added based on results from the Durbin-Watson statistic indicating autocorrelation. This term was positive, but only weakly significant with a p-value of .26.

Concerning the labor market, Mathur and Stein believed that wages would be positively related to population growth and employment growth due to agglomeration economies of scale. As growth occurs, households would view rising wages as a benefit of growth along with better employment opportunities. In this model, the results clearly demonstrate that for this region, wages and employment are positively correlated with

population growth. In a direct sense, households view more jobs and better wages with favor. However, the theory is contradicted with regard to population growth since the results indicate that higher county and regional population (metropop) lead to lower wage growth. This may be due to more traditional labor supply effects on wages.

The wage equation is specified as a classic hedonic function. Intraregional wage differentials are specified as a function of local attributes along with other characteristics that are likely affect such differences. A key empirical question is the degree to which wage differentials between counties are capitalized. If wage differentials are capitalized, population should not respond to those differences. The correlation between the general government spending variable and wage changes is a measure of capitalization. The wage residual, reflecting non-capitalized wages, was placed into the population equation to determine if this hypothesis is correct. Wage equation results are presented in Table 7.

Table 7: Wage Equation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.029208	0.026831	-1.088606	0.2793
AMENITY?	-9.86E-05	7.47E-05	-1.319075	0.1906
TAX?	-5.14E-06	4.10E-05	-0.125180	0.9007
ROADS1?	0.064833	0.041924	1.546424	0.1256
PARKS1?	0.153319	0.072592	2.112080	0.0375
WELFARE1?	0.040872	0.057930	0.705533	0.4823
HEALTH1?	-0.165045	0.154175	-1.070504	0.2873
SAFETY1?	0.012894	0.072683	0.177407	0.8596
JUDICAL1?	0.141227	0.330124	0.427799	0.6698
SCHOOL?	-5.11E-07	2.79E-06	-0.183537	0.8548
EMPPF?	0.003601	0.001589	2.266200	0.0259
EXTRACT?	0.001545	0.002405	0.642517	0.5222
METROPOP	-0.545936	0.347375	-1.571605	0.1196
CNSTSHARE?	-0.000814	0.002220	-0.366883	0.7146
TCPUSHARE?	0.004965	0.004915	1.010109	0.3152
WHLESHARE?	-0.044230	0.026064	-1.696999	0.0932
RETSHARE?	-0.001511	0.001661	-0.910148	0.3652
SERSHARE?	0.000444	0.003795	0.117069	0.9071
FIRESHARE?	-0.003837	0.010263	-0.373918	0.7094
MANSHARE?	-0.001325	0.002781	-0.476372	0.6350
POPPF?	-0.000536	0.003707	-0.144540	0.8854
WAGE?(-1)	0.113936	0.101247	1.125335	0.2635

In support of previous research, we find that wages are negatively correlated with total amenity spending and some amenity shares. In particular, public safety and public health spending are negatively and significantly correlated with wage growth. These results are also in agreement with the findings of the housing price equation. However, the results on amenity shares are not completely consistent. Roads, welfare and park spending lead to higher wages. This may be due to the perceived effect of different types of government spending on firm productivity and costs. The general conclusion is that amenities tend to depress wages, due to an influx of labor based on amenity demands, but a couple of spending categories are reflected as unpaid inputs to the production process.

Industry shares explain part of the variation in relative wage growth. Changes in the percentages of workers in wholesale industries lead to lower relative wage growth, while service industry shares are associated with higher wage growth. These results are consistent with other findings.

Population Change Equation

Generally, the population equation has relatively good diagnostics. The R-squared is .85 and the F-statistic indicates overall significance at the .01 level. The Hausman test indicated that wages, housing prices and employment were simultaneously related to population. As with the other equations, an instrumental variable approach was used. A lagged dependent variable was included based on the Durbin-Watson test. The term was negative and significant at the .01 level. In short, past population growth has a strong influence on current and future population growth.

Population growth is likely to be the result of residential factors together with access to jobs. Due to the difficulty of measuring spatial distance using county

boundaries, a strong relationship was assumed between county population and metro employment. Jobs would attract people to the general region, but not necessarily to a particular county. The choice of where to live would be driven by commuting time along with a host of other residential amenities including natural amenities and fiscal amenities and housing.

The population equation was specified to represent the factors that drive net migration into or out of a region. For the Denver regional economy, the late 1980's represented a time of net migration loss while the decade of the 1990's was one of tremendous population growth, due primarily to migration. Table 8 presents the population equation results.

Table 8: Population Equation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EMPPF?	0.159611	0.073937	2.158731	0.0338
HPINDEXF?	14.51070	8.168048	1.776520	0.0794
RESHP?	1.91E-05	1.00E-05	1.905081	0.0603
WAGEF?	-11.99357	10.03191	-1.195542	0.2353
RESWAGE?	22.83740	6.218914	3.672250	0.0004
PARKS1?	-3.503790	4.178137	-0.838601	0.4041
SCHOOL?	0.000266	0.000201	1.321703	0.1899
ROADS1?	2.669722	1.646605	1.621350	0.1088
HEALTH1?	3.360909	10.26358	0.327460	0.7442
JUDICAL1?	35.82940	22.86696	1.566863	0.1210
DV6?	2.093514	0.839075	2.495025	0.0146
DV9?	1.604959	0.627764	2.556627	0.0124
TAX?	-0.004619	0.002595	-1.780160	0.0788
SAFETY1?	-5.730186	3.078890	-1.861121	0.0663
WELFARE1?	4.678363	2.860710	1.635386	0.1058
METROEMP	3.802058	14.93362	0.254597	0.7997
POPP?(-1)	0.663919	0.073588	9.022063	0.0000
AMENITY?	-0.009678	0.003381	-2.862307	0.0053

The housing price instrument variable is positive and significant as is the residual housing price variable in the population equation. These variables account for equilibrium and disequilibirum factors in the housing market and the coefficients indicate

that these prices act as signals to households of regions where certain types of attributes are present. The housing price residual result indicates that the demand for housing is much stronger than even indicated by the hedonic equation. Higher housing prices are signals for some unspecified indicators in these counties. What at first glance may appear to be white noise may in fact be capturing unmeasureable amenity attractors in a county or region.

In the labor market, the instrument wage result is not significant, while the residual wage result is significant and positive. In line with the discussion of Clark and Cosgrove (1991), the residual wage result seems to represent compensation for other type of regional or human capital characteristics. To the extent that households are attracted to a county based on wages, those wage differentials may also indicate of some disequilibirum force in the labor market. Taxes, as expected, are a negative and significant influence on population growth.

The amenity variable is of key interest to the stated research objectives. General amenity spending is negative and significantly related to population growth. The negative result makes sense in the context of the often large degree of anti-tax sentiment in these counties and relatively larger interest and preferences for natural amenities (wilderness, open space and or less congestion and density). Suburban residents rely on core urban counties for many public services such as museums, large public libraries, zoos, conference centers and large urban parks, while many of the benefits of suburban living are captured in private markets such as shopping malls and newer and larger homes. Rural public services, especially in mountain communities of Park and Clear

Creek, may or may not be a population magnet, although higher spending is often required on snow removal and road maintenance.

Regarding population, it is unsurprising to find that counties in a region with strong employment growth also experienced greater own-county population growth. These two variables are strongly correlated to each other in almost every previous study. A very surprising result is the relative strength of own-county employment versus regional employment. Initially, the expectation was that, due to commuting linkages, regional employment would be more important. In fact, the own-county employment variable was highly significant while the regional employment variable was insignificant. This is true even with the regularity of commuting across county borders.

The dummy variables represent the counties of Park (dv9) and Elbert (dv6). These counties appear to have some a unique positive linear trend with regard to population growth. Both counties are rural, bedroom counties for their more urban counterparts. Even during the economic downturn of the late 1980's, they experienced population growth due to their offering of a rural lifestyle.

Employment Change Equation

The employment equation had a fairly good statistical and explanatory power. The adjusted R-squared was .58 and the overall F-statistic had a p-value of 0.0. Out of twenty-one independent variables, eight indicated a strong degree of statistical significance and five indicated weak degree of statistical significance. No signs of severe multicollinearity were detected using a cross correlation matrix. Autocorrelation problems were detected using the Durbin-Watson statistic and corrected using a lagged

version of the dependent variable. As with population, past employment growth strongly affects current employment growth. This may be partly due to an agglomeration effect.

Employment growth was expected to be a function of total metro population growth that represents potential labor force. Other factors include wages (cost of the labor force), unemployment and labor force participation (labor availability) and fiscal amenities and taxes. Taxes are likely to raise firm costs and detract from employment growth. The empirical question is what the taxes buy, and whether those goods and services are valued by firms as latent inputs into their production processes.

Employment growth was found to be significantly related to a number of industry share variables, income, residual wages, school spending, road spending, population, lagged employment and some of the fixed effects and exhibits many of the characteristics we expected. Employment results are provided in Table 9.

Table 9: Employment Equation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXTRACT?	0.660128	0.658750	1.002092	0.3190
CNSTSHARE?	0.016871	0.347533	0.048546	0.9614
MANSHARE?	1.359346	0.396447	3.428819	0.0009
RETSHARE?	0.575092	0.305233	1.884111	0.0628
WHLESHARE?	-10.19015	4.715844	-2.160832	0.0334
FIRESHARE?	3.581243	1.084593	3.301924	0.0014
SERSHARE?	1.540710	0.545845	2.822613	0.0059
WAGEF?	-4.229918	24.77402	-0.170740	0.8648
INCOME?	25.10834	21.55778	1.164700	0.2473
SCHOOL?	0.000904	0.000545	1.658947	0.1006
POPPF?	0.645360	0.554789	1.163252	0.2478
PARKS1?	8.615103	8.589641	1.002964	0.3186
ROADS1?	4.212266	3.897511	1.080758	0.2827
HEALTH1?	-16.71060	18.53957	-0.901348	0.3698
WELFARE1?	-9.659234	9.091361	-1.062463	0.2909
SAFETY1?	5.285478	7.334579	0.720625	0.4730
METROPOP	-5.923389	48.14303	-0.123037	0.9024
HPINDEX?	-6.868202	4.102656	-1.674087	0.0976
AMENITY?	-0.004207	0.009549	-0.440534	0.6606
TAX?	0.003406	0.006873	0.495561	0.6214
EMPP?(-1)	0.470108	0.090967	5.167886	0.0000

Industry shares played an important role in explaining employment growth. Services, finance, retail, manufacturing, construction and extraction were all significant and positively related to employment growth. The service, manufacturing and finance industries had particularly strong results. This result seems consistent with the relatively high proportion of job growth in sectors such as business services, health care, software and computer services in the Denver regional economy. The extractive industry finding is more puzzling as this industry has been generally stagnant. However, in certain cases, growth has occurred in some the of oil and gas sub-industries. Most of the other industry share variables were statistically insignificant.

Wages and income were used to represent two facets of employment change. Wages are the cost of doing business for a firm, so we would expect higher wages to repel firm growth. However, income also represents demand side factors such as disposable income available in a particular county. Previous research has demonstrated a strong link between employment growth and income. Income is close to statistically significant and positive in our model. Wages, constructed as an instrument variable, is negative but not statistically significant.

The effect of amenities on employment change was negative, but not significant. This finding coincides with the wage findings. This finding indicates that there is no relationship between these variables which is supported by a large body of evidence indicating that public services are generally not a latent input for firms.

However, certain types of spending, such as roads, may in fact lower costs. Some evidence in the employment equation points to the possible productive role of fiscal amenities. Road and safety spending are positively correlated with employment

growth although not significant. Welfare and health spending are negatively correlated with employment growth although also not significant. School spending is in fact positively associated with employment growth. It is difficult to decide the exact relation between these two variables especially given the potentially long time lag between K-12 education and employment except that it may attract families who prioritize education

Employment was found to be an important determinant of population growth. However, evidence is weaker for the causality in this direction. Own-county population growth appears to have some positive effect on employment growth, but regional population growth has a positive, but highly insignificant effect on employment. Apparently, employers are concerned about the local availability of workers in deciding where to locate or grow.

An important difference between previous empirical studies and this one is the use of residual wages and housing prices as explanatory variables in population and employment growth equations. The majority of previous studies simply ignored the possibility of endogenous wages and housing prices. Residual wages are the remnants of what could not be explained from the hedonic wage equation. The hypothesis is that if all effects on wages can be stripped, then the remaining effect is the true residual or wedge between the implicit price in the market and participant willingness to pay. A zero residual would imply perfect correlation or even explanation and no wedge would exist for the movement of population or employment. It was hypothesized in chapter one that households would only respond to residual wage and not the hedonic or capitalized wage. Businesses on the other hand are likely to respond to the nominal wage that represents the

businesses cost of production. In this equation, businesses do not respond to the residual wage, but rather, the nominal wage.

Chapter 5 Summary and Conclusion

This research study began with a discussion of two opposing theories of regional growth and migration. One school of thought is that real wages and employment conditions drive growth, while the other school of thought believes that amenities, natural and fiscal amenities drive regional change. It was further acknowledged that within a labor market area, these dynamics are likely to be different than in an interregional setting. The commuting effect implies that households and employers will look across county lines and make different work and residence choices. In this setting, fiscal amenities may exhibit an effect on regional change relative to employment conditions. If this is the case, economic development and growth control strategies must take these interdependencies into account.

The focus here concerned the relative role of local government fiscal amenities (revenues and expenditures) in changing the patterns of employment and population growth. The general finding in this study is that public service spending (fiscal amenities) has a mixed effect on population and employment change. The empirical results revealed a lack of strong results, positive or negative, for population and employment growth. Still, this result is not unexpected; much of the previous empirical work found similar results. A more interesting result was that, after accounting for wage and housing price capitalization, these disequilibrium forces were major factors influencing population and employment growth. Providing support for the disequilibrium literature, wages are a

positive attractor for population into a county. On the other hand, support for the equilibrium literature was found in the housing price equation. After accounting for capitalization, higher housing prices were found to attract households. Higher prices may be signals of broader housing quality or other community characteristics potentially missed which were not captured in this model. For example some public cultural amenities, which are not as fixed as natural amenities, may be captured in this notion.

The results are interesting in that they provide a mixed picture regarding the equilibrium versus disequilibrium debate. Clearly, some capitalization of amenities and productivity (as well as disamenities) occurs in wages and rents. However, the capitalization is not complete and disequilibrium forces are present in both wages and housing prices. In fact, it is these disequilibrium forces that are influencing the Denver region's tremendous population and employment growth over the last decade.

The evidence presented also potentially supports the notion that both instrument variables and instrument residuals can be utilized in employment and population equations to analyze disequilibirum and equilibrium growth factors. Previous research has avoided this issue and potentially opened itself up to charges of omitted variable bias. In particular, previous simultaneous equations models have treated wages and housing prices as strictly exogenous variables. Also, amenities may be endogenous in some cases. The Hausman test for this model did not find evidence of this with local government fiscal amenities, but this may not be true in all cases.

It is possible that the results reflect data aggregation and county size. Fiscal management strategies may be better reflected at the municipal or even neighborhood level. Cities are generally more active participants in attracting businesses and/or

households. Counties tend to be more reactive, especially in metropolitan regions. Also, the aggregation of taxes and spending misses the use of abatements and tax breaks for specific businesses or developments.

Empirical support for the Mathur and Stein framework was also found. Amenities did lead to lower wages, and in some cases, higher housing prices. However, Mathur and Stein did not recognize the potential for amenities having a negative effect on population. This result could be handled in their framework by adding an equation for amenities. The Hausman tests did support their contention that population, employment, housing prices, and wages should all be explained in contrast to previous studies.

For Denver communities, the basic insight is that fiscal amenities do not have the expected relationship assumed in many policy and academic circles. It appears that traditional economic models based on disequilibrium notions, for example that migration moves in response to regional differentials, are generally more appropriate. This statement is true with the caveat that some degree of capitalization does occur between fiscal and natural amenities and wages and housing prices. The growing body of evidence also points to the possibility that higher housing prices may signal quality in the market and attract households. Researchers must be careful to assess whether housing prices reflect cost-of-living differences or cost-of-benefit differences.

As for economic development and growth control strategies, the results seem to imply that it depends on where a county is located in the geography of the labor market area. Growth in rural counties appears to be driven by concerns other than fiscal amenities. In some cases, growth control may be achieved through a greater provision of government services and higher taxes. In suburban counties, the evidence points to

similar conditions. Growth is driven by suburban edge-city employment centers or residential neighborhood qualities as measured by housing residuals. The urban core appears to be the place where fiscal amenities can drive growth. This fits with the general picture of the region where Denver county has driven growth through large scale, public-funded projects.

These results are also suggestive for work in general equilibrium modeling and other types of simulation approaches, such as input output analysis. Frequently, CGE models are based on a notion that households and businesses respond to regional differences in deciding where to locate. These decisions, in turn, are often modeled as affecting wages and land prices that in turn affects growth. However, one problem with CGE specifications is that they do not account for the fact that fixed location amenities may in fact be capitalized, in part, by wage or land price differentials. In this case, people or households will not respond to these differentials. Further, differentials will not be completely arbitraged away by the movement of households and firms.

The effectiveness of input-output analysis does not come out very favorably based on the evidence presented in this study. Its assumptions about perfectly elastic labor supply and no feedback effects with respect to prices are particularly questionable given the state of the literature. Although this study was focused on urban, suburban and rural counties, in fact the reality of wage and land price effects may be even more severe in a rural economy (Kilkenny, 1998).

The location-specificity of publicly provided amenities is also an issue that is difficult to integrate into migration decisions, and thus, regional impact analysis. Although there are numerous public goods that are exclusive to residents of a jurisdiction

(schools and fire districts), there are also those that similarly benefit those employed or visiting the area (roads, parks and open spaces) even though they may not contribute to the tax base. Future work in this project will look at how to integrate a distance function into the migration decision related to such variables. It is also possible that a fiscal management strategy, especially one that attracts population and even employment, exists at the sub-county level. Unfortunately, time series economic data does not exist for these communities.

Another possible extension, suggested in Mathur and Stein (1993), is the endogenous impact of population and firm growth on the direct value of amenities. One could test whether other types of amenities, natural amenities or even disamneities such as congestion, are endogenous and provide another source of negative feedback on population and employment growth.

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APPENDIX 1: EQUATION RESULTS

Dependent Variable: HPINDEX?
Method: GLS (Cross Section Weights)
Date: 02/28/01 Time: 12:06
Sample: 1986 1997
Included observations: 12
Number of cross-sections used: 10
Total panel (balanced) observations: 110
Convergence achieved after 10 iteration(s)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.053365	0.053348	1.000317	0.3197
ROADS1?	-0.030474	0.080537	-0.378380	0.7060
PARKS1?	0.373276	0.100755	3.704793	0.0004
WELFARE1?	-0.320137	0.088354	-3.623356	0.0005
HEALTH1?	-0.492481	0.223526	-2.203243	0.0300
SAFETY1?	-0.029581	0.116224	-0.254517	0.7996
SCHOOL?	7.98E-06	5.84E-06	1.365203	0.1754
TAX?	6.90E-05	8.41E-05	0.819985	0.4143
JUDICAL1?	-0.762310	0.522451	-1.459104	0.1478
VACANCY?	0.006187	0.033648	0.183886	0.8545
PERMITS?	1.26E-06	6.19E-06	0.203457	0.8392
POPPF?	0.001402	0.002733	0.513060	0.6091
AMENITY?	0.000236	0.000105	2.257499	0.0262
AR(1)	-0.339808	0.105655	-3.216220	0.0018

Weighted Statistics			
R-squared	0.516180	Mean dependent var	0.020046
Adjusted R-squared	0.450663	S.D. dependent var	0.082606
S.E. of regression	0.061225	Sum squared resid	0.359857
Log likelihood	200.8412	F-statistic	7.878537
Durbin-Watson stat	1.847074	Prob(F-statistic)	0.000000

Unweighted Statistics			
R-squared	0.070984	Mean dependent var	0.009045
Adjusted R-squared	-0.054820	S.D. dependent var	0.059614
S.E. of regression	0.061226	Sum squared resid	0.359874
Durbin-Watson stat	1.303568		

Dependent Variable: WAGE?
Method: GLS (Cross Section Weights)
Date: 02/28/01 Time: 14:05
Sample: 1987 1997
Included observations: 11
Number of cross-sections used: 10
Total panel (balanced) observations: 110

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.029208	0.026831	-1.088606	0.2793
AMENITY?	-9.86E-05	7.47E-05	-1.319075	0.1906
TAX?	-5.14E-06	4.10E-05	-0.125180	0.9007
ROADS1?	0.064833	0.041924	1.546424	0.1256
PARKS1?	0.153319	0.072592	2.112080	0.0375
WELFARE1?	0.040872	0.057930	0.705533	0.4823
HEALTH1?	-0.165045	0.154175	-1.070504	0.2873
SAFETY1?	0.012894	0.072683	0.177407	0.8596
JUDICAL1?	0.141227	0.330124	0.427799	0.6698
SCHOOL?	-5.11E-07	2.79E-06	-0.183537	0.8548
EMPPF?	0.003601	0.001589	2.266200	0.0259
EXTRACT?	0.001545	0.002405	0.642517	0.5222
METROPOP	-0.545936	0.347375	-1.571605	0.1196
CNSTSHARE?	-0.000814	0.002220	-0.366883	0.7146
TCPUSHARE?	0.004965	0.004915	1.010109	0.3152
WHLESHARE?	-0.044230	0.026064	-1.696999	0.0932
RETSHARE?	-0.001511	0.001661	-0.910148	0.3652
SERSHARE?	0.000444	0.003795	0.117069	0.9071
FIRESHARE?	-0.003837	0.010263	-0.373918	0.7094
MANSHARE?	-0.001325	0.002781	-0.476372	0.6350
POPPF?	-0.000536	0.003707	-0.144540	0.8854
WAGE?(-1)	0.113936	0.101247	1.125335	0.2635

Weighted Statistics			
R-squared	0.332455	Mean dependent var	-0.001568
Adjusted R-squared	0.173154	S.D. dependent var	0.021505
S.E. of regression	0.019555	Sum squared resid	0.033651
Log likelihood	300.1541	F-statistic	2.086966
Durbin-Watson stat	2.153702	Prob(F-statistic)	0.009290

Unweighted Statistics			
R-squared	0.232022	Mean dependent var	-0.001545
Adjusted R-squared	0.048755	S.D. dependent var	0.021297
S.E. of regression	0.020771	Sum squared resid	0.037967
Durbin-Watson stat	2.026882		

Dependent Variable: POPP?
Method: GLS (Cross Section Weights)
Date: 02/28/01 Time: 14:48
Sample: 1988 1997
Included observations: 10
Number of cross-sections used: 10
Total panel (balanced) observations: 100

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EMPPF?	0.159611	0.073937	2.158731	0.0338
HPINDEXF?	14.51070	8.168048	1.776520	0.0794
RESHP?	1.91E-05	1.00E-05	1.905081	0.0603
WAGEF?	-11.99357	10.03191	-1.195542	0.2353
RESWAGE?	22.83740	6.218914	3.672250	0.0004
PARKS1?	-3.503790	4.178137	-0.838601	0.4041
SCHOOL?	0.000266	0.000201	1.321703	0.1899
ROADS1?	2.669722	1.646605	1.621350	0.1088
HEALTH1?	3.360909	10.26358	0.327460	0.7442
JUDICAL1?	35.82940	22.86696	1.566863	0.1210
DV6?	2.093514	0.839075	2.495025	0.0146
DV9?	1.604959	0.627764	2.556627	0.0124
TAX?	-0.004619	0.002595	-1.780160	0.0788
SAFETY1?	-5.730186	3.078890	-1.861121	0.0663
WELFARE1?	4.678363	2.860710	1.635386	0.1058
METROEMP	3.802058	14.93362	0.254597	0.7997
POPP?(-1)	0.663919	0.073588	9.022063	0.0000
AMENITY?	-0.009678	0.003381	-2.862307	0.0053

Weighted Statistics			
R-squared	0.833863	Mean dependent var	3.217946
Adjusted R-squared	0.799420	S.D. dependent var	2.819092
S.E. of regression	1.262562	Sum squared resid	130.7132
F-statistic	24.20997	Durbin-Watson stat	1.895258
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.887729	Mean dependent var	3.361080
Adjusted R-squared	0.864453	S.D. dependent var	3.763173
S.E. of regression	1.385477	Sum squared resid	157.4027
Durbin-Watson stat	1.853893		

Dependent Variable: EMPP?
Method: GLS (Cross Section Weights)
Date: 03/02/01 Time: 13:37
Sample: 1987 1997
Included observations: 11
Number of cross-sections used: 10
Total panel (balanced) observations: 110

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXTRACT?	0.660128	0.658750	1.002092	0.3190
CNSTSHARE?	0.016871	0.347533	0.048546	0.9614
MANSHARE?	1.359346	0.396447	3.428819	0.0009
RETSHARE?	0.575092	0.305233	1.884111	0.0628
WHLESHARE?	-10.19015	4.715844	-2.160832	0.0334
FIRESHARE?	3.581243	1.084593	3.301924	0.0014
SERSHARE?	1.540710	0.545845	2.822613	0.0059
WAGEF?	-4.229918	24.77402	-0.170740	0.8648
INCOME?	25.10834	21.55778	1.164700	0.2473
SCHOOL?	0.000904	0.000545	1.658947	0.1006
POPPF?	0.645360	0.554789	1.163252	0.2478
PARKS1?	8.615103	8.589641	1.002964	0.3186
ROADS1?	4.212266	3.897511	1.080758	0.2827
HEALTH1?	-16.71060	18.53957	-0.901348	0.3698
WELFARE1?	-9.659234	9.091361	-1.062463	0.2909
SAFETY1?	5.285478	7.334579	0.720625	0.4730
METROPOP	-5.923389	48.14303	-0.123037	0.9024
HPINDEX?	-6.868202	4.102656	-1.674087	0.0976
AMENITY?	-0.004207	0.009549	-0.440534	0.6606
TAX?	0.003406	0.006873	0.495561	0.6214
EMPP?(-1)	0.470108	0.090967	5.167886	0.0000

Weighted Statistics			
R-squared	0.557108	Mean dependent var	4.771705
Adjusted R-squared	0.457582	S.D. dependent var	4.545383
S.E. of regression	3.347632	Sum squared resid	997.3908
Log likelihood	-246.9893	F-statistic	5.597595
Durbin-Watson stat	2.095910	Prob(F-statistic)	0.000000

Unweighted Statistics			
R-squared	0.512580	Mean dependent var	4.391209
Adjusted R-squared	0.403047	S.D. dependent var	5.239507
S.E. of regression	4.048185	Sum squared resid	1458.515
Durbin-Watson stat	2.247036		

APPENDIX 2: HAUSMAN TEST RESULTS

Dependent variable

		+	+	+
	+		0	+
	+	0		0
	+	+	0	
	0	0	0	0
	0	0	0	0

+ Indicates rejection of null hypothesis- the potential instrument variable is not simultaneously related with independent variable; 0 indicates a failure to reject null hypothesis

APPENDIX 3: MATHUR AND STEIN FRAMEWORK

This appendix presents a chart that parallels the discussion in the text. Given all the assumptions made by Mathur and Stein in their framework, this chart allows for the interpretation of results based on the effect of exogenous amenity change on population and employment location.

Population (dP/dE)	Uncertain, employment losses weighed against amenity benefits	> 0, population growth
Employment (dN/dE)	< 0, employment losses	Uncertain, amenities reduce costs, while pop. growth raises costs