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THE ISSUE OF LABOR AVAILABILITY AS IT RELATES TO WESTERN ENERGY DEVELOPMENT

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ABSTRACT

The issue of labor availability for Western energy development deserves a more thorough analysis than it has received, given the scenarios that suggest a shortfall of labor to meet industry needs. An historical and economic framework is developed that enables such an analysis to take place. Labor and labor mobility are examined as they function in traditional economic theory and in the "real world." Examples of labor market failure and the theory of human capital formation provide the basis for the development of a model of labor migration that can be used in the Western energy labor market. Historical and empirical evidence show that labor migration is highly correlated with economic opportunity, but that personal characteristics and non-monetary considerations can outweigh monetary considerations. Both measurable and unmeasurable variables interact to affect the decision-making process, and these variables are described. The labor migration model developed in this thesis can be field-tested in the Western energy labor market using the hypotheses suggested in the final chapter.

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CHAPTER 1

LABOR AVAILABILITY FOR WESTERN ENERGY DEVELOPMENT--* AN INTRODUCTION

As the 1980's got underway, Western energy development continued to face an uncertain future. Labor problems and soft demand plagued the coal industry, and the bottom fell out of the uranium market. The synthetic fuels industry, buoyed by passage of the Energy Security Act in July 1980 and its $20 billion initial commitment toward development, faced possible deflation with the less-than-enthusiastic reception of the Reagan Administration. In the oil and gas industry, drilling was spurred by incentives, but high earnings of the larger companies led to hostility among Congress and certain segments of the public.

Even with this uncertainty, the current picture is one of relative optimism within the Western energy community. Coal operators are making plans to supply a growing export market. Oil and gas development proceeds at a frenetic pace in such areas as the Overthrust Belt. Oil shale companies continue predevelopment work, with several forecasting commercialization even without substantial government outlays.

The prognosis, then, is for continued growth in the Western energy industry, even in "worst possible case" scenarios. Because of this, it is time to begin examination of the constraints that may impede development at the rates and levels of growth that are being forecast. This thesis will examine one of those constraints.

The Issue of Labor Availability

The issue of labor availability has been given cursory review in recent studies of the Western energy industry. Yet it is an issue that portends serious problems as the industry attempts to attract and retain a stable workforce for construction and operation of plants and mines. Much of Western energy development will take place in remote, rural areas that do not have a large population base; the oil shale industry is a case in point, as initial development of the resource will take place in Colorado's 3,200-square mile Piceance Basin, a three-county area with only one city over 5,000 in population.[1] The Office of Technology Assessment assumes 1,200 construction workers and 1,600 operators will be required for each 50,000 barrel-per-day plant, with a population multiplier of 2.5 used for construction workers and 5.5 for operators.[2] One oil shale company vice president projected the need for 4,000 construction workers and 4,000 operators once his firm's 57,000 barrel-per-day operation reaches full scale.[3] The Exxon scenario of 15 million barrels of synthetic fuels a day by 2010--8 million of these associated with shale oil--assumes a labor force alone of 870,000 people.[4]

Western energy firms are recognizing the availablity problem. Occidental Oil Shale Vice President William McDermott said his company is more concerned about this problem than that of either capital or water availability. "The restriction is not so much on the capability of firms to do development work, but in the capability to get workers

[1]References are found at the end of each chapter.

to do it here," he said during a 1980 site visit.[5]

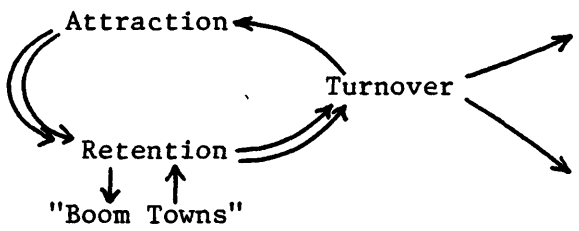
Officials from Bechtel and Fluor agree, according to a subsequent article in Business Week.[6] Bechtel estimates that an aggressive synfuels program to produce three million barrels of oil a day by the year 2000 would bring on severe shortages of manual labor in parts of the Great Plains states as well as in the Rocky Mountains, at least in part because of a growing reluctance among U.S. construction workers to relocate. This point is important in light of a recent Colorado study of energy employment forecasts. The state is pursuing a Jobs for Coloradans program, designed to make available a pool of trained resident employees to reduce the problems associated with massive in-migration of labor.[7] The study recognizes that "a backup strategy of guided importation" is needed, and should concentrate on states that have traditionally provided the state with new residents. As it turns out, this includes "our plains states neighbors to the east," the same area that is also expecting labor shortages caused by synthetic fuels development.

The national supply of labor is growing at a slower rate than it did in the past,[8] which is another consideration to take into account when studying labor availability. At the same time, attitudes toward relocation into remote areas require substantial investment by companies to provide the types of amenities that newcomers left in their previous place of residence.

This issue of labor can be examined from two standpoints--that of the attraction of the labor force itself, and that of the boom town problems, including high turnover rates, that accompany rapid growth in

energy areas. Attraction and retention are closely tied together, as the following figure shows.

FIGURE 1-1



A high turnover rate, based on the percentage of job vacancies that are refilled each year, implies a strong relationship between problems of labor availability and labor retention. Once a population base is established, retention becomes the more important problem; until then, the problem of enticement is primary.

The issue of labor in Western energy has been examined primarily in terms of the problems that result when growth is too rapid for easy accommodation by impacted communities; a well-documented case is that of Sweetwater County in southwestern Wyoming. There, impacts were felt most strongly in the early 1970's, when construction began on the Jim Bridger Power Plant east of Rock Springs.

> "Housing availability fell far short of demand. In 1974, between 4,500 and 5,000 families were living in mobile homes, many on scattered, isolated tracts in unincorporated parts of the county.
>
> These housing areas often lacked adequate water, sewer, and other facilities.
>
> Health care became a major problem. An estimated 40 percent of the residents had to seek medical care outside the county; the mental health clinic caseload expanded ninefold as alcoholism, suicide attempts, and divorce rates soared.

> Local government was overwhelmed with difficulties. Costs for capital construction of public facilities, such as water and sewer treatment plants, were greater than the communities' borrowing capacity, and demands for public services, such as fire and police protection, were beyond the available resources.
>
> Schools could not keep up with the pupil increases. The school districts were already bonded up to legal limit and were not able to provide the needed additional services.
>
> As a result of the boom town conditions, industry was unable to recruit and retain employees. Employee turnover in 1973 ranged from 35 to 100 percent, and productivity declined. Cost overruns resulted from construction delays."[9]

Impacts of these kinds of problems affected other industries in the county. A trona firm proved unsuccessful in its attempts to bring unemployed Eastern coal miners to Wyoming.[10] Once power plant construction ceased, the situation improved, but only to a degree. Even in 1980, four years after the power plant and its captive coal mine were opened, problems remained. The local government had taken care of many of the capital needs such as a hospital, schools, and a sewage treatment plant. Housing remained in short supply, however, even though 1980 population figures showed a stabilization since the boom years of the early 1970's. The production manager of Jim Bridger Coal Mine pointed with pride to the fact that turnover rates in 1980 decreased to 54 percent from 75 percent a year before.[11]

The problems of Sweetwater County cannot be taken lightly. Yet it is sobering to compare them with those expected in Colorado's oil shale industry. Sweetwater County's population grew from 18,391 in 1970 to 36,860 in 1974.[12] Even the scenarios based only on presently

planned development in northwestern Colorado show population growth at least two times that level. In the scenario based on a 500,000 barrel-per-day industry in 1990, eightfold population increases are forecast.[13] The growth-related problems in Sweetwater County were caused primarily by construction of one power plant. Each 50,000 barrel-per-day oil shale operation will require a similarly sized construction force, and it would take eight such plants in Colorado's Piceance Basin to comprise a 400,000 barrel-per-day industry.

Given the problems experienced in other Western energy growth centers and the concentrated nature of the oil shale resource, it is not unreasonable to expect the problem of labor availability to be a severe one. The problem will be compounded by growth in other sectors of the energy industry and the construction of the MX system in a western state. Gilmore believes that acceptance of growth, and willingness to assume the risks that accompany it, is no longer a characteristic of the West. Until the 1950's, he said, boom towns had always been accepted as desirable, because the newcomers retained "the century-old fantasy of hitting it rich."[14] That hope is gone today as mining has become dominated by the larger firms; and, in the case of oil shale, the deposit is well-delineated and leaves little room for small prospectors to cash in on the benefits.

Labor Availability as an Issue for Study

This thesis will provide the historical and economic framework required to address the issue of labor availability. Although initial energy industry employment will continue to come from the impacted

communities and neighboring areas, it is obvious that in-migration from other parts of the country will be essential if any of the high-growth scenarios become reality. Conventional economic theory assumes that wages are the primary motivating force behind labor mobility. This assumption is tested in an examination of two historical patterns of migration--the westward migration of the nineteenth century and the movement of the blacks from South to North in the first half of the twentieth century. A discussion of the economic theory of labor and labor mobility enables development of a labor migration model based on a number of empirical studies.

The issue of labor availability--and the assumption that labor migration will be required for Western energy forecasts to be met--is examined from the standpoint of the individual decision maker. Such an examination is necessary for the energy industry to be able to assess the ways in which its employment projections can be satisfied and production levels reached. Only by understanding the variables included in an individual's decision to migrate can firms efficiently recruit and retain a stable workforce. These variables are examined in detail in the following chapters.

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CHAPTER 2

LABOR MIGRATION IN THE UNITED STATES: AN ECONOMIC AND HISTORICAL OVERVIEW

Introduction

This chapter provides an economic and historical overview of labor migration in the United States. The inclusion of labor as a factor of production in economic theory is well-grounded in the literature, with perfect labor mobility the key to a perfectly functioning labor market. The economic overview will include a discussion of labor and labor mobility as they function both in a perfectly competitive market and in the "real world." Examples of labor market failure will provide the framework for the labor migration model that is developed in Chapter 3. The historical overview will describe the two most dominant migration movements in the United States, that of the advancing western frontier in the nineteenth century and that of the blacks from the rural South to the urban North in the first half of the twentieth century. These migrations show that, in an historical sense, labor migration is a function of economic opportunity.

Role of Labor in Economic Theory

The study of labor has a long history in classical and neoclassical economics. Along with land and capital, labor traditionally has been identified as one of the three factors of production, or "inputs used by business, in varying proportions, to produce goods and services."[1]

In preindustrial society, when agriculture was the major source of wealth, the land, with what Ricardo described as the "original and indestructible powers of the soil," was the major economic factor. With the advent of the Industrial Revolution, the capital requirements of a machine and technology-oriented economy became dominant. The increasing importance of the labor component in the twentieth century economy of the United States has led to the development of "manpower economics" as an area of study that has challenged and refined many of the historical assumptions about labor in economic theory.

Emphasis on quality, quantity and utilization of human resources in the economy has received growing attention for a number of reasons:

1) Economists recognized that traditional theory had no means to assess such market failures as labor-management conflicts, unionism, unemployment and underemployment.

2) Social scientists other than economists began to study the American worker as a social and political being; the results of much of their empirical research led economists to modify and refine their definition of the "rational economic man," and to incorporate the findings into economic theory and models.

3) Government interest in manpower planning during World War II increased in succeeding decades. Passage of the Manpower Development and Training Act of 1962, the emphasis of the civil rights movement on jobs and income rather than equal access issues, and President Johnson's declaration of war on poverty are evidence of this interest.

Economics is concerned with the efficient allocation of scarce resources among competing ends, and is defined as the "study of all factors of production." As such, Jakubauskas and Palomba's definition of manpower economics as the "study of human factors of production" is appropriate.[2] In some circles of study, the human being is viewed as both a factor and beneficiary of production, as a producer and consumer. Harbison describes human beings as "the active agents who accumulate capital, exploit natural resources, build social, economic, and political organizations, and carry forward national development."[3]

Characteristics of a Perfect Labor Market

Much of classical economic theory depends on the concept of a perfect labor market, which exhibits three characteristics:

1) A homogeneous labor force. Each worker is identical in terms of marketability, and employers are indifferent in deciding whom to hire to fill a vacancy. At the same time, there is a large enough number of both employees and employers that no worker or institution on the supply side has monopolistic or oligopolistic powers, and no employer or group of employers on the demand side has monopsonistic or oligopsonistic powers.

2) A fully mobile labor force. Perfect mobility is possible only with full and accurate information by every worker regarding alternative employment opportunities, working conditions and wages, and when no economic or social costs are involved.

3) An income-motivated labor force and profit-motivated employers.

Workers are motivated only by a desire to improve their economic positions, with non-wage considerations either non-existent or disregarded. Employers hire the workers willing to accept the lowest possible wages.

Such a perfect market results in one wage rate, where all workers obtain employment and all employers obtain an adequate labor force. Perfect mobility ensures market equilibrium when either the demand or supply side of the market fluctuates for any reason; neither surpluses nor scarcities of labor can exist for long periods of time.

The Concept of Mobility in Economic Theory

Kuznets' analysis of the link between geographic mobility and economic opportunity lends credence to the economist's view of labor described in the previous section. He cites evidence from a study of U.S. population redistribution between 1870 and 1910.

> "Internal migration and the redistribution of population by residence among various parts of the country are a major way in which people respond to changing economic opportunities emerging in the course of economic growth. Not all internal migration is in response to economic growth; and not all the opportunities emerging in the course of growth require a shift of residence to be converted into realized economic advance. But migration induced by growth that promises greater opportunities has been sufficiently massive in the presently advanced countries to warrant the view that the relation between population redistribution and economic development is an important and indispensable link in the mechanism of modern economic growth."[4]

The economic role of labor mobility is to shift workers from jobs in which the value of their marginal contribution to production is low to jobs in which it is higher. Geographic mobility, or labor migration

that involves a change of residence, is but one type of labor mobility. Industrial mobility refers to changes of employer, and occupational mobility involves changes in the type of work performed.[5] A move from one part of the country to another always involves geographical mobility, and may or may not involve industrial and occupational mobility as well. In a broader sense, mobility has been defined "to include changes of job, of employer, of occupation, of industry, of locality or region, and also changes of status, such as entrance to or exit from the labor market and shifts from employment to unemployment or vice versa."[6]

In studies that will be cited later in this study, mobility is measured by actual movement, although the term is theoretically characterized by "ability to move" or "propensity to move" as well. Ability to move involves the transferability of specific skills and the aptitudes and skills required for particular jobs, an important concept in determining the maximum potential flexibility of manpower in an economy. The propensity to move, or willingness of workers to make job changes, provides an indication of actual flexibility in a free enterprise economy's labor supply. Ability and propensity to move are theoretically appealing but almost impossible to measure; therefore, past patterns of labor movement provide the most useful basis for measuring labor mobility.[7]

Market Imperfections in "the Real World"

Later in this chapter, historical evidence will be cited that indicates the importance of economic opportunities in two large migration

movements (the westward movement and the migration of blacks out of the South). To the extent that the migrations took place, it can be argued that the labor market functioned according to economic theory. Evidence is also available to show that although the market can work well, it does not function perfectly for the following reasons:

1) Absence of homogeneity in the labor force. Neither all workers nor all employers can be alike, so there cannot be perfect substitutability or indifference on the part of either. Employers pay wage differentials to those workers with above-average skill and drive, experience and education. Because of preference, skill, education and experience, workers are not indifferent toward potential employers. In either case, "the willingness of many workers and employers to absorb the cost of their preferences is a major cause of labor market imperfection."[8]

2) Impediments to labor mobility. Economic and social costs, to be examined fully in the next chapter, do hinder a worker's ability and propensity to become mobile. In addition, workers characteristically have limited knowledge of employment alternatives, and decisions are characteristically made with imperfect information. Even so, workers do have a concept of what constitutes, for them, a "reasonable" wage or set of working conditions. Communication is also deficient between employers and the labor market, largely because of firms' inabilities to predict their future needs. (Fluctuations and discrepancies in employment projections for the oil shale industry, cited in Chapter 1, provide a prime example. In some cases, the problem is compounded when

employers do not disclose their needs even when they have the information at their disposal, or when institutions responsible for labor supply (colleges, training centers, unions) fail to respond to those needs.

3) Non-wage considerations. Preferential hiring, barriers to entry, union shops, and seniority promotions are evidence of employees' non-wage considerations. Traditional economic theory assumes that wages are the chief motivating factor leading to labor mobility, despite the fact that Alfred Marshall cautioned against the substitution of money earnings as labor's supply price ("...we must always understand that the term earnings is only used as a short expression for its 'net advantage'"[9]). Peitchinis more recently noted, "Economists have not paid adequate attention to the non-monetary factors bearing on labor mobility, in spite of the considerable evidence brought forth by sociologists of their importance to the worker."[10] These considerations will be discussed more fully in Chapter 3, where they will be used in development of a model for labor migration decisions.

An Historical View of Migration

A statistical analysis of 80 years of census data concluded that from 1870 to 1950, "net migration to and within the United States responded positively and significantly to decadal swings in economic activity, increasing in periods of prosperity and falling off during depression."[11] The results led Kuznets to ask the question:

> "How did growth of the population and the structural changes in production and consumption through which the rise in per capita product took place generate changing economic opportunities that induced and required internal migration and population redistribution?"[14]

His answer is threefold:

1) A rise in population numbers changes differential economic opportunities and induces migration if it occurs in a population settled in only part of a country's territory. As the land-man ratio decreases in the settled areas, a point is eventually reached where the differential attraction of a move to the less settled areas is great enough to offset the costs of pioneering.

2) Increasing populations in the areas of in-migration lead to economies of scale in transportation and division of labor, thus reducing costs of migration for subsequent waves of movers and leading to even further migration. Declining land-man ratios add to psychic costs of migration only when empty land is no longer available, and so they do not offset the reduced costs, at least in the early development stages.

3) Exploration of natural resources is prohibitively expensive when conducted from a distance, so an increasing population in a less settled area would be expected to increase nearby exploration activities, thus leading to discovery of new deposits or more accurate information about previously discovered deposits. This leads to even further migration activities.

Kuznets makes three assumptions in his analysis. First, potential

migrants are aware of the changes in differential opportunities, including the expected awareness of the increased costs of staying put and the less-expected awareness of the benefits of migration. Second, the perceived change in differential opportunities is large enough to overcome inertia and any margin of error in information. Third, differences in the rate of natural increase of the labor force are not enough to offset the effects of population increase on the differential opportunities; that is, that regardless of the rate of growth of the labor force, the resulting differential opportunities will still favor migration.[13]

The study of population migration in this country can essentially be characterized as a study of labor migration. The two types of migrants described by Shryock[14] are primary--those who make the decision to move for themselves and their families, and secondary--those whose migration is a result of someone else's decision to move. The total number of migrants at any one time will exceed the number of migrants who are actually members of the labor force,[15] since geographical moves involve minors and spouses who may not be employed at the time of the move.

The Westward Migration[16]

The dominant pattern of migration in the United States has long been the advancing western frontier, a pattern that was particularly evident in the last half of the nineteenth century. By 1870, the frontier had

pushed west of the Mississippi River to the fringe of the Great Plains, with 60 percent of the nation's three million square miles considered uninhabited (with fewer than two persons per square mile). Three major areas of settlement were identified beyond the frontier itself--one each along the eastern and western bases of the Rocky Mountains, and the third in the Pacific states. Together they included about 120,000 square miles and nine-tenths of the population west of the frontier.

Settlers in the most eastern band were first attracted in 1859 and 1860 when important mineral deposits were discovered in the eastern Rockies. They were followed by farmers enticed by the soil, water for irrigation, and the land disposal patterns of the federal government. Settlements were founded in a narrow band that stretched from southern Wyoming into central New Mexico. Mormons fleeing from Illinois in search of their "Promised Land" comprised the bulk of settlers in the second populated area that extended from southern Idaho to northern Arizona. This area developed as an agricultural economy, as church authorities discouraged mining as "tending to attract Gentile adventurers." [17] Further west still, the largest and oldest of the outlying settled areas was that of the Pacific states. Their growth was set off in 1848 by the discovery of gold and the rush of the Forty-niners.

The importance of U.S. land disposal policy can not be overstated in encouraging the westward expansion. Until about 1835, both the federal government and the states used the sale of public lands to generate

revenue and retire public debt. "At various times, and for lengthy periods, Congress seemed concerned with little besides the land question and the disposal of public lands was a leading issue in Congress for at least its first 75 years."[18] The end of the revenue-generating era was followed by active promotion of settlement and exploitation of public lands, explained in the following narrative:

> "The Homestead Act of 1862 and railroad land grant practices combined economic development incentives with geographic labor mobility incentives in a brief era where both converged upon the development of the hinterlands. Whether it was a primary or secondary goal of land policy, the net flow of migration was unmistakably toward previously undeveloped areas for several decades."[19]

The most spectacular growth from 1870 to 1880 occurred as a result of discovery of silver near Leadville, Colorado. The settled lands grew from 1.27 to 1.57 million square miles, the result of railroad expansion, agricultural growth in the Midwest and cattle and sheep grazing on the plains. The year 1890 is of special importance in the study of population redistribution, because that is the year the frontier is said to have disappeared. A special report of the Bureau of the Census contained this passage by Frederick Jackson Turner: "Up to and including 1880 the country had a frontier of settlement, but at present the unsettled area had been so broken into by isolated bodies of settlement that there can hardly be said to be a frontier line."[20]

The following table shows the relative growth of that part of the United States that lies west of the Mississippi River from 1870 to 1910.

TABLE 2-1
Population East and West of the Mississippi River
1870 to 1910

	Population (thousands)		Percent Increase		Percent U.S. Total	
	East	West	East	West	East	West
1870	32,714	7,104	--	--	82.2	17.8
1880	38,896	11,259	18.9	58.5	77.6	22.0
1890	46,172	16,775	18.7	49.0	73.4	26.6
1900	55,024	20,971	19.2	25.0	72.4	27.6
1910	64,724	27,248	17.6	29.9	70.4	29.6

SOURCE: Census of 1950, Volume I, United States Summary, Table 6

The following table also indicates the pattern of westward expansion.

TABLE 2-2
Population of Five Western States*
(in thousands) 1870-1910

1870	1880	1890	1900	1910
171	431	918	1,314	2,020

Percent Change in Population
Five Western States*
1870-1910

1870-1880	1880-1890	1890-1900	1900-1910
151.4	113.1	43.1	53.7

*Colorado, Utah, Wyoming, Montana, Idaho

SOURCE: Population Distribution and Economic Growth, Vol. III, p. 10-11

The Move North[21]

Because native whites comprise the bulk of the U.S. population--and because the westward expansion was essentially a migration of whites--data for the entire population can easily mask a second major migration,

that of blacks out of the South. Net out-migration from the South increased abruptly for both native whites and blacks from 1910-1920, the decade of World War I. In all but two decades following 1890, the shift was disproportionately the result of the migration of blacks, who moved primarily to the North and North Central regions of the country (specifically, to the District of Columbia; Subregion N-3: New York, New Jersey and Pennsylvania; and Subregion C-1: Michigan, Ohio, Indiana, Illinois and Wisconsin). Not only was the movement of blacks from the South generally heavier than for whites, but the preferred states of destination were often states of net out-migration for native whites, as shown in the following table.

TABLE 2-3
Net Migration: Subregions N-3 and C-1

	Native whites	Blacks
1870-1880	- 815	47
1880-1890	- 720	64
1890-1900	44	156
1900-1910	- 644	153
1910-1920	256	428
1920-1930	396	779
1930-1940	- 233	324
1940-1950	- 977	1,040

SOURCE: Population Redistribution and Economic Growth, Vol. III, p. 93

Black migration northward was stimulated with the end to immigration during World War I and the sharp expansion of wartime manpower needs. Northern employers turned to the South and especially to the blacks to fill the void, and a boll weevil epidemic in the cotton fields further facilitated this movement.[22] By 1940, two-thirds of all black workers were in nonfarm occupations, compared to one-half in 1910. By 1960,

there were nearly 73 percent living in urban areas (including those in the South), compared to 27 percent in 1910.[23]

Conclusions

A perfectly functioning labor market assumes a labor force that is homogeneous, fully mobile and income-motivated. These assumptions, while convenient for a study of the principles of economics, do not take "real world" market imperfections into account, imperfections that must be understood in a study of labor mobility. While the market does not function perfectly, an overview of historical patterns of migration in the United States does demonstrate a link between population redistribution and economic opportunity. Chapter 3 will build on the base established through this economic and historical overview, and discuss the concept of labor mobility from the standpoint of the individual member of the labor force.

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23 Ibid, p. 66.

CHAPTER 3

DEVELOPMENT OF A LABOR MIGRATION MODEL

Introduction

In theory, thousands of occupational choices are available to an individual. In practice, however, these choices are narrowed considerably by various constraints, ranging from preferences and skills of the individual to costly barriers to entry. This chapter analyzes the characteristics of geographical mobility within the framework of a cost-benefit model of labor migration decisions. Schultz' theory of investment in human capital will be discussed in terms of migration options. A cost-benefit model of migration decesions will then be developed using empirical evidence accumulated by economists and other social scientists. Finally, the difficulties of measuring costs and benefits will be discussed, and Woolsey's "quick and dirty" method for weighting objectives and selecting alternatives will be discussed as a way for individuals to include many of the otherwise unmeasurable costs and benefits in their migration decisions.

Human Capital Formation

Schultz was the first economist to test the theory of human capital formation; that is, that an individual's expenditures can be differentiated between consumption and investment in himself. "Much of what we call consumption constitutes investment in human capital. Direct expenditures on education, health and internal migration to take advan-

tage of better opportunities are clear examples. . . By investing in themselves, people can enlarge the range of choice available to them. It is one way free men can enhance their welfare."[1] Becker's model of human capital formation states that a person's decision to invest in himself will be made on the same basis as for any other investment decision, on the rate of return of that particular investment.[2] "Disregarding the psychic costs and benefits of migration, the higher the rate of return on the investment in migration the more willing a rational individual will be to search for a better economic opportunity."[3]

Adapting Becker's model of present value analysis and incorporating certainty equivalent factors,[4] the individual's migration decision could be viewed in the following way:

$$NPV = \sum_{i=1}^{n} \frac{B_i \beta_i}{(1+r)^i} - \sum_{i=1}^{n} \frac{C_i \gamma_i}{(1+r)^i}$$

Where

NPV = net present value
B = benefits accruing from migration in time period i
C = costs of migration in time period i
r = rate of return
β = certainty equivalent factor for benefits in time period i, $0 \leq \beta \leq 1$
γ = certainty equivalent factor for costs in time period i, $0 \leq \gamma \leq 1$

(the certainty equivalent factor is a risk ratio that shows how much an investor must be assured of making given a total amount placed under risk; i.e., the closer the factor is to 0, the more risk averse the investor.)

This model--and others like it using different assumptions--serve a theoretical, not empirical purpose. It includes the assumption that all of the benefits and costs associated with a migration decision can be quantified, and furthermore, that risk and uncertainty factors can be measured for each time period. These assumptions, of course, are unrealistic; however, they do allow us to examine the issue of migration as an investment decision, in terms that are readily understandable to most investors. The theory of human capital formation, which this model describes in quantitative terms, is a way of looking at an individual's decision-making process. "If a worker knows private costs and private lifetime benefits of each possible investment, he can make a rational decision about which investments he should undertake to improve his human capital."[5] A labor migration model of decision making requires parameters that are testable; in this study, empirical evidence will be presented before a suitable model is developed.

Cost-Benefit Analysis

This section carries the comparison of costs and benefits into a more formal setting usually referred to as "cost-benefit analysis," The use of cost-benefit analysis as a method of quantifying costs and benefits associated with public projects is becoming more sophisticated as a method of dealing with market failure. It has been defined as "an attempt to replicate, for the public sector, decisions that would be made if private markets worked satisfactorily."[6] This study is not

concerned with public sector decisions, but it is proposed that cost-benefit analysis can be a useful tool for examining individual migration decisions for the same reason it is used in the public sector--because, as shown in the preceding chapter, imperfections are present in the private labor market.

Some of the considerations that must be evaluated in cost-benefit analysis of public sector projects are also useful in this study:

1) Allocative vs. distributional effects. Allocative effects are characterized by increases in efficiency, while distributional effects involve changes in some people's well-being at the expense of others. Cost-benefit analysis is concerned only with allocative effects, with distributional effects disregarded or assumed to be non-existent.

2) Primary vs. secondary effects. Primary effects, or increases in well-being resulting from a project or action, are normally emphasized in cost-benefit analysis. Secondary effects in the case of individual migration could involve the impact on society; if the worker was employed before, his migration to a new area only benefits society to the extent of the wage differential of the new job. If the worker was unemployed, his migration results in a benefit to society as well as the firm. Other secondary effects, related to distributional effects mentioned above, could involve effects of migration on other members of the household or on long-time community members of the new place of residence.

3) Measurable and unmeasurable effects. These effects are sometimes termed "tangible" and "intangible," having to do with whether benefits or costs can be measured. Haveman and Weisbrod note that measurements of various variables become more sophisticated over time. "Failure to measure quantitatively certain program effects--whether they are benefits or costs--does not in any way simplify or change the nature of a rational decision-making process."[7] An attempt will be made in this study to identify both the measurable and unmeasurable criteria involved in migration decisions.

4) Option value and irreversibility. Cost-benefit analysts sometimes look at the irreversibility of a method of action (i.e. building a dam) as a criterion to be used in a study. Option value, or the ability to make the decision at a future date, is also considered. In terms of migration decisions, it will be assumed that irreversibility is not a consideration, but that option value is. In other words, a person can make a migration decision many times throughout his lifetime, and that decision may be postponed to better determine the costs and benefits of various options.

5) The discount rate. The magnitude of benefits and costs, in present value analysis, is largely determined by their timing and the discount rate used. Many economists believe that the discount rate used should reflect a weighted average of the various opportunity cost rates for the sectors from which a project or action draws resources.[8] An individual could look at expected wage adjustments, in-

creases in cost of living in different areas, rates of growth in investments including a residence, and other factors in determining the correct discount rate. Such an effort will not be easy, given the varying ranges of opportunity costs present throughout the economy and within an individual's frame of reference.

6) What to compare. In comparing benefits and costs, analysis should be made on a with/without and not a before/after basis. In other words, an individual should compare the present situation with a future based both on moving and not moving.

The Empirical Evidence

Empirical studies of migration generally fall into two categories--those involving personal interviews of persons making migration decisions, and those involving regressions on census and other population data testing the determinants of geographical mobility. In this section it will be shown, using empirical evidence, that the decision to migrate is a function of personal characteristics, as well as wage and non-wage considerations.

Labor does not respond automatically to changing economic conditions and shifting market forces. Peitchinis proposed the hypothesis that most labor movement is involuntary, in the sense that workers would prefer to stay where they are if the economic situation would warrant it. "Generally workers move out of areas and industries in which job opportunities decline, and into areas and industries in

which jobs are available and opportunities are expanding."[9] This hypothesis is supported mainly by such studies as that edited by Kuznets and explained in Chapter 2, where regressions of migration data and economic data show migration and economic opportunity to be positively correlated.

Such a statement does not explain all the variables involved in individual decision making. Studies have shown that geographical mobility does not respond automatically to differentials in economic opportunity. Miernyk's case study of displaced textile workers in Massachusetts in the early 1950's showed that these workers were not filling the void in New England's growing electronics industry. The study disproved the assumption "that industrial workers are relatively mobile, and that if employment is declining in one group of industries and expanding in others the same workers must be involved in the shift."[10] A study of Canadian laborers in a small town concluded that although the workers knew of better-paying jobs in a nearby area, they were not enticed to move. The investigator concluded, "Such workers, established in their communities and their families, will not be induced by higher wages to move to another community or another firm."[11] More recently, Lentz' longitudinal study of unemployed workers in a Midwest manufacturing city concluded, "Fear of personal bankruptcy does not always motivate people to accept any job. Age, habit, and need for status interact with the effect of growing economic insecurity on search and choice."[12]

Personal characteristics.

1) Age. The importance of the relationship between age and mobility has been established in many studies. Parnes' study of research on mobility concluded that age is the personal variable most clearly associated with mobility.[13] A national study conducted by the University of Michigan found that 40 percent of family heads aged 18 to 24 moved to the area in which they were currently living, compared to 4 percent of those aged 65 or over.[14] A study of mobility in the southeastern United States in the 1950's found young workers to be 45 percent more mobile than older workers.[15] Miernyk's study of textile workers concluded, "Perhaps the greatest barrier to inter-industry mobility is the advanced age of many of the displaced workers."[16] Age was also positively correlated with migration in Kuznets' study, with maximum mobility found among the 25-29 age group.[17]

The correlation of age and mobility has intuitive appeal in terms of the theory of human capital formation advanced by Schultz.

> "Young men and women move more readily than older workers. Surely this makes economic sense when one recognizes that the costs of such migration are a form of human investment. Young people have more years ahead of them than older workers during which they can realize on such an investment. Hence it takes less of a wage differential to make it economically advantageous for them to move, or, to put it differently, young people can expect a higher return on their investment in migration than older people. This differential may explain selective migration without requiring an appeal to sociological differences between young and old people." [18]

2) Level of education. Employment information and job opportunities are expected to increase with increased education. Using Bureau of Labor Statistics data, Saben concludes that risk and uncertainty of migration are less for the better-educated because "most migrants who were professional and technical workers had a job in view when they moved."[19] Suval and Hamilton show that the correlation between education and migration becomes stronger as the distance of migration increases.[20] Schwartz' study within a given age group finds that the effects of distance decline substantially with education.[21]

3) Nature of skill. Peitchinis hypothesizes that unskilled workers are more mobile than skilled workers, especially those whose skill is required only in a particular industry. The costs of migration for an unemployed skilled worker may exceed the costs of remaining unemployed, if the choice is between unemployment and offering their services as unskilled laborers. To be accepted, this hypothesis requires support.

4) Job preferences. This characteristic is not easily measured, but deserves mention since some jobs are more conducive to mobility than others. Someone who "likes office work" would not be induced by higher wages to work putting in a mine shaft, for example, unlike someone who "enjoys a constant change of scenery" and "likes working with machines."

5) Race and sex. Some studies have been done trying to correlate race and sex with migration propensity, but they appear inconclusive since it is impossible to completely isolate these attributes from the others mentioned above. The discussion of the black migration from South to North implies that blacks are as mobile as whites, but no conclusions are possible regarding destinations of migration. Parnes states that although males have generally been found to be more mobile than females, the differences may be caused by different exposures to the labor force and the measures of mobility used.[22]

Wage considerations.

Wages or net advantage, which in terms of this model can be considered the equivalent of benefits, have been shown to be an important criterion in making a migration decision. Benefits to be compared certainly include more than wages. Pension plans, savings programs and other benefit programs can raise the costs of migration, depending on their accumulated value at the time of the decision and whether or not they are transferable if the individual moves to a new location. Other monetary considerations include the accumulated value of a home and other investments, with their relative importance in decision-making a function of whether or not they are transferable.

Empirical studies look at monetary benefits and costs from one of two standpoints--either mean income or earnings levels in the sending and receiving regions, or the determination of whether and to what extent migrants themselves benefit by moving.[23] In a comparison of

migrants from a locality and similar individuals who stayed behind, Lansing and Morgan conclude that two of the dominant migration streams in the United States have been profitable for movers--movements out of the Deep South and movement off the farm.[24] Greenwood states that a common finding with gross migration studies is that income (and job) opportunities provide a better explanation of in-migration than they do out-migration;[25] that is, as Perloff and Lowry demonstrate, the labor market characteristics of the original area do not have as great an effect on decision making as do destination characteristics.[26]

Net returns to migration can be overstated for a number of reasons, states Greenwood. An entire increase in earnings may be attributed to migration, when in fact a change in job and/or industry may also be included. Since migration often occurs at the end of a period of investment in human capital (such as after college), the return to migration may also include the return to some other form of human capital investment. On-the-job training after migration should be calculated separately as it affects income, and a comparison of incomes between staying and moving should take this into account.[27]

The monetary costs of migration, according to Sjaastad, include the out-of-pocket expenses of moving, or increases in expenditures for food, lodging and transportation (for migrants and their belongings).[28] He notes the importance of differentiating between expenses that would be paid regardless of whether the move takes place and those caused

solely by the move. In terms of returns to migration, he suggests a differentiation between returns due solely to the move and those due to other factors such as occupational upgrading. Sjaastad uses the human capital theory to explain the relationship among migration, training and experience.

> "These investments, specific to the individual, are subject to depreciation and deterioration both in a physical and an economic sense. If market forces reduce the relative wages of a particular occupation, practitioners of that occupation suffer a capital loss and are faced with the alternatives of accepting the lower earnings or making additional investments in themselves to increase their earnings in a more favorable market. If the relative wages in an occupation are adversely affected locally, migration alone is sufficient; if the adverse effect is national, such as the earnings in agriculture, the entire occupational earnings structure is under stress and migration is feasible only if new skills are acquired by the migrant." [29]

The availability of unemployment compensation and welfare payments, which reduce the effectiveness of the price system as a resource allocator, must be mentioned in a discussion of monetary effects on migration. Theoretically, the availability of these monetary options could be expected to increase the benefits associated with immobility. The closer such payments are to the wage in the next best employment opportunity, the higher the imputed cost of changing employment.[30] Gallaway, Gilbert and Smith's study of labor mobility between 1955 and 1960 tested welfare and unemployment differentials between the areas of in-migration and out-migration, but found the statistical correlation coefficients "were not impressive."[31] On

a final theoretical note, Peitchinis distinguishes between costs to the economy caused by unemployment; in the case where a worker turns down a paying job to continue receiving benefits, an actual cost to the economy is the sum of the unemployment or welfare benefits plus the output the worker would have produced in accepting the position. If the worker has no offer of a job, the cost to the economy is only imputed.[32]

Most studies of migration look at the decision to move in terms of the individual and not the family, but it is clear that family moves have monetary implications. Mincer found that "family ties tend to deter migration, to reduce the employment and earnings of migrating wives, and to increase the employment and earnings of their husbands."[33] The results of his census regression confirmed his hypothesis that families tend to be less mobile than individuals.

Non-wage considerations.

"The non-money considerations involved in migration are surely significant, probably far more so than money costs."[34] Sjaastad divides non-monetary costs of migration into two areas--that of opportunity costs and "psychic" costs. Opportunity costs include earnings foregone while traveling, searching for, and learning a new job. And again, these are examined in terms of increment to costs and earnings associated with migration.[35] The risk and uncertainty costs are treated similarly to on-the-job training costs, by an appropriate in-

crease in the rate of discount for the increment to expected future earnings created by migration.[36]

Psychic costs are difficult to quantify. Sjaastad suggests they do not represent real resource costs, as do opportunity costs, but rather they are similar to lost consumer or producer surplus on the part of the migrant. In other words, the psychic value of a job at a given location can be characterized as those "earnings" over and above the minimum earning level required for an individual to be indifferent between migrating and staying. The maximum amount that could be taken away without inducing migration represents the value of the surplus. Psychic costs affect resource allocation, and, "even if knowledge were perfect, psychic costs could explain the existence of earnings differentials larger than those implied by the money and opportunity costs of migration."[37] However, notes Sjaastad, these differentials do not represent resource misallocation. "The optimal allocation of resources must take tastes as given, and will differ accordingly if people prefer familiar over strange surroundings."[38]

Although non-wage considerations are difficult to measure, especially those involving psychic costs, they have been analyzed in two ways--using distance as a proxy for psychic costs (including uncertainty) and using a lagged variable to represent availability of information. In their study, Gallaway, Gilbert and Smith found that distance involved seemed as important an explanatory variable as wage differentials.[39] The hypothesis that distance is a proxy for

uncertainty seems corroborated by previously cited studies that show the negative effects of distance decrease substantially with higher levels of education.

In a number of his migration studies, Greenwood used a migrant stock variable--categorizing the number of persons born in one state and living in the state under scrutiny--as a means of measuring levels of information quality.

> "The larger the number of persons born in state 'i' and living in state 'j', the more (employment and other) information that is likely to be channeled from 'j' back to 'i'. Moreover, the presence in 'j' of relatives and friends from 'i' is likely in itself to encourage migration from 'i' to 'j'. Relatives and friends of similar background help make the social transition easier for the recent migrant, and they also may provide him with food and shelter until he can find a job. In either case the potential migrant in state 'i' will be less uncertain about his prospects in state 'j' than elsewhere."[40]

Inclusion of the migrant stock variable increased the proportion of explained variance in his model to a large extent, and reduced the distance elasticity of migration, "which is an indication that distance entered into the determination of past migration."[41]

A Model of Labor Migration Decisions

Based on the evidence cited in the previous section, the following model is proposed as one that is suitable for testing the variables involved in migration decisions:

$$LM = f(W, NW \mid P)$$

Where LM = labor migration
W = wage considerations
NW = non-wage considerations
P = personal characteristics

If an individual possesses personal characteristics that have been shown to be positively correlated with decisions to migrate, then he will make that decision based on both wage and non-wage considerations. The historical evidence described in Chapter 2 used aggregate population data to demonstrate the positive relationship between population redistribution and economic opportunity. The discussion of human capital formation and cost-benefit analysis provided a theoretical framework for examining the issue of population redistribution from the individual's point of view. Finally, the validity of the model is established by the empirical evidence concerning variables associated with migration decisions.

It is proposed that this model can be used to test propensity to migrate and variables involved in actual migration decisions. For purposes of this thesis, which is concerned with labor availability needs of the western energy industry, testing the model could be the next logical step in an effort to determine whether these needs can be met. Recommendations for testing the model are included in Chapter 4.

Conclusions

Migration decisions, like most others made by individuals, can by analyzed on a cost-benefit basis as described in this chapter.

It is helpful to use Schultz' theory of human capital formation to assess the reasoning that goes into a migration decision, with the method of cost-benefit analysis further explaining the decision-making process. It can be argued that the migration decision itself is a function of personal characteristics (such as age, education level, nature of skill and job preference), wage considerations and non-wage considerations. Both monetary factors and the opportunity costs associated with a move can be described in quantitative terms, but psychic costs are much more difficult to measure. The literature describes a number of ways that economists and other social scientists have used to assess migration decisions, including statistical models and studies of individual migrants.

A model of labor migration decisions can be developed based on preceding discussions of historical migration, economic theory, and empirical evidence. The model is proposed to be testable in terms of western energy manpower needs, as described in the following chapter. The appendix describes Woolsey's "quick-and-dirty" model for decision making as one way of prioritizing objectives and measuring otherwise unmeasurable variables in decision making.

Appendix to Chapter 3

Measuring The Unmeasurables

For an individual deciding whether or not to migrate, measuring the monetary considerations and opportunity costs is not exceedingly difficult. The non-monetary or psychic costs can be much more difficult to measure in any kind of quantitative way that would be acceptable to an economist conducting a cost-benefit analysis.

Woolsey's "quick and dirty" model[42] for weighting objectives and selecting alternatives is proposed here as an easy, straightforward method for an individual to use in determining total utility for given alternatives. Both monetary and psychic costs can be included in the model. The model is described here, using a migration decision as an example.

Q&D for weighting objectives and selecting alternatives.

1) Put objectives in order of importance.

2) Assign the first objective a satisfaction level of 100 units.

3) "Weight" the remaining objectives with appropriate unit values.

4) Sum the unit values for all objectives and find the percent satisfaction for each objective.

A potential migrant could look at the following objectives:

Wage and benefit package	= 100	units	(29 percent)
Community amenities	= 80	units	(23 percent)
Proximity to family	= 75	units	(22 percent)
Climate	= 50	units	(14 percent)
Population density (less is better)	= 40	units	(12 percent)
	345	total	100 percent

5) Form a table of objectives and alternatives.

Let us assume our migrant has two alternatives--staying in Michigan or moving to Colorado. The following table takes into consideration each of the above objectives in the two alternatives, where each matrix value is the amount that each alternative satisfies each objective on a 0-10 basis.

	Wage	Comm	Fam	Clim	Pop
Michigan	5	7	10	3	5
Colorado	9	4	2	8	7

6) To determine which alternative best satisfies the objectives, for each alternative, calculate the payoff by multiplying each matrix value by the percentages figured above.

Michigan = 5(29) + 7(23) + 10(22) + 3(14) + 5(12) = 628

Colorado = 9(29) + 4(23) + 2(22) + 8(14) + 7(12) = 593

In this case, the potential migrant would choose to remain in Michigan, given the set of objectives that he deems most desirable. The advantage of this model is not only that it is easy, but also that it can be revised quickly if objectives are revised.

In addition, it is possible to conduct sensitivity analysis on the parameters of this model. This can be done for both the percentages assigned to the variables and the matrix values used in payoff calculations. The impact of each variable on final outcome can be determined by varying each matrix value by ± 10 percent, holding all other factors constant. When this is done for each value used in the Michigan payoff calculation, the following results:

	PAYOFF
Wages + 10%	642.5
Wages - 10%	613.5
Comm + 10%	644.1
Comm - 10%	611.9
Family - 10%	606
Climate + 10%	632.2
Climate - 10%	623.8
Pop + 10%	634
Pop - 10%	622

It can be seen that, keeping Colorado payoff calculations constant, varying the Michigan factors one at a time does not change the final result, since each payoff above remains above the Colorado payoff of 593.

Sensitivity analysis is also possible on the percentages, but varying one (increasing wage importance from 29 to 40 percent, for example) requires adjustment in the other factors as well. Increasing the wage percentage and adjusting the others appropriately leads to the following results:

Michigan = 5(40) + 7(20) + 10(18) + 3(12) + 5(10) = 606

Colorado = 9(40) + 4(20) + 2(18) + 8(12) + 7(10) = 642

In this case, the individual would decide to move.

Use of this model is appropriate for the individual decision maker. More sophisticated analysis can be conducted only in an empirical test in which a statistically significant sample of respondents perform an exercise similar to that cited above. Empirical testing of the labor migration model is beyond the scope of this thesis. It is easily apparent, however, that once such testing is completed, significance testing of both the model (using the F-test) and the variables (using the t-test) would be required. It is conceivable that the variables deemed important above, for illustrative purposes, will not all be significant when empirical testing is completed. It may be that wages and proximity to family are found to have a high correlation with the decision to migrate, while the other three factors do not. In any case, such speculation is better postponed until the model is actually tested. Chapter 4 includes suggestions for ways in which the model can be tested.

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CHAPTER 4

RECOMMENDATIONS FOR TESTING THE LABOR MIGRATION MODEL

The labor migration model developed in the previous chapter is the culmination of the theoretical framework and empirical evidence included in this thesis. The model explains how measurable and unmeasurable variables interact to weight the decision-making process. It has been shown that, contrary to economic theory, wages are not the sole motivating factor in individual decision making. Decisions to migrate depend on personal characteristics, as well as monetary and non-monetary considerations.

Age is the personal characteristic most clearly associated with mobility, although level of education, skills, tastes, race and sex are also related to differing degrees. Economic theory assumes that wage-related considerations are primary in the mind of an individual contemplating migration. The historical evidence shows a high correlation between income and migration, both in surveys and in analyses of aggregate population data. The evidence also shows, however, that unmeasurable costs and benefits are important in migration decisions, and, depending on the individual, may outweigh monetary concerns. Models have been developed that enable the individual to weight all considerations, whether or not they are measurable. Human capital theory provides an analytical framework for the exercise that is intuitively appealing.

Implications for Western Energy Development

The labor migration model can be used to test the variables associated with labor availability needs for western energy development. The model could test the following hypotheses:

1) Personal characteristics such as age, level of education, nature of skill and others have an important bearing on an individual's propensity to migrate. Surveys of individuals in a position to migrate or individuals who have already moved to the West for energy-related employment could provide a data base on which regression analysis (and appropriate sensitivity analysis) could be run to determine whether previously cited evidence continues to be valid. Census data could also provide an information base to test appropriate variables.

2) Wage considerations are one of the determinants of propensity to migrate, given an appropriate set of personal characteristics. It would be expected that income expectations play a large role in migration decisions, and that opportunity costs associated with staying are also brought into the decision.

3) Non-wage considerations affect the migration decision to varying degrees, depending on such factors as accuracy of information, distance to the new job, and family responsibilities. Such considerations could be measured in different ways, (for example, distance as a proxy for psychic costs), although they are often difficult to quantify.

The model can be used to test migration decision variables of skilled and unskilled, and management and operating employees. It

would be expected, however, that the industry is much more certain about its management personnel, since their decision to migrate is often the result of a transfer and/or promotion within the company. The model could also test the willingness of construction workers, for example, to continue working for a firm in operating positions after project completion (since some companies have indicated such a preference).[1]

Conclusions

The purpose of this thesis was to develop a proposed model for the analysis of labor availability in the western minerals market, under the assumption that labor needs will necessitate in-migration. Of principal concern was a preliminary analysis of the suspected important factors in such migration. The traditional economic assertion that increased wages will spur migration to this market is shown to be highly suspect based on research cited in this thesis. The impact of non-wage considerations appears to be noticeably greater than previously considered. Further, the extent and success of migration is considerably dependent upon the accuracy of information about economic opportunities elsewhere. This conclusion should be seriously considered by firms contemplating recruitment in distant areas.

There is little question that a considerable need exists for accurate projections of labor in western energy development. The primary results of this thesis are: (1) a proposed model that may

be used for such analysis and (2) some preliminary conclusions as to the relative importance of wage versus non-wage considerations for labor migration in this market.

CHAPTER 4 REFERENCE

1 William McDermott, Vice President of Occidental Oil Shale, in a site visit to the C-b tract, August 14, 1980.

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