



Economic models of intraregional and interregional migration in the Northern Great Plains region  
by David Matthew OMeara

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE  
in Applied Economics

Montana State University

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Abstract:

This study, as one part of an extensive analysis involving rural community development in the Northern Great Plains Region, analyzes the availability of labor in these rural communities by means of population migration. The availability of labor is considered important because human capital will be needed to develop the vast coal reserves in the region as the Nation becomes increasingly dependent upon coal as a source for energy.

The review of previous work dealing with migration establishes a basis for the methodology, used in the study. The elasticity between particular economic conditions in the Plains Region (especially the change in average wage) and migration are of paramount concern. A model for intraregional migration is treated separate from interregional migration in order to find differentials in responses to conditions in the Region. In addition to the economic conditions, certain State Economic Area characteristics are introduced as controls for other causes to migrate. The capability of analyzing each factor of mobility separately for origin and destination sites is accomplished by studying relevant gross migration rather than net migration. After adjusting for simultaneity between migration and wages (where migration is considered a determining factor for the change in average wage in a Plains' State Economic Area), the values of elasticities between wages and the migration flows showed interregional immigration to be the most responsive. This implies that those living within the Plains in 1965 received more nonpecuniary benefit from site amenities than did those living outside the region. The elasticity between the wage and interregional immigration is 3.13. The stream responding the least to the wage is intraregional outmigration with an elasticity of -.35. However, this value proved to be insignificant. The elasticity values adjusted for simultaneous inconsistency bias relating the wages to intraregional immigration and interregional outmigration are 1.68 and -.87 respectively. Besides the wage, other economic conditions also proved to be important in determining the migration flows.

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ECONOMIC MODELS OF INTRAREGIONAL AND INTERREGIONAL MIGRATION  
IN THE NORTHERN GREAT PLAINS REGION

by

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The results and conclusions are the sole responsibility of the author and do not necessarily represent the viewpoint of others who contributed, or the policies of the Montana State University, the Economic Research Service, or the Environmental Protection Agency.

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## ABSTRACT

This study, as one part of an extensive analysis involving rural community development in the Northern Great Plains Region, analyzes the availability of labor in these rural communities by means of population migration. The availability of labor is considered important because human capital will be needed to develop the vast coal reserves in the region as the Nation becomes increasingly dependent upon coal as a source for energy.

The review of previous work dealing with migration establishes a basis for the methodology used in the study. The elasticity between particular economic conditions in the Plains Region (especially the change in average wage) and migration are of paramount concern. A model for intraregional migration is treated separate from interregional migration in order to find differentials in responses to conditions in the Region. In addition to the economic conditions, certain State Economic Area characteristics are introduced as controls for other causes to migrate. The capability of analyzing each factor of mobility separately for origin and destination sites is accomplished by studying relevant gross migration rather than net migration. After adjusting for simultaneity between migration and wages (where migration is considered a determining factor for the change in average wage in a Plains' State Economic Area), the values of elasticities between wages and the migration flows showed interregional immigration to be the most responsive. This implies that those living within the Plains in 1965 received more nonpecuniary benefit from site amenities than did those living outside the region. The elasticity between the wage and interregional immigration is 3.13. The stream responding the least to the wage is intraregional outmigration with an elasticity of  $-.35$ . However, this value proved to be insignificant. The elasticity values adjusted for simultaneous inconsistency bias relating the wages to intraregional immigration and interregional outmigration are 1.68 and  $-.87$  respectively. Besides the wage, other economic conditions also proved to be important in determining the migration flows.

## CHAPTER 1

### INTRODUCTION

Recent scarcity of energy derived from oil has awakened a quest for new oil reserves, and more importantly, a search for oil substitutes. Coal is a major source for the production of electrical energy as well as a technically potential source for gas used in residential heating. The Fort Union coal formation in Montana and several coterminous states is not only rich in this fossil fuel, but the reserves also can be recovered with relative ease. This abundant supply, the feasibility of mining, and the quality of energy release and chemical composition of the coal give the Fort Union coal an important part in the Nation's energy program.

Large flows of capital and human resources will be needed to mine and process coal in the region. This study is one part of a research effort dealing with the problem of formulating a methodology to estimate the economic impacts of coal development on rural communities in the Northern Great Plains. The general problem of this study is to relate local economic conditions to the migration of people. The area of special interest is within five states in the Northern Great Plains where strippable subbituminous coal deposits are located. Migration is an important aspect of local impacts of development for two reasons. First, migration is the single most important source of population change as labor demands increase. Second, the wage increases required to attract and hold additional labor to an area will increase the capital and

operating costs of community facilities. Thus, local government costs will be dependent upon the responsiveness of migration to changes in local economic conditions, especially wage levels.

### Justification of Project

The expansion of coal mining and conversion throughout the latter half of the 1970-1980 decade and into the first half of the 1980's will add to the economic base of the study area. The Mitre Corporation reported that the known coal resources in the Rocky Mountain region are 309,135 million tons. Recoverable reserves are estimated at 33,345 million tons (Huffman 1972). Recoverable reserves will change over time as new technology is developed and as the demand for coal increases. In 1972, 31.8 million tons of coal were mined in the study area, while anticipated 1985 production is 306 million tons. The depletion of 2,265 million tons from current total reserves of 33,345 million tons is projected during the 1972-1985 period (Federal Energy Administration 1974).

Existing mines cannot deliver the large quantities of coal expected to be demanded in the near future. Expansion of current mines and projected new mines by 1985 number 75 in the study area. Average employment for a 10-million ton mine is estimated at 220 employees (Polzin 1974). Because of these 220 basic jobs, other indirect and induced job opportunities will emerge. The local population may increase by even larger amounts since each worker may have several dependents.

Another source of the increased labor demand could be from new coal gasification and power generation plants within the region. Eighteen new coal gasification plants are in the proposal stage (Federation of Rocky Mountain States 1975). Although few of these plants are expected to be completed (Stroup 1976), their impacts are currently being evaluated (U. S. Environmental Protection Agency 1976). The peak construction employment for building a plant capable of producing 250 million standard cubic feet of gas per day approaches 3,000 employees while the average operating employment will be about 625 (Polzin 1974). New generating plants in the area are projected at 68 (Smith 1975). A plant producing 500 megawatts annually will need a peak construction employment of 625 and will require an average permanent work force of 43 employees (Polzin 1974).

Since the study area is sparsely populated and has essentially an agricultural base, there may not be enough local labor to sustain development. Therefore, the size and characteristics of the labor force likely will change in the next decade, primarily through changes in migration flows related to the Northern Great Plains.

The expansion of the economic base, that is, "the change in those activities bringing export revenue or transferring income into the community from outside" will create an increase in the demand for labor (Bender 1975, p. 1). Higher wages will be reflected in these new labor demands. Thus, the locality will experience increases in immigration

and decreases in outmigration. The cause of the change in migration rates primarily is through events in the market place which reflect the economic conditions of a locality. Also important are nonmarket aspects such as amenities and social ties, which may change as the community expands over time, and these also may affect changes in migration.

Migration into and from any community has consequences that are sometimes overlooked when decisions concerning local growth are made. When a community experiences an influx of people, the community may provide new facilities such as streets and highways, sewage treatment plants, storm and sanitary sewers, and schools. There is also the burden of increased fire, police, welfare, and recreation services. These expenditures put stress on the revenue structure of the community. It is thus important to identify and quantify the migrants entering and leaving developing areas so that reliable decisions can be rendered.

Policy decisions also will depend upon the background conditions of the community. Each community is different in terms of average income of residents, distribution of income among residents, ethnic composition, social group structure, cultural values, traditions, topography, settlement patterns, inherited physical structures, relation of major transport facilities, land values, commercial composition, industrial mix, labor skills, governmental structure, local government efficiency, interest conflicts, and many other factors (Isard 1957). These differences may appeal to different types of migrants such as aged

versus young workers, skilled as opposed to the unskilled, or professional against the white collar worker. Depending on these differences as well as local economic conditions, policy decisions may need to be different from one community to the next.

Additionally, planners may consider the externalities which are imposed on a community when its population changes. For some migrants, the social cost to the community may be greater or smaller than the individual's private cost to relocate in the community. This may result, as far as the community is concerned, either in too many migrants entering the community when the social cost is greater than the private cost, or too few when private costs are greater than the benefits received. The original population may wish to estimate the type and extent of development and its impact on them, and then extract revenues and make expenditure changes in the directions and amounts that minimize fiscal externalities.

#### The Problem and Approach

The general research objective is to relate migration responses in the Northern Great Plains communities to local economic conditions. Three major concerns will be reflected in the specific objectives and methodology: (a) a generalized migration model, (b) nonmarket considerations, and (c) the interrelatedness of cause and effects.

The generalized model to be constructed must be consistent in the explanation of both immigration and outmigration. Theoretically, market

conditions in both destination and origin areas influence the migration flows. Data are not available to relate an individual migrant's utility function to the conditions affecting a decision to migrate. Rather than that, conditions at sending and receiving areas are linked to migration flows. The observed migration flows consist of people who were at the margin when conditions changed. The generalized model is applied to three migration streams: (a) intraregional migration, (b) interregional immigration, and (c) interregional outmigration.

The justification for three migration streams is that nonmarket considerations may influence the responsiveness of labor to changes in economic conditions.<sup>1</sup> People may have a psychic investment in a community or social structure. Family and social ties may be valuable to them. Development in any one community will attract labor from nearby localities and from distant labor pools. The magnitude and response of those potential migrants in nearby areas may differ from reactions of migrants in more distant areas. The reason that there are differences is that both market and nonmarket costs rise as distance increases. Wage rate changes will attract more people from surrounding areas than from far-off areas. These are direct pecuniary costs. There may also be nonpecuniary or psychic costs that delineate migrants as long- or short-distance migrants. Short-distance migrants may find that there is

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<sup>1</sup>Nonmarket considerations will influence the choice of explanatory variables in the migration models as discussed in Chapter IV.

little loss in life styles and environmental conditions when moving to nearby areas. However, over a more distant move, the thought of being removed from one's place of origin may play a role in the decision process. Therefore, this study disaggregates the migration streams into intraregional and interregional moves and allows the coefficients associated with the economic variables to differ for each segment.

The third major concern of this study is that some of the local economic conditions that influence migration flows may be influenced in turn by migration. Economic theory states that as wages in an area change, potential migrants are induced to stay or leave depending on this wage change. However as migrants leave the supply of labor changes, thus influencing wage levels in a locality. The interdependency of migration and local economic conditions means that an ordinary least squares estimation technique will have a simultaneous inconsistency bias. In order to compensate for this bias, additional equations besides the migration equation must be introduced for each additional endogenous variable. In this case, only one additional equation will be brought into the system, an equation for the change in wages over the migration period. By doing so, the coefficient for the effect of wages on migration can be solved as an integral part of a system of equations. This is accomplished through the two-stage least squares regression technique.

### Objectives

The objectives of the study are:

- 1) To estimate the effects of selected economic variables at origins and destinations and among gross migration flows for State Economic Areas in the Northern Great Plains.
- 2) To adjust for nonmarket influences in an effort to distinguish between the responsiveness of separate migration flows.
- 3) To adjust for the simultaneity between local wage changes and migration.

The results of this analysis can be used to anticipate how responsive migration is to local economic conditions; that is, where people will move as conditions change. Although beyond the scope of this study, the results can be used to estimate the effect of local economic conditions on tax revenues and expenditures of developing communities.

### Description of Study Area and Data

The State Economic Areas<sup>2</sup> considered to be the most representative of the Northern Great Plains are located in Eastern Montana, North and

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<sup>2</sup>A State Economic Area (SEA) is defined by the Bureau of Census as a subdivision of a state consisting of a single county, or groups of counties, that have similar social and economic characteristics.

South Dakota, Eastern Wyoming, and Eastern Colorado. This Region is somewhat extended geographically throughout the Great Plains where population density, employment opportunities, and income levels are generally divergent. The common bond among these areas historically has been agriculture. The Plains area is basically rural in the sense that there are very few cities with a population of 50,000 or more.

Areas in the Northern Great Plains have experienced immigration and outmigration even though their economic bases have been relatively stable. Part of the reason may be a normal turnover of labor as the market and its participants adjusted over time. A typical State Economic Area is rural southeastern Montana (SEA4). The 1970 population was 33,310 and gross outmigration and immigration from 1965-1970 was 8,746 and 5,649 persons respectively. Thus, 15 percent of the 1970 population in this SEA had moved into the SEA within the past 5 years.

The data presented in Table I-1 are the migration flows within and among states in the study area. These numbers represent the magnitude of aggregated intraregional migration; that is, these figures are given by state rather than by a single SEA. For example, 130,035 people were living in Colorado SEA's in 1970. The number of people moving from Colorado to an adjacent state (Wyoming) is 6,950. The number of people moving to each of the other states (nonadjacent) in the Region from Colorado is 1,950, 916, and 3,338. The greatest number of people in any one migration flow is within states. The next largest flow is from a state to adjacent states.

TABLE I-1. MIGRATION WITHIN AND AMONG NORTHERN GREAT PLAINS STATES,  
1965-1970\*

State of Residence 1970	State of Residence 1965				
	Montana	North Dakota	South Dakota	Wyoming	Colorado
Montana	35,855	5,753	2,329	4,000	3,338
North Dakota	3,415	33,957	4,260	918	916
South Dakota	1,506	7,355	33,815	1,626	1,950
Wyoming	3,429	1,380	2,901	13,902	6,960
Colorado	4,918	3,656	5,341	11,914	130,035

\*Source: U. S. Department of Commerce, Bureau of the Census, U. S. Census of Population, Migration Between State Economic Areas, Washington, D. C., 1970.

The number of people in each stream moving between states in the study area and nonadjacent states is relatively small (Table I-2). However, the aggregate of the flows to and from states outside the study area is a large part of total migration. Data in Table I-2 are the number of people moving to and from states in the study area and all other states. The number moving within North Dakota is 33,957 people. Those moving to the adjacent state of Montana are 5,753 (Table I-1). The majority of separate flows to nonadjacent states and to North Dakota are smaller (Table I-2). However, California and Washington are exceptions to the magnitude of interaction for most states in the study area.

Redistribution of population results in an informal network for communicating job information among people throughout the Nation. Those people who have moved into the Northern Great Plains from elsewhere likely maintain communications with people in other locations where they have lived. The redistribution of population is indicated by contrasting state of birth with place of residence at any point in time. These data are reported for states in the study area in Table I-3. Approximately one-half of the population reside in their state of birth in these states. The fact that large numbers were born elsewhere indicates that information about other locations is available.

TABLE I-2. OUTMIGRATION AND INMIGRATION, PLAINS STATES AND ALL OTHER CONTIGUOUS UNITED STATES, 1965-1970\*

Other Contiguous States	Northern Great Plains States									
	Montana		North Dakota		South Dakota		Wyoming		Colorado	
	Out	In	Out	In	Out	In	Out	In	Out	In
Alabama	403	257	393	250	317	182	325	264	1,990	2,712
Virginia	1,263	665	1,026	291	1,007	590	634	487	5,589	5,279
Arkansas	554	293	679	429	328	230	415	204	2,643	2,380
Connecticut	376	128	270	290	263	124	176	99	1,392	2,413
Delaware	53	62	165	139	55	100	95	100	230	465
Florida	1,495	1,097	1,887	1,150	1,857	706	1,130	558	6,771	8,096
Georgia	740	301	629	396	696	462	364	163	3,137	3,413
Illinois	1,845	1,940	2,942	1,837	3,649	1,851	1,520	1,183	11,345	21,244
Indiana	809	578	905	886	1,019	642	676	520	3,180	5,767
Kentucky	403	304	336	354	209	293	152	159	1,680	2,567
Louisiana	506	348	537	308	570	304	745	318	2,254	3,298
Maine	180	363	104	182	138	145	52	114	489	837
Maryland	552	419	767	367	803	244	423	240	3,798	4,719
Massachusetts	710	451	618	500	453	402	224	158	2,390	4,291
Michigan	1,349	1,164	2,164	1,052	1,559	809	836	1,264	5,713	9,131
Mississippi	377	417	133	381	420	174	290	365	996	1,502
Missouri	1,306	1,142	1,541	1,136	2,124	1,195	990	907	10,100	11,481
New Hampshire	227	135	41	193	75	28	24	33	583	893
New Jersey	591	403	513	346	393	462	205	411	2,944	5,741
New York	1,101	1,342	1,024	942	831	804	621	810	6,207	14,294
North Carolina	515	438	634	464	367	301	348	241	1,828	2,665
Ohio	1,257	1,027	1,263	1,013	819	891	453	931	5,631	9,957
Oklahoma	1,215	699	762	720	1,380	653	1,455	1,087	7,461	9,613
Pennsylvania	996	850	800	628	538	592	576	430	3,890	6,786
Rhode Island	80	72	48	27	110	35	43	13	523	510
South Carolina	332	257	338	315	403	77	304	180	1,417	1,730
Tennessee	414	182	408	356	440	264	335	85	2,232	2,198
Vermont	35	70	17	591	135	155	13	144	307	524
West Virginia	545	167	197	127	41	112	138	106	372	797
Wisconsin	1,367	1,748	2,773	1,399	3,487	1,381	631	340	3,767	6,767
Texas	3,186	2,047	3,264	1,979	2,780	1,477	3,230	2,242	22,186	26,599
New Mexico	1,112	924	635	408	663	397	1,456	1,637	9,806	13,433
Arizona	3,404	1,021	2,119	625	2,126	455	2,598	1,010	13,663	8,601
Iowa	1,109	909	2,181	1,570	6,448	6,320	783	922	5,733	11,260
California	14,469	10,629	10,798	4,708	10,315	4,087	8,394	4,458	54,050	45,281
Nevada	1,155	924	418	94	822	229	905	568	3,300	2,400
Oregon	5,754	2,940	2,646	596	1,985	543	1,685	801	5,545	3,837
Utah	1,988	1,876	502	268	384	143	3,262	2,925	6,650	8,059
Washington	21,335	7,766	5,284	1,736	5,436	1,049	3,752	908	11,099	6,525

\*Source: U. S. Department of Commerce, Bureau of the Census, U. S. Census of Population, Migration Between State Economic Areas, 1970, Washington, D. C.

TABLE I-3. STATE OF RESIDENCE IN 1970 BY STATE OF BIRTH, NORTHERN GREAT PLAINS STATES\*

State of Birth	State of Residence, 1970				
	Montana	North Dakota	South Dakota	Wyoming	Colorado
Montana	400,119	5,180	3,506	8,602	10,491
North Dakota	38,750	452,112	16,211	3,605	10,651
South Dakota	12,680	14,800	472,797	85,98	18,413
Wyoming	10,419	1,089	2,886	146,877	23,072
Colorado	6,735	1,927	2,645	16,340	992,219

\*Source: U. S. Department of Commerce, Bureau of the Census, U. S. Census of Population, State of Birth, Washington, D. C., 1970.

Population in Northern Great Plains.

The combined 1970 population in the State Economic Areas included in the study area was 3,222,362 persons. The largest city is Billings, Montana with a 1970 population of 87,350. Other major cities are Bismarck (34,670), Mandan (11,093), Dickinson (12,405), Williston (11,280) in North Dakota; Miles City (9,023) in Montana; and Casper and Sheridan, Wyoming (39,361 and 10,856) respectively. The main flow of population throughout the 1960-1970 decade was from the rural areas to these leading trade centers. Dalsted, Leistritz, and Hertsgaard (1974) maintain that there was a high rate of net outmigration from each of the areas. Since all the areas had more outmigration than immigration, it is assumed that labor supplies in the past have been reduced through labor mobility. They concluded that the age group below 25 (that might be prone to migrate so as to increase their expected lifetime earnings) were a larger percentage of the population than is true of the Nation as a whole. Therefore, age distribution may be important in determining migration flows related to the Northern Great Plains.

Economic Conditions.

The traditional economic base in the Northern Great Plains has been agriculture. In the recent past, however, there was marked a decrease in job opportunities in this sector of the economy. In

Montana from 1960-1970, there was a decline of 22.1 percent in agricultural employment, and the largest percentage gain in employment was in the service industries. Employment in all sectors within Montana gained 7.4 percent. North Dakota and South Dakota had the largest declines in agricultural employment (38.6 percent). Also, the total labor force participants in each of these states declined by 2.5 percent. Wyoming's percentage decline in agriculture was 26.7 percent, where the service industries had the greatest increase (29.3 percent), and total employment in all sectors increased by 3.9 percent. For the Northern Great Plains as a whole, there was a 33.9 percent decrease in agricultural employment during the 1960-1970 period; mining employment increased by 8.8 percent, manufacturing by 33.1 percent, and total employment by 6.1 percent. Therefore, diversification in the industrial sector is evident throughout the Northern Great Plains. Furthermore, declines in agricultural employment have resulted from farm and ranch consolidation, but the acreage devoted to this sector remained about constant (Dalsted, Leistriz, and Hertsgaard 1974).

As for the economic well-being of the labor force, in the Region, incomes of the residents in the Northern Great Plains usually fall short of the national average. The 1970 per capita money income in North Dakota was the lowest at 72.2 percent of the national average, while Wyoming's northern area had 100.8 percent of the national average.

### Trade Areas.

Cities within the study area that are considered complete shopping centers are: Bismarck, Mandan, Minot, Dickinson, Williston in North Dakota; Miles City in Montana; Sheridan and Casper in Wyoming; and Rapid City in South Dakota. In addition to the complete shopping centers, the area is serviced by the primary wholesale-retail center of Billings, Montana. Bismarck, Mandan, Minot, Casper, and Rapid City also perform certain wholesaling functions and can be described as secondary wholesale-retail centers (Hoover 1971).

On the fringes of the study area there are four major metropolitan centers; Minneapolis-St. Paul, Omaha, Denver, and Spokane. Generally, the Dakotas relate economically to Minneapolis-St. Paul, Wyoming to Denver, and western Montana to Spokane. However, these large metropolitan areas do have some overlapping of influence within the study area.

### Data and Sources

The data used in the study are primarily from the 1970 U. S. Census of Population. This census is the most recent documentation of cross-sectional migration flows available for SEA's in the Northern Great Plains. This secondary source is not as accurate or applicable to the 1970 decade as would be more recent primary data. However for purposes of this study, the secondary data were available readily and less costly than that from any other source.

The migration data are calculated from a 15 percent sampling of the population. The independent variables used in the study are calculated on the basis of 5 percent to 20 percent samples. Therefore, these data may be subject to both sampling and response errors.<sup>3</sup> People living in a Plains SEA in 1970 who lived elsewhere in 1965, and those who lived elsewhere in 1965 but were living in a Plains SEA in 1970 are observed as the migration flows. The characteristics of the origin and destination areas that are relevant in the explanation of migration are based on the 1970 sampling of the population. Unfortunately, most of these characteristics are 1970 observations. It would have been better to have obtained both the 1965 and 1970 observations. The results of the study thus are dependent on data that rely heavily on secondary sources, and data observed at the end of the migration period.

The primary area under observation is demonstrated in Figure I-1. For the specific observation SEA's and states see Appendix A. Thus Nebraska SEA's are excluded from the intraregional model because they are not considered part of the Plains Region for these flows, but are included as origins and destinations for the interregional models. The adjacent states and portions of Plains states are excluded from all models. This was a result of the data and no economic justification is given for their exclusion.

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<sup>3</sup>See U. S. Department of Commerce, U. S. Census of Population, 1970 for sampling procedures.











































































































































































































