# APPROACHES TO
# MODELLING OFF-FARM MIGRATION

by

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# I. INTRODUCTION

A major concern in developing any agricultural sector model is the projection of the farm household population which provides labor for agricultural production and makes the first claim on agricultural products for household consumption. In order to project the farm household population, it is necessary to understand and model the off-farm migration process. The purpose of this paper is to explore various methods for improving the modelling of off-farm migration in the population component of the Korean Agricultural Sector Model (KASM).

This working paper first discusses the conceptualization of migration as social phenomenon and statistical datum and compares migration with the other important population processes of mortality and natality. Next, the authors review the treatment of migration in dual-economy growth models and in large-scale economic simulation models which explicitly consider the agricultural sector and its link to the national economy. This is followed by a review of research which has focused on the econometric analysis of variables which "explain" patterns of geographical mobility. Then, some of the special characteristics of the off-farm migration process are discussed. Several studies which have developed regression equations to predict the number of farm operators or agricultural workers over time are also noted. Finally, a methodology is outlined for improving the modelling of off-farm migration in the Korean Agricultural Sector Model. A list of data sources available for the analysis is appended to the paper.

## II. MIGRATION AS SOCIAL PHENOMENON AND STATISTICAL DATUM

### Migration -- Event or Act?

Although migration holds formal status as one of the three components of population growth and change which demographers recognize to fall within the ambit of their concern, in most standard texts it is considered after, and more cursorily than, either fertility or mortality. Moreover, it is recognized at least implicitly that standard demographic tools are least fruitful when applied to the analysis of migration. Donald J. Bogue writes that:[1]

> "Migration is the major unknown component of population estimates and forecasts... . the demographer who specializes in migration analysis must have interdisciplinary interests, for he finds many of his explanatory hypotheses in the fields of economics, sociology, geography, and technology."

Mortality, natality, and migration differ from one another as phenomenon, and these differences result in a need for differing methods of analysis and parameterization. These differences lie along four dimensions:

a) the degree of biological or environmental determinism

b) the degree of irreversibility

c) the degree of independence between events

d) the number of loci in which the event takes place

Mortality stands at one end of the spectrum in each of the above four dimensions. Death is determined largely by the biological, socio-economic and cultural environment, it rarely voluntary, and is only marginally subject to postponement through intentional behavior. It is completely irreversible and for the social scientist the only loci of interest are the geographical,

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1/ "Internal Migration", Chapter 21 in The Study of Population (Chicago: Univ. of Chicago Press, 1959) edited by P.M. Hauser and O.D. Duncan.

biological, and social situses occupied at the time of death. Under most circumstances deaths are independent probabilities, although death rates among different sub-populations are frequently correlated by virtue of their basis in a common environment. Constrained to a well defined range by biological factors, largely free of volitional elements and determined largely by long-run trend lines in a variety of environmental factors, mortality rates have proven amendable to internal parameterization (eg. the Coale and Demeney Regional Model Life Tables) and have been related with considerable success to simple models involving gross social welfare indexes.[2/]

Fertility involves a greater degree of individual volition, although it is strongly influenced by biological factors, norms regarding marriage and family formation, and the level of knowledge concerning fertility control. Reversibility of a sort is possible through induced abortion, infanticide, and a change in decision with regard to the number of desired additional births. While there is probably a measure of cross sectional and serial correlation among birth rates, the relationships are sufficiently indirect so that for most purposes independence can be assumed. Somewhat more loci are relevant than in the case of mortality, since those concerning both the mother and father are of interest.

Migration stands at the far end of the spectrum in each dimension.

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2/ G.B. Rodgers, for instance, found that the following regression of life expectancy at age zero in 56 countries yielded and $R^2$ value of .773:

$$LE(0) = 87.2 - \underset{(4.93)}{3389}\,(1/Y) + \underset{(1.74)}{76880}\,(1/Y^2) - \underset{(3.76)}{36.47}\,(G)$$

where Y = GDP per capita in dollars
G = Gini coefficient of income inequality
(bracketed figures are t-values)

See "An International Cross-Section Analysis of Mortality", typescript ILO, May 1974.

The voluntary aspects are strong, frequently dominant, although still contrained by biological, and cultural factors. Geographical migration within a country is also usually reversible in the short-run, and often even in the long-run. It also seems likely that there is considerable direct cross-sectional and serial corelation between migration events: the migration of young or elderly dependents is typically dictated by the movements of the heads of the households to which they belong; the timing of migration, moreover, is quite responsive to short-term fluctuations in the economy with the result that migration rates among a cohort in one period may be influenced by that cohort's migratory behavior in the preceding period.[3] Finally, migration also involves a multiplicity of loci, including geographical and social situses both before and after the move. It is for these reasons that migration is presented here as an "act", rather than an "event." The nominal distinction would be trivial except for the fact that much migration analysis and forecasting treat migration as if it were in a common phenomenological class with mortality and fertility.

The definition of what constitutes an event is central to the analysis of migration. "Theoretically", Bogue notes, "the term migration is reserved for those changes of residence that involve a complete change and readjustment of the community affiliations of the individual."[4] Migration data is typically collected and analysed in terms of areal units the boundaries of which may bisect unitary communities in some cases, resulting in an over-estimation of true migration, or, as is more frequently the case, encompass several distinct communities and thus under-estimate migration. Moreover, non-migrants in

3/ Hope T. Eldridge, "A Cohort Approach to the Analysis of Migration Differentials", Demography 1, (1964).

4/ Donald J. Bogue, op.cit. p. 489.

rapidly changing communities with high population turn-over rates may face as many adjustment problems as migrants, while highly mobile professional groups with far-ranging social networks may move without "migrating" in Bogue's sense. From a sociological perspective, four distinctive but interrelated dimensions of migration can be identified:

a) movement from one career-path to another

b) movement from one set of social networks to another (with the networks sub-divided, after Parsons, into those associated with economic, social, and political activities)

c) movement from one generalized normative system to another

d) movement from one physical/ecological environment to another.

Only the last is inevitably associated with spatial movements. The others are neither necessary corollaries of movement, nor require movement totake place.

From the viewpoint of analyzing or modelling migration, this implies a question: which dimension should be modelled? A focus on one necessitates at least implicit assumptions about the others. Having modelled rural-urban migration do we assume that all migrants leave the agricultural sector and enter the non-agricultural sectors? Do we assume they adopt urban consumption patterns, retain rural ones, of affect some compromise between the two? What is assumed about migrants' attitudes towards family size, towards educational attainment targets for their children? A similar set of questions arises if migration is approached from the direction of occupational mobility, where, among other issues, we are forced with making assumptions about the spatial juxtaposition of different economic activities. Regardless of the dimension of migration in which we are primarily interested, a model of

migration must take account, endogenously or exogenously, of variables operating in the other dimensions.

This paper will not argue the case for a complete migration model, much less attempt to specify one, but will rather focus on several alternative approaches and the potential contributions, limitations, and operational difficulties of each.

Gross Migration and Net Migration

Gross migration as used here means the number of persons living in one region at the beginning of a time interval who are living in another region at the end of the time interval. This is a "statistical" measure, rather than a phenomenological measure -- in the sense that it reflects how migration is typically counted, as opposed to a measure of the "true" number of migratory acts. So defined, gross migration from region "i" to region "j" during time interval t(notated as $M_{ij}(t)$) excludes those who move from "i" to "j" during the interval but do not survive until the end of the interval. It also excludes those migrants born after the beginning of the interval (although these numbers can be estimated separately or included as an additional component if data is available), and those moving from "i" to "j" during the period who were living elsewhere than "i" at the beginning of the interval or elsewhere than in "j" at the end of the interval.

The terms gross in-migration or gross out-migration refer, respectively, to the sum of gross migration to a region from all origins ($M_{.j}(t) = \sum M_{ij}(t)$, for all i) and the sum of gross migration from a region to all destinations ($M_{i.}(t) = \sum M_{ij}(t)$, for all j). Total period movement includes gross migrants

plus all those who made a permanent or semi-permanent move from "i" to "j" during the interval, regardless of whether they survived, were living outside "i" or even born at the beginning of the period, or living outside "j" at the end of the period.* Corresponding aggregate movement into or from a particular region are termed total period in-movement and total period out-movement.

The sum of $M_{ij}(t)$ and $M_{ji}(t)$, referred to as gross migration by some demographers, is here termed gross turnover.

Net migration is the difference between cross movements in a given stream ($NM_{ij}(t) = M_{ij}(t) - M_{ji}(t)$) while net in-migration and net out-migration refer to the difference between gross in-migration and gross out-migration to a particular region.

Since the length of the time period over which migration is computed affects what is defined as an act of migration, gross migration calculated on the basis of a single interval T units in length will different from that calculated on the basis of n intervals each T/n units in length covering the same period. The two figures are fundamentally incomparable. Although the calculation of net migration also depends on the choice of interval length, approximate comparison is possible if assumptions can be made about the distribution of gross movements over the time period and concerning the mortality rates affecting each stream.

Whether to focus on the analysis of gross or net migration (or the corresponding rate measures) depends on the theoretical groundings of the analysis,

* An accurate vital events registration system would register what has here been termed total period movement.

and only secondarily on specific character of the questions being asked. If the underlying theory about mobility is essentially behavioral, in which gross or net migration is seen as an outcome of individual (or household) decisions, then the gross migration rate calculated on an appropriate population at risk is the variable on which migration analysis logically focuses, with the estimation of net migration taken residually as the difference between cross movements.

If, however, the theoretical base is a more classical economic model in which net migration is an adjustment to inter-regional or inter-sectoral labor market disequilibrium, the relevant focus of analysis is net migration or net migration rates. Both approaches are explored in detail below.

## III. TREATMENT OF MIGRATION IN ECONOMIC GROWTH MODELS

Historical studies of economic growth and development commonly note the relationship between inter-regional migration and shifts in industrial structure, or between migration and the changing distribution of final demand; yet Simon Kuznets has noted that

> the magnitude of the migration (from the A-sector to the non-A-sector) and of the factor contribution involved may not have been given the attention it deserves. ... this transfer of workers from the A-sector to the non-A-sector means a sizeable capital contribution because each migrant is of working age and represents some investment in past rearing and training to maturity.
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> ... granting that the 'contribution' in question depends upon the employment capacity of the non-A-sector, we could still agree that the internal migration of labor from agriculture represents a large contribution to the country's economic growth. 5/

### Dual Economy Models

Within the family of macro models of economic development only the so-called "dual economy" models which focus on the interaction between a traditional-cum-agriculture sector and modern-cum-manufacturing sector have incorporated migration or inter-occupational/inter-sectoral labor mobility as an explicit variable in the development process. In dualistic models the focus is on net labor transfers between the traditional or subsistence agricultural sector and the modern or manufacturing sector, as well as on the resultant changes in total and sectoral labor productivity, intersectoral terms of trade, and patterns of final demand. In all of the dualistic models migration is treated essentially within a classical model of factor mobility and these models abstract from migration processes much in the same

5/ "Economic Growth and the Contribution of Agriculture: Note on Measurement," in C. Eicher and L. Witt (eds.) Agriculture and Economic Development (New York: McGraw-Hill, 1964) p. 117,118.

way their treatment of population growth abstracts from the processes of natality and mortality.

The treatment of migration in the two best-known dualistic development models, those by Ranis and Fei, and Jorgenson, is typical of the treatment of migration in subsequent derivative models as well.

Ranis-Fei Model

The initial Ranis-Fei model assumed a closed economy in which a) when[6/] development starts the marginal product of a considerable fraction of the agricultural labor force is zero and the complement of arable land and agricultural capital is fixed; b) per capita consumption of food in the agricultural sector is initially determined by average output of the agricultural sector population even under conditions of technical labor redundancy, with these institutionally determined wage levels, initially above marginal product, persisting unchanged even after a portion of the potential labor force has been removed to the manufacturing sector; c) workers removed to the manufacturing sector buy out of wages the food they previously consumed on the farm; d) the market for manufactured goods is limited to manufacturing workers and the owners of capital, with no manufactured goods consumed by the agricultural population.

In the Ranis-Fei model economic development proceeds in three stages. In the first stage, during which there is absolute technical redundancy of agricultural labor, labor is available to the manufacturing sector at a constant wage which is equivalent to the institutional agricultural wage plus perhaps a premium to overcome economic and non-economic constraints on labor mobility; total agricultural output remains unchanged and the share of the

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6/ G. Ranis and J.C. H. Fei "A Theory of Economic Development," The American Economic Review. Vol 51 (Sept. 1961).

output previously consumed by transferred workers now goes to the urban food market.

When all technically redundant labor has been removed, the agricultural sector encounters what Ranis and Fei designate as the "shortage point" or the "Lewis turning point". In the phase of development which follows, further transfer of labor to the manufacturing sector reduces total agricultural output. Since workers in the agricultural sector continue to receive the institutional wage -- which remains above (now rising) marginal productivity -- the "average agricultural surplus" (AAS) available to manufacturing workers is reduced unless there is autonomous technological progress in agriculture. Falling AAS supresses real urban wages, and increases the supply price labor to the manufacturing sector as calculated in terms of manufactured goods. If capital accumulation in the manufacturing sector and/or technological progress in agriculture is sufficient to overcome this constraint on the expansion of manufacturing employment, marginal productivity in agriculture eventually converges on the institutional agricultural wage and the relative size of the agricultural labor force continues to decline. This point, called the "commercialization point" by Ranis and Fei, marks the beginning of the last development phase (identified with "take-off") wherein "we enter a world in which the agricultural sector is no longer dominated by non-market institutional forces but assumes the characteristics of a commercialized capitalist system". 7/

While much of the discussion surrounding the Ranis-Fei model has concerned the assumption of zero marginal productivity in agriculture during the first phase of development 8/, this is of less relevance to the question of off-farm

7/ Ranis and Fei (1961) op. cit. p. 543.

8/ Choe Sang-Chuel has suggested that if zero marginal productivity in agriculture ever existed in Korea, the "shortage point" had been passed by 1966 at the latest. See "Dual Economic approach to Regional Inequality and Migration Process (the Case of Korea)." Paper presented April 30, 1974, at a Seminar jointly sponsored by USIS and the Seoul National University.

migration than the mechanisms governing inter-sectoral labor transfers during the second phase of development. In the Ranis-Fei model off-farm migration is determined by three factors: the length of time required to reach the "commercialization point"; the distribution of the population between the two sectors at this point; and the rate of labor absorption by the manufacturing sector.

In their 1961 formulation, Ranis and Fei show that under their assumptions the percentage of the population in agriculture at the commercialization point, presuming no population growth, depends only on the coefficient of non-redundancy (i.e. the fraction of the agricultural population that is not technically redundant) at the outset of the development process.

When the population in both sectors is growing at a uniform, exogenously determined rate, the proportion of the population in agriculture at the "commercialization point" depends both on the non-redundancy coefficient and on the growth rate. Any positive rate of growth will in fact increase the proportion of the population that must be transferred out of the agricultural sector before commercialization (or "take-off") can be achieved. A further implication of the Ranis-Fei model is that the number of years required to reach the commercialization point can be determined given the initial fraction of the population outside agriculture, the initial non-redundancy coefficient, the rate of population growth and the rate of capital formation in the manufacturing sector (assuming no change in the capital-labor ratio).

In a subsequent paper Ranis and Fei themselves have presented a structural[9/] model of dualistic development which retains the assumptions of a closed economy, exogeneously determined population growth, an institutional agricultural wage

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9/ "Agrarianism, Dualism and Economic Development," in I. Adelman and E. Thorbecke (eds.) The Theory and Design of Economic Development (Baltimore: The Johns Hopkins Press, 1966) pp. 3-40.

and the fixity of land but includes a Cobb-Douglas production function in each sector which distinguishes between the causes of technological progress in agriculture and manufacturing. Essentially, they argue that technological progress in manufacturing is determined exogenously by the stock of innovations that can be borrowed from already developed countries, while progress in agriculture is introduced by forward-looking agricultural entrepreneurs who are motivated by the desire "to acquire ownership of the industrial sector capital stock or industrial consumer goods." [10] The pace of progress is a linear function of the terms of trade between the two sectors.

In the later formulation, however, neither the time required to reach the "commercialization point" nor the proportion of the population in agriculture at this point are amenable to a simple solution since marginal productivity in agriculture is a function of the intensity of agricultural innovations which are in turn determined by the terms of trade between the sectors.

Both the formal implications of this model and the interpretation of the Japanese development experience on which it is based lead Ranis and Fei to argue that the connectedness of the agricultural and industrial sectors has been much neglected in the literature on dualistic development:

> "If the owner of the surplus can invest directly in an extension of the industrial sector close to the soil and in familiar surroundings, he is much more likely to choose the productivity cut of which further savings can be channelized ... intersectoral connectedness is much influenced by the growth of decentralized rural industry, often linked with large scale urban production stages via a putting-out system." [11]

Much of the criticism of the Ranis-Fei model has focused on the realism of the assumptions, especially that of a closed economy (Oshima), the persistence of a constant institutional wage in agriculture through the first

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10/ G. Ranis and J.C.H. Fei, (1966), op. cit. p. 39.

11/ Ibid., p. 39.

and second development stages (Oshima, Hagen), and the assumption that population growth is determined exogenously (Jorgenson). Only Harry Oshima has commented on the treatment of migration in the model. Oshima feels that the absolutely redundant population in agriculture "will move to the cities and in the short-run will be openly unemployed, as is the case in most parts of Asia today. In due time these unemployed workers will be absorbed into small industries and shops or will return to their villages."[12] How seriously the model is compromised by ignoring this preemptive movement to the cities depends on the effects it has on agricultural productivity, on the "institutional wage" and on the so-called "average agricultural surplus" which must be supplied to the non-agricultural population through the urban food market; this is a question which lies beyond the scope of this working paper.

Jorgenson Model

The Jorgenson model is characterized as a neo-classical model, in[13] contrast to the classical models of Lewis or Ranis and Fei, on the grounds that all factors of production are everywhere considered scarce and marginal productivity is nowhere nil or negative. Jorgenson assumes a quasi-institutional wage in agriculture which is variable and proportional to wages in the modern sector which are determined by marginal productivity. Population growth is determined endogenously as the difference between a birth rate which is constant and culturally determined and a death rate which varies directly with per capita income between maximum and minimum values. Land is fixed, and technological change (Hicksian-

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12/ "The Ranis-Fei Model of Economic Development: A Comment," in Eicher and Witt (1964) op. cit., p. 197.

13/ The discussion of the Jorgenson model herein refers to the model as it appears in Dale W. Jorgenson, "The Role of Agriculture in Economic Development: Classical versus Neo-Classifical Models of Growths," Chapter 11 in Clifton R. Wharton, Jr. (ed.) Subsistence Agriculture and Economic Development (Chicago: Aldine, 1969). This differs from the model as originally presented by Jorgenson in 1962 chiefly in the treatment of population growth. In the earlier version mortality rates were assumed to be constant while birth rates varied directly with income.

neutral as in Ranis-Fei's later model) proceeds at constant rates of intensity in both sectors. In the Jorgenson model sustained growth requires that agricultural production be maintained at or above the critical level which minimizes the force of mortality and by implication allows population growth to reach its maximum value. This level of production is reached only if the advanced sector is economically viable and able to escape the "low equilibrium trap" case.

Having surpassed the critical level of productivity, the distribution of the labor force between the agricultural and non-agricultural sectors is equal to the ratio between the critical level of per capita output in agricultural products and the current level of per capita output in agriculture.

In the Jorgenson model, also, the parameters of the model completely determine the relative size of the agricultural population at each point in the development cycle, and hence set the profile of net migration out of agriculture over time.

Bruce F. Johnston has remarked that

> "... for countries at an early stage of development there are cogent reasons for assuming that the causal factors work in such a way that the rate of change in the agricultural population (or labor force) is the dependent variable. That is, owing to institutional arrangements such as the family farm or a 'communal' system of land tenure, which gives agriculture its special character as the 'self-employment sector,' the size of the agricultural labor force is determined essentially as a residual."14/

While one might agree in general with this characterization, the residual character of the agricultural labor force is far from total and a variety of social and institutional factors constrain the rate of movement of labor in either direction between the agricultural and non-agricultural sector.

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14/ B.F. Johnston, "Sectoral Interdependence, Structural Transformation, and Agricultural Growth," in C.R. Wharton (ed.) (1969) op. cit.

At some point in our subsequent work on off-farm migration the authors of this working paper hope to trace the time-paths of agricultural out-migration which are implied by the Ranis-Fei and Jorgenson models using a range of parameter values. Comparison of these net migration profiles with those that have actually occured in Japan and other countries may provide one measure of the realism of such macro dual economy models. In particular it should be possible to note at what point in the development process the net migration profiles implied by the dual economy models begin to depart significantly from profiles that seem reasonable on the basis of historical experience and sociological considerations. It will, at the same time, be possible to observe the range of parameter values that corresponds to feasible rates of net withdrawal from agriculture.

Sandee Model

One of the simplest models simulating the processes of dualistic development is a programming model for a dual economy presented by Jan Sandee. As a "programming model" it is constrained by terminal year target values but nonetheless offers some insights on the quasi-endogenous treatment of migration.

The Sandee model consists of a traditional peasant agricultural sector, and a modern sector which has "factories, plantations, wage labor, cities, tap water, sewers, manufactured goods, cinemas, taxes, banks, and police." 15/ Moreover, "to enjoy all these advantages people migrate toward the cities. The birth rate in the urban areas remains somewhat lower than in the rural sector. Products of the modern sector are shipped by rail or by sea to destinations within the country and to the developed areas of the world." 16/

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15/ Jan Sandee, "A Programming Model for a Dual Economy," in E. Thorbecke (ed.) The Role of Agriculture in Economic Development (New York: Universities-NBER, 1969) p. 220.

16/ loc. cit.

The model includes 9 exogenous policy variables and 16 endogenous variables, 14 of which are constrained by provisional final year targets for a five year planning period. Net migration is assumed to average a half million persons a year over the period. The elements that make this model of interest are those that tie realized net annual migration into the model proper.

Net rural-urban migration is treated as a linear function of the difference between urban and rural standards of living. Working through a number of intermediate relationships, the urban standard of living depends on urban productive investment, urban slack capacity, urban consumption of food, and the terms of trade between the sectors. The rural standard of living depends on the rural consumption of food and manufactures, which in turn is a function of the terms of trade, and the amount of food sold to the urban sector in competition with foreign food imports.

The reduced matrix of the programming model indicates that migration is reasonably insensitive to changes in the policy variables. In the case of the variables to which migration is sensitive, a doubling of exports leads to a 38% increase in net annual migration from the rural sector over the expected amount. A doubling of foreign capital imports, the only other variable to which net migration was sensitive, results in only a 10% increase in net annual rural-urban migration.
Even with these two variables the sensitivity of migration appears to arise chiefly because as an accounting convention food imports are computed as simply

the sum of export earnings plus foreign capital imports minus non-food imports. Food imports, which go to the urban areas, reduce domestic food transfers, rural consumption of manufactures, and hence the rural standard of living.

Optimalization of rural income in the model resulted in only a 16% improvement over the target income level,[17] and under none of policy options tested by Sandee was net rural-urban migration in the final year reduced by as much as 8%. With respect to migration, Sandee concludes " this aspect of duality is probably of far less importance than food prices, food subsidies, and food rationing."[18]

17/ Ibid., pp. 228f , Tables 3,4,5.

18/ Ibid., p. 227.

## Simulation Models

### Byerlee-Halter Model

The Byerlee-Halter model[19] developed to simulate the indirect employment and income distribution effects of alternative agricultural development strategies makes a conscious attempt to improve upon the simplistic treatment of urban and rual wage determination and rural-urban migration of most dualistic models.

Structurally, net migration from the agricultural sector is influenced by total population growth (exogenous), and the discrepancy between expected urban wages and expected rural income from both agricultural and non-agricultural activities.

Byerlee employs an extension of the Todaro-Harris model of migration in which urban modern sector wages are institutionally fixed and expected urban wages depend on wages and the probability of gaining employment in the modern sector.

Formally, the migration function in Byerlee-Halter is

$$M(t) = M(t-dt)\left[1 + b \cdot D\left(d\left[\frac{W_a}{E(W_n)}\right]\Big/\frac{W_a}{E(W_n)}\right)dt\right]$$

where

$M(t)$ = the proportion of the agricultural population that migrates in a given year.

$D(\ )$ = an exponentially lagged response function to changes in the ratio of agricultural income to expected non-agricultural income,

$$d\,\frac{W_a}{E(W_n)} \Big/ \frac{W_a}{E(W_n)}$$

[19] Derek Byerlee and A.N. Halter "A Macro-Economic Model for Agricultural Sector Analysis" American Journal of Agricultural Economics, Vol. 56, No. 3 (Aug. 1974).

$W_a$ = average real income in agriculture.

b = elasticity of migration with respect to lagged changes in the differential between agricultural and non-agricultural incomes.

$E(W_n)$ = expected non-agricultural income.

Expected non-agricultural wages, a central component of the model, are calculated as

$$E(W_n) = \frac{L^s(t)\cdot W_s(t) + H\left[L_g^w(t)\cdot \bar{W}_g(t) + \sum_{i=5}^{10} L_i^w(t)\cdot \bar{W}_i(t)\right]}{L_U}$$

Where

$L^s, L_i^w, L_g^w$ = small sector self-employment, "i" th large-sector employment, and government employment, respectively.

$\bar{W}_i, \bar{W}_g$ = exogenously determined wage rates in the "i" th large-scale sector and government sector, respectively.

$W_s$ = average income in the small scale sector, calculated as total returns to labor divided by the small-sector labor force which is calculated residually.

$L_U$ = total urban labor force:

$$L_U = L^s + L_g^w + \sum_{i=5}^{10} L_i^w$$

H = "a weighting coefficient to reflect the higher probability that migrants will obtain a job in the large-scale and government sectors because of their above average education". $H > 1$.

In the Byerlee -Halter model labor input in each modern industrial sector is determined from an I-O matrix under the assumption that employment expands at the same rate as total output, with exogenous adjustments for changes in productivity levels.

Wages in each sector are determined exogenously, as are wages in the public sector. Public sector employment is determined by the total government personnel

budget divided by public sector wages. Small urban sector employment and wages depend on an approach similar to that used in the BACHUE-2 model discussed below: small-sector self-employment includes the entire non-agricultural labor force not occupied in the modern sector, and wages in this sector are calculated as total small sector value-added accruing to labor divided by this residual labor force.

BACHUE - 2 Model

The BACHUE-2 model of population and employment specified for the Philippines did not include a final form of a migration function as of the writing of Working Paper 5 [20], although a considerable amount of empirical research on migration in the Philippines had already been conducted in conjunction with the model.

The demographic accounting system of BACHUE-2 dissects the population into 152 groups along 4 dimensions: age (sixteen categories), sex (male, female), location (rural,urban) and education (three categories). In the accounting system only net migration is considered but the authors indicate that net migration will be calculated as a residual from estimates of rural-urban and urban-rural streams. The behavior of migrants is not distinguished from that of non-migrants in the sub-models of educational passage, fertility, or mortality.

The empirical basis of the proposed BACHUE-2 treatment of migration is two studies based on data from the 1968 National Demographic Survey. The first is a micro analysis of the migration of persons married as of 1968 in which the dependent variable is a dichotomous dummy, migrated or not migrated, and the

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20/ R. Wery, G.B. Rodgers, M.D. Hopkins BACHUE-2: Version - I, A Population and Employment Model for the Philippines, Population and Employment Working Paper No. 5, ILO, Geneva (July 1974).

independent variables are age variables and dummy variables covering educational attainment levels, work status, wage status, occupational status, and marital status at the beginning of the migration interval, as well as father's wage and occupational status at age 40, and current farm or non-farm residence. Migration is defined and measured on the change of residence basis.[21/]

A second, macro model regresses aggregate gross inter-regional migration rates ($M_{ij}/P_i$) on a variety of "push" and "pull" factors at both origin and destination. These include distance between origin and destination, average income in each region, a coefficient of variance in household incomes, percentage of "modern" employment, school enrollment rates, and dummy variables on access to good water and the availability of electricity. The model is run separately for males and females by rural-urban and urban-rural streams.[22/]

With regard to the form of the proposed migration sub-model, the authors report that aggregate migration rates for each sex in each stream will be determined from a model incorporating the estimated responsiveness to the origin-destination income ratio, origin income inequality, and percentage of modern employment at origin--variables which except for destination income, appeared significant in the macro analysis of rural-urban migration. Distance, althrough significant in the empirical results, is excluded as irrelevant to the BACHUE-2 model. The micro—analytic results with respect to education, age, sex, and marital status are retained and "treated as classifiers, generating age-sex-education-marital status specific multipliers on overall migration given by the macro

21/ Ibid. pp. 105-6.

22/ Ibid. pp. 109-11.

function."[23] The authors do not mention how the groups excluded from the macro-analysis, the young and unmarried, will be handled.

Urban Dynamics

The treatment of in- and out-migration from a single city in Jay Forester's urban dynamics model is of interest even though it refers to a developed economy and takes an essentially engineering approach.[24] Forester's model is unique in that it recognizes three social classes and models the migration decision on social mobility aspirations rather than economic aspirations.

The rate of gross in- or out-migration is treated separately for each social class, and the treatment afforded Forester's "underemployed class" is representative of that afforded the others.

Normal in-migration among the "underemployed" is set at 5% a year of the total of the underemployed population and the "laboring" population. This normal flow rate is modified by an attractiveness multiplier reflecting stock levels in several other variables: (a) scarcity in the underemployed housing stock, (b) the ratio of jobs available to the underemployed to the underemployed population, (C) the per capita level of public expenditures, (d) the perceived probability of upward mobility from underemployed to laboring class status. Two delays are built into the attractiveness multiplier -- perceived mobility is a delay function of past realized mobility to allow for "training time and time necessary for social influences to become effective,"[25] and the multiplier itself is a distributed lag function over the actual values of the various component factors.

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23/ Ibid. p. 112.

24/ Jay Forester, Urban Dynamics (Cambridge: MIT Press, 1969).

25/ Ibid., p. 150.

Out-migration among the "underemployed population" is based on a normal rate of 2% a year of the underemployed population, modified by the underemployed departure multiplier which is the reciprocal of the attractiveness multiplier.

The realism and usefulness of the Forester approach is seriously compromised by the abstraction from economic variables and the ubiquitous reliance on tabular functions which may prove difficult to parameterize on real data. Forester's explicit inclusion of social processes marks a step forward in the simulation of social systems, however, and the model provides useful guidelines for incorporating such considerations into models of rural-urban migration in developing countries.

Purdue Demographic Model

The proposed PDM model[26] takes the most disaggregated approach to internal migration of any of the simulation models discussed in this section. Internal migration in the PDM model depends on the calculation of ninety net migration rates, a rate for each of three pairs of the model's three locations (ie. "urban", "agriculture", "rural non-agriculture") for thirty population sub-groups. These population sub-groups are defined by three age groupings, both sexes, and five levels of educational attainment. The model would appear to assume that the sub-group migration rates are independent probabilities and predicts these rates on the basis of differences in the value of socio-economic indices between origin and destination. The indices provided within the model are:

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26/ To be fair, the only available information concerning the PDM model was a summary outline entitled "Extracts from Population As a Variable in the Economic Development Process with Special Emphasis on Relationships with the Agricultural Sector!"

a. the availability of medical services (physicians per capita)
b. the accessibility of educational opportunities to both children and adults (age-specific enrollment rates)
c. the prevailing level of education and education-related skills (average levels of educational attainment)
d. the prevailing levels of material welfare (per capita income)
e. the anticipated levels of future material welfare (rate of growth of per capita income)
f. the expected value of labor services (prevailing wage rates multiplied by the probability of being employed)
g. the population "pressure" faced by the potential migrant if he remains in his present environment versus that he will face if he moves (a sub-group's relative share in the total population at each location)

The theoretical and operational difficulties of using net migration rates are noted at various points in this paper. The "expected value of labor services" variable also suggests an affinity to the Todaro model, although as in the case of the Byerlee-Halter model the explicit recognition of the process of migrant economic integration that is incorporated within the Todaro model is absent.

While almost all of the factors reflected in the PDM model have been included in one or another econometric models of migration, variables such as average educational attainment levels, school enrollment, and amenity indicators such as the number of physicians per capita have not yielded unequivocal results--for reasons which are elaborated below. The list of included factors also ignores several which have proven to be very significant, such as migrant stock and distance.

Korean Agricultural Sector Model

All demographic parameters in the first version of KASM were handled exogenously. Two separate studies provide the empirical basis for the treatment of population in the model: J.A. Beegle and B.D. Kim's projection of population growth and rural-urban migration and Dale Hathaway's estimates of

labor force participation rates and total regional labor force.[27]

In calculating the expected rate of rural out-migration (their estimates were not in fact used in the final version, however), Beegle and Kim assume that the average annual number of net rural-urban migrants experienced between 1961 and 1966 in the three cropping regions recognized in the model would continue through 1969, declining by 40% a year in each of the next three successive years, and thereafter remain stable up until 1985. Evidently the sole rational for making these assumptions was the authors' belief "it was clear that the same level of migration would soon denude rural areas if extended far into the projection period."[28]

Although the Beegle-Kim estimates of net rural-urban migration were not employed as such, they did influence the Hathaway projections of total available labor force. Hathaway first projected age-sex specific labor force participation rates for the farm and non-farm household populations based on an extrapolation of recent trends. Using these rates and the Beegle-Kim estimates or rural and urban population by region Hathaway next projected total labor force in each region (assuming a 5% rate of unemployment). Next, with slight adjustments to the EPB projected rates of employment expansion in non-agricultural sectors, total non-agricultural employment in each region was projected, and the residual labor force in each region assigned to that region's agricultural sector.

The final projections of rural-urban migration for the KASM model were computed by Carroll "based on the assumption that people would leave agriculture to fill jobs created by a 7 per cent annual rate of expansion of employment

27/ Both studies are reported in J.A. Beegle, T.W. Carroll, et al., KASS Special Report 6: Population, Migration, and Agricultural Labor Supply, Agricultural Economics Research Institute, MOAF, and Dept. of Agricultural Economics, MSU, East Lansing (n.d.)

28/ Ibid., p. 30.

between 1970 and 1985, with a 5% unemployment rate." The rate of net out-migration from the agricultural population was adjusted from approximately 1% (.80,000 net migrants) per year in 1970 to approximately 13% (900,000 net migrants) per year in 1985 in order to make the projection of the agricultural labor force from the KASM population component track to Hathaway's projection of the agricultural labor force determined by the residual method. The age-sex distribution of net rural-urban migrants was determined by maintaining constant ratios between the net rural out-migration rate in each two-year age-sex cohort and adjusting the total migration rate to generate the required number of migrants. Unlike Beegle and Kim, Carroll felt that there was insufficient evidence to justify the assumption of significant differences in the out-migration rate between cropping regions, and used weighted regional age-sex migration rates from the period 1961-1966 to specify the inter-cohort net migration ratios.[29] In addition to the undesireability of treating all demographic variables exogenously in a model of the breadth and complexity of KASM, several specific comments can be made about the present treatment of rural-urban migration and employment.

Beyond the questionable assumptions on which the Beegle-Kim estimates of rural-urban migration are made, the 1966 Special Demographic Survey on which these estimates are based had a very small sampling ratio (1:450 for the urban population and 1:750 for the rural population) and reflected observations on approximately 850 households making intra-or inter-provincial moves. These were distributed among 226 possible migration streams between the rural and urban sectors. Compared to a census survival ratio estimate for the same period the 1966 SDS underestimates total rural-urban movement by 40%, yields a somewhat distorted age-sex distribution for net rural-urban migration, and displays very large errors in the estimates of rural out-migration at the level of individual provinces. This is the apparent source of the very large differences in net

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[29] Ibid., p. 48.

out-migration rates found for the three ecological regions. However, even within the 1966 SDS figures there is greater variance in the net out-migration rates between the provinces within each cropping region than between cropping regions as wholes.

The Beegle-Kim estimates also fail to incorporate any interaction between migration and the expansion of urban/non-agricultural employment. In the final analysis this is a more serious short-coming than the decision to begin from absolute levels of net migration rather than from migration rates.

The weaknesses of the Beegle-Kim treatment of migration are carried over into the projections of non-farm and farm employment and labor force made by Hathaway. Since Hathaway accepts the Beegle-Kim projections of the "urban" and "rural" populations, his calculation of total regional labor force implicitly reflects assumptions concerning the division between agricultural and non-agricultural employment--the division between "urban" and "rural" in the KASM model being consciously defined in a manner that approximates the division between the non-farm and farm populations. As a consequence the projections of non-agricultural employment made by Hathaway can only be reconciled with the Beegle-Kim population projections if it is deemed reasonable that a growing proportion of the non-agricultural labor force is located within the "rural" sector. Otherwise, Hathaway's employment projections must be reduced, non-agricultural labor force participation rates increased, or more urban in-migration allowed for (see following table).

Table 1. Inconsistencies between the Beegle-Kim Projections of the Urban and Rural Populations and the Hathaway Projections of Non-Agricultural Employment.

| | Year 1975 | 1980 | 1985 |
|---|---|---|---|
| (A) Urban population as projected by Beegle and Kim (1000): | 19,379 | 21,922 | 24,576 |
| (B) Size of urban labor force implied by Beegle-Kim estimates and the non-farm labor force participation rates assumed by Hathaway* (1000): | 6,356 | 7,190 | 8,060 |
| (C) Minimum estimate of non-agricultural employment as projected by Hathaway (1000): | 6,391 | 8,605 | 11,636 |
| (D) Percent of the non-agricultural work force implied to be employed in the rural sector**: | 5.5% | 20.6% | 34.2% |

* based on the age-specific labor force participation rates used by Hathaway, and the 1970 urban age/sex distribution. These estimates imply that 32.8% of the urban population is in the labor force, and and urban dependency ratio of 2.05.

** assuming, along with Hathaway, a 5% unemployment rate in the urban sector.

The final estimates were tracked to the Hathaway projections for the sake of consistency and hence embody these same distributions. While it may be reasonable to assume that the relative responsiveness of different population sub-groups to economic and social incentives to migration remains fairly constant over a projection period of the length used in the KASS model, this assumption is appropriately applied to <u>gross</u> selectivity ratios. Migration selectivity is a behavioral concept, reflecting relative differences in the propensity to migrate. To this extent the concept is basically probabilistic, entailing the frequency of an act (migration, however defined) and a population-at-risk. The notion of net migration rates or selectivity is

somewhat of an anomaly precisely because there is no unambiquously appropriate population-at-risk. Whichever of the several possible denominators is chosen to calculate the net migration rate, there arises the question of the meaning of the rate from a behavioral perspective. If selectivity is approached from the side of gross migration then net migration rates and their relationship are artifacts of the size and selectivity of two cross-currents of movement. Over any long term, constant gross and constant net selectivity patterns are antithetical.

Analytical Weaknesses in the Treatment of Migration

The macro dual economy models and simulation models discussed above suffer from a number of analytical weaknesses and implicit assumptions which are largely untenable in the light of present knowledge about migration processes. Although all models necessarily include simplifications, it is important that the nature of these simplifications, the difficulties they raise for parameterization, and the extent to which they bias the conclusions or results be fully recognized.

In reviewing the models above, the authors have identified analytical weaknesses related to the following four aspects of the treatment of rural-urban migration:

a. the abstraction from physical space

b. the neglect of inter-sectoral activities and traditional-type non-agricultural sub-sectors, or their arbitrary assignment to either the traditional/agricultural sector or the modern/manufacturing sector.

c. the typical identification of labor force with total population even when endogenous treatment of population growth implies endogenously determined population structure

d. the unsatisfactory treatment of rural wages and/or income, and the failure in general to recognize differences in the social and economic meaning of work and labor force participation in the urban and rural sectors.

Abstraction from Physical Space

All of the above dual economy models ignore the influence of spatial juxtaposition on economic activities. Although a number of general frameworks for conjoining intersectoral and inter-regional activity flows have been developed[30],

30/ Much of this work depends on the contribution of Walter Isard and his students; see, for instance, The Methods of Regional Planning (Cambridge: MIT Press, 1960), especially chapters 4, 8, 10, 12. Isard's work is directed chiefly toward the construction of linear models of regional development, but much of it is applicable to a simulations approach as well.

when models have sought to focus on inter-regional relationships they have usually been made operationally feasible only at the cost of much realism in the handling of intersectoral relationships.

In a model of the scope and focus of KASM--and given the relative compactness of Korea itself--there is probably little to be gained by incorporating a complete inter-regional system into the body of the model. Nonetheless, it seems both desireable and realistic to introduce exogenous constant or variable parameters reflecting spatial relationships or alternative regional development strategies which might be considered subsequent versions of KASM when regionalization is re-introduced. Although it seems superfluous to say so, the mere introduction of two "locations" as in the Purdue Demographic Model or the BACHUE models does nothing to introduce such spatial relationships.

Why is space important? First, because distance and related potential variables have proved to be an important determinant of gross inter-regional migration flows even after non-spatial corollaries of distance have been accounted for. As elaborated on below, migration is at one time an inter-locational and inter-sectoral or inter-occupational movement and the factors influencing one type of movement inevitably influence the other as well.

Second, the juxtaposition of the agricultural and non-agricultural sectors affects the degree to which farm operators or farm households can derive income from non-farm employment. Already a considerable proportion of farm household income derives from non-agricultural activities,[31/] and if the experience

31/ The writers of the KASS Special Report No. 8 apparently feel that side employment is "an attempt on the part of the many small farmers to augment their income in about the only way they have, because they cannot very readily expand the area in their farms." (Y.S. Kim, K. H. Kim, K. T. Wright Crop Production Data and Relationships, NAERI-MSU (1972) p. 34). Table 8 (p.35) of that report, however, suggests a U-shaped relationship of total non-agricultural income to farm size (and agricultural income). Without entering upon an extended discussion, this seems to contradict the conclusion that non-agricultural work is a last report for those with insufficient land to provide an adequate livelihood through fulltime farming.

of the United States and other developed nations is considered, the solution to rural welfare problems is more likely to be achieved through increasing non-farm employment opportunities for the farm population than through policies directed exclusively at increasing farm labor productivity and expanding the opportunities for viable full-time farming. 32/

The relationships implied here are not encompassed solely by policy parameters establishing the amount of new modern sector employment to be established in the rural sector. The extent of intra-rural income multiplier effects depends in large part on the degree to which urban services or production activities can be difused-out or filtered down to the rural sector.

Spatial juxtapostion also affects the rural-urban division of income from inter-sectoral activities. To cite only the most obvious example, farm households that are closer to their urban markets have a greater opportunity to transport their produce to market directly, or through local cooperative organizations, This permits farm households to secure a share of the value-added that would otherwise go to urban-based commercial transporters, wholesalers, and retailers.

The availability of rural non-agricultural employment, or increased potential

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32/ With respect to Korea, R.H. Johnson has noted that: "The differentials in average income among provinces are of people in low income occupations. Income policy is likely to be are of people in low income occupations. Income policy is likely to be effective in proportion to the degree to which it is directed to the cause of low income, rather than its location. The analytical base for an income policy should be developed in terms of the structural factors associated with low income, rather than in terms of regional average-incomes." See: "Comments on Regional Aspects of the Third Five-Year Plan," in Basic Documents and Selected Papers of Korea's Third Five-Year Economic Plan (1972-1976), edited by S.H. Jo and S.Y. Park (Seoul: Sogang University Press, 1972). Similar conclusions have been roached by researcher concerned with regional and rural-urban income differences in developed nations.

for farm-city commuting is also likely to have a stabilizing effect on the supply price of hired agricultural labor during the two seasonal peaks (totally a period of four months) which account for about 55% of the total yearly labor input into Korean agriculture.[33/] Many of those raised in a farm environment but chiefly employed in non-agricultural occupations may be available for farm work during these periods. Likewise their dependents, who, had they migrated to the city, would be essentially lost to the rural labor market.

The third influence of space is what might be called its "market effect." Agricultural activities as a whole are intensive users of land, and ever since the publication of von Thunen's Der Isolierte Staat (1826) it has been recognized that farmgate-to-market distance has an important influence on both the choice of crops and the degree of intensity of cultivation. These considerations may be of little significance in a subsistence peasant economy, but they will become more important as the degree of commercialization increases.

Distance also provides agricultural producers a degree of monopoly protection against producers located further from the same market—an advantage reflected in locational premiums on land rent. With a more dispersed pattern of urban development effective protection with respect to one urban market or another is likely to involve a greater proportion of farm operators since marginal transportation costs decline with distance. A measure of market-share security, coupled with better market information growing out of more direct interaction between the agricultural producer and the urban market, is likely to encourage more rational planning in farm management.

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33/ Kim, Kim, and Wright, op. cit., p. 30 f.

Easier access and more frequent iteraction with the urban sector will also serve to lower the effective price of urban goods and services to rural consumers-thereby stimulating consumption and the desire for cash income. It has been argued that a preference for modern services or manufactured goods spurs rural-urban migration (although the "bright lights" theory of migration is now largely discredited); it is equally possible, however, that the greater access to such goods and services, even if they are not available in the immediate community, may reduce the perceived real income differentials existing between the rural and urban sectors.

To recapitulate, it seems important that a simulation model of the development of a dualistic agricultural sector incorporate some recognition of the effects of the spatial juxtaposition of modern/urban - traditional/rural activities on the potential for non-agricultural employment by farm household members, on the rate and pattern of agricultural development and commercialization, and--within the framework of a population sub-model--on rural-urban migration.

The Allocation of Economic Activities

The second weakness of an aggregate two sector model is that all activities are forced into either the modern urban manufacturing or traditional rural agricultural sector. Many of the two-digit industrial classification categories for which data is available in developing countries include both modern technology-using and traditional or craft technology-using firms, and it is a characteristic of dualistic development that closely substitutable modern and traditional activities exist side by side for a prolonged period. Since the technological frontiers and production functions differ between the two types of firms in each sector, growth within each sector consists not merely of capital and labor augmentation to a homogenous production function, but includes changes

in the proportions of sector output produced under very different production functions. 34/

Two of the simulation models discussed above have incorporated useful compromise solutions to this problem. The Byerlee-Halter model developed for sub-Sahara Africa, and Nigeria in particular, allocates activities to the modern or traditional economic modes on the basis of dominant firm size. Moreover, firm size itself is the basis on which manufacturing activities and commercial and service activities are divided into the small manufacturing sector, large manufacturing sector, small trade/services sector and large services sector. 35/

The BACHUE-2 model of population and employment developed for the Philippines incorporates a comparable division of sectors. In BACHUE-2 the division is into modern and absorptive categories on the basis of mixed criteria including wage levels, firm size and extent of self-employment. In addition, each sector is assigned to the urban or rural location or, in the case of three sectors, to an intermediary "split" category. 36/ The division of non-agricultural activities differs from that of Byerlee-Halter primarily in the separation of capital goods from other manufacturing, the lumping of utilities and transportation activities, and the treatment of government as an independent sector. Both Byerlee-Halter

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34/ R. R. Nelson, T. P. Schultz, and R. L. Slighton Structural Change in Developing Economy: Columbia's Problems and Prospects (Princeton: Princeton U. P., 1971) esp. pp. 103-27.

35/ The Byerlee-Halter sectors are (1) export and large scale agriculture, (2) residual agriculture, (3) small scale manufacturing, (4) small trade and services, (5) mining (large scale), (6) construction (large scale), (7) transportation (small scale), (8) utilities (large scale), (9) large scale manufacturing, (10) large scale services.
(Derek Byerlee, Indirect Employment and Income Distribution Effects of Agricultural Development Strategies: A Simulation Approach Applied to Nigeria, African Rural Employment Paper No. 9, Dept. of Agricultural Economics, Michigan State University, 1973.

36/ The BACHUE-2 sectors, by type (M=modern, A=absorptive) and location (U=urban, R=rural, S="split"), are (1) domestic food crops (A,R), (2) export crops (M,R), (con't)

and BACHUE-2 assume that modern employment-wage relationships hold in the large-scale or modern sectors, while the small-scale sectors are assumed to absorb the remainder of the available labor force. Hence neither model forces migration to track directly onto modern sector employment expansion.

Labor Force Participation

Implicit in the macro dual economy models is the assumption that the labor force is equivalent to, or stands in some constant relationship to population, so that the rate of growth in the former is equivalent to that in the latter.37/ Different growth rates, however, and different regimes of mortality and natality leading to the same growth rate, have an important influence on the overall dependency ratio,38/ and will clearly influence the labor force participation of women as primary or secondary workers.39/

(con't)

(3) livestock and fishing (A,R), (4) forestry (M,R), (5) mining(M,U), (6) modern consumer goods (M,U), (7) traditional consumer goods (A,S), (8) other manufactures (M,U), (9) construction (M,S), (10) transportation and utilities (M,S), (11) modern services and wholesale (M,U), (12) traditional services and retail (A,S), (13) government (M,U), R.Wery, G.B. Rodgers, M.D. Hopkins BACHUE-2: Version I, A Population and Employment Model for the Philippines, World Employment Programming Research, Population and Employment Working Paper No. 5, ILO, Geneva.

37/ Vernon W. Ruttan "Comment: Two Sector Models and Development Policy" in Subsistence Agriculture and Economic Development (Chicago: Aldine, 1969), edited by Clifton R. Wharton, Jr., p. 355.

38/ Joseph T. Spengler, "Demographic Factors and Early Modern Economic Development" in Daedalus (Spring, 1968).

39/ John Craig is critical of the assumption in KASS that fertility declines will affect the labor force only through the size of the birth cohort, while in fact, it should also be expected to also affect the participation rates of fecund women already in working ages because they may be marrying later, and face fewer child-care demands on their time. He also notes that the rate of population growth may affect savings and capital accumulation--although the presence and direction of such an effect have yet to be empirically validated. John E. Craig, Jr. "Evaluation of the Demographic Component, Korean Agricultural Sector Study" Socio-Economic Analysis staff, International Statistics Program, U.S. Bureau of the Census. Typescript, March 15, 1974, p. 17.

The appropriate modelling of labor force participation is particularly important to the question of migration when the labor supply in certain sectors is calculated residually and the wages in these sectors determined by average rather than marginal value-added. At present KASM employs Hatheway's exogenous projections of age and sex specific labor force participation rates in the rural and urban sectors based on trends in the EPB annual survey of economic activity rates in farm and non-farm households. In contrast, BACHUE-2 encorporates an elaborate model for generating labor force participation rates endogenously--based on a linear regression estimation model including variables suggested by a household decision model of labor force participation.40/ The authors concluded,however, that models based on time-allocation theory developed in the context of labor force behavior in the advanced economies do not appear to be relevant to the situation in developing countries.

Labor force participation is at best a fuzzy concept, and the appropriate interpretation of the data collected to measure it is not unambiguous. Both questions are compounded in a developing country were the division between productive work and non-productive work within the household or in family firms is vague.

At present Korean labor force participation statistics are based on criteria of labor force participation and employment developed to measure the extent of unemployment during the U.S. Depression of the 1930's. As Rae-Young Park notes, "looking for work" as one criteria for enclusion among the measured unemployed breaks down when public labor exchanges and private employment services

40/ Wery, et al, op. cit. p. 56-68

are poorly developed and when a large proportion of employment is secured through personal contacts rather than direct application to the individual firm.[41]

Reported labor force participation in Korea is also strongly influenced[42] by current economic conditions of both a seasonal and cyclical nature. Lee Kyu-sik has found statistically significant confirmation of the "discouraged worker" hypothesis for male and female, farm and non-farmer workers in all age groups. The sensitivity of labor force participation rates to changes in employment levels is greatest among cohorts in which secondary workers are concentrated, and among females in general. He also finds that participation rates among the farm population are more sensitive than those of the non-farm population, suggesting the presence of considerable hidden rural unemployment--Mincer having noted that "the importance of hidden unemployment in a population group is a direct function of the degree of labor force responsiveness to short-run variations in employment conditions." [43]

The much greater sensitivity of labor force participation rates to cyclical changes in employment in Korea than in the U.S.[44] forces one to question the realism of using historical participation rates to determine labor supply, since to an important extent these rates have emerged as a behavioral artifact of demand-side constraints. This has been particularly the case among those cohorts in which the greatest increase in labor force participation is anticipated.

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41/ "Population Pressure on Labor Force in Korea", Paper presented at ILCORK Conference on Population Growth and Its Societal Impacts, Pusan, Korea, Feb. 21-24, 1974.

42/ "Labor Force Behavior in Korea" Paper presented at the ILCORK Conference on Population Growth and Its Societal Impacts, Pusan, Korea, Feb. 21-24, 1974.

43/ J. Mincer "Labor Force Participation and Unemployment: A Review of Recent Evidence", in Prosperity and Unemployment (New York: Wiley & Sons, 1966). p. 101.

44/ Lee Kyu-sik, op. cit. p. 8.

The BACHUE-2 group seem to suggest by implication that a social definition of labor force participation would be desireable if there were some agreement on the guidelines that should determine such a definition.[45] In the absence of such a definition BACHUE-2 employs a multivariant algoritm for estimating labor force participation, with the caveat, noted above, that many of the behavioral relations which appear to be important determinants of labor force participation in developed countries are less readily applied to the Philippines or other developing countries.

If it is necessary to choose between simplified approaches for use in the KASM, an ad hoc approach which focuses on problematic population sub-groups would seem to be the most reasonable alternative if some equivalent of Kuznet's "socially approved labor force" can not be operationalized.

We suggest that in the Korean case the major difficulties in estimating labor force participation concern that of young adult males in both the urban and rural sectors, urban females under age 25 and over age 45, and the rural female population in general.

In recent years the decline in urban marital fertility has been such that further declines of a magnitude sufficient to significantly increase the labor force participation of married women in their twenties and thirties should not be expected. On the contrary, there is evidence that marital fertility has increased in these ages as desired births are concentrated in a shorter period.[46]

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45/ R. Wery, et al. p. 56.

46/ Cho Lee-jay "Korean Population: Trends and Prospects", a paper prepared for the ILCORK Conference on Population and Its Societal Impacts, Pusan, Korea, Feb. 21-24, 1974

With fewer births in later married years some change in the labor force participation rates among older women seems likely, but the major changes in urban female labor force participation will undoubtedly occur in the groups 15-25 years of age as the age at marriage rises and labor force participation by unmarried women becomes increasingly acceptable. While further declines in rural marital fertility are expected, very serious conceptual difficulties surround the definition of female labor force participation in agriculture;[47] here reality may be best served by a concept of maximum feasible participation as governed by social and cultural values, fertility patterns, dependency rates, and the distribution of family structure types.

Among males between the ages of 30 and 50 (or 54) less than total labor force participation is probably chiefly a function of the incidence of disabilities. It may be useful to asume that the socially approved participation rate is the same in both the rural and urban sectors, while the lower actual rates in the former are a function of higher rates of incapacitation and limited opportunities for non-agricultural residual employment.

Treatment of participation rates among males under age 30, especially in the urban sector, is a much more serious problem. Reported open unemployment among these groups is fairly low, but a large proportion of those neither employed nor in school have reported themselves as "doing nothing" in several surveys.[48] No materials are available to suggest how many of those 15-19 so

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47/ One indication of this problem is the great disparity in the rates farm female labor force participation as measured in the 1970 Census of Population, and the 1970 Census of Agriculture, respectively.

48/ Cf. Gregory G. Y. Pai Rural to Urban Migration and Squatter Settlements with Special Reference to Seoul, Korea (Manuscript, Aug. 1973).

reporting are studying for the high-school or college entrance exams, waiting for an appropriate job (ie. they have an implicit reservation price on employment), or awaiting military induction. Others may be passively occupied part of the time in quasi-housekeeping activities or in watching a family shop, so that their entrance into the formal labor market is not entirely costless. A review of the social survey literature and discussions with Korean professors working on labor force problems may provide insights into this problem which would allow more sensitive modelling.

The labor force participation of young male farm-household population, turns on some of the same questions, but much less severely. It is probably appropriate to consider all those neither employed nor in school as potentially in the agricultural labor force.[49/]

Among older males in the urban sector, labor force participation rates in the modern wage employment sector are constrained by institutional retirement norms, while withdrawal from the absorptive sector is both difficult to measure and strongly influenced by the state of demand for absorptive sector services. Cultural norms affecting retirement are not fixed or unitary, and depend on both the family situation and the activity in which the worker has been engaged. The apparent rising trend in the participation of older male cohorts in agriculture is undoubtedly in part a function of increasing non-farm employment opportunities which reduce the commitment of primary workers to agriculture. For the purposes of KASM however, an extrapolation of historical trends would probably be sufficient—even a ten percentage-point shift in the labor force participation rates of males

49/ The validity of this assumption will depend in part on the spatial juxtaposition of farm and non-farm employment—the more accessible non-farm employment is, the more the behavior of young male farm household members will resemble that of young male urbanites.

over age 60 would have relatively little effect on total labor supply.

The Treatment of Rural Wages and Income

The treatment of rural wages and income in most dualistic development models is inadequate from the standpoint of providing inputs to the endogenous determination of rural-urban or off-farm migration. Within the tradition of the Ranis-Fei and Jorgenson type macro models, KASM presently outputs only measures of total and per capita farm income, with and without non-agricultural employment. It appears to be within the capabilities of the model as it now stands to generate average hourly wages for hired farm labor, and Abkin's NECON model anticipates the generation of non-agricultural wages in the rural and urban sectors, either exogenously or quasi-endogenously.[50] For the purposes of modelling migration endogenously, knowledge of wage levels by sex and educational attainment is of crucial importance, and in addition it would be desireable to have a further breakdown by broad age groupings--although for the reasons given below this is of less importance than the breakdown by sex and education. Since migration in Korea and elsewhere is often a household decision, it would also be desireable in the long-run to have some measure of the household income distribution, although we are still undecided as to how best incorporate this variable into a migration model. Both Byerlee and BACHUE-2 discuss sub-models for generating a household income distribution.

BACHUE-2 offers a useful model for the differential treatment of wages in the modern and absorptive sectors. In each modern sector except government wages are determined directly from the (Cobb-Douglas) production function.

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50/ NECON will also apparently be the source of the variable OTHINC (non-agricultural income of farm households). In KASM this appears in the calculation of farm incomes, but is referred to nowhere else in the KASM report or the User's Manual. Michael H. Abkin "On A National Macro Model Linking Korean Agriculture and Non-Agriculture" KASS Working Paper 74-3. Typescript (Aug. 22, 1974). Also, Thomas J. Manetsch, Tom W. Carroll "User's Manual for the Korean Agricultural Simulation Model--Version I," KASS Special Report No. 9 (Seoul: NAERI-MSU, June, 1973).

Equating wages with the marginal productivity of labor, the partial derivative of the production function with respect to labor yields $w(i) = (1-a(i)).Y(i)/L(i)$ where

$w(i)$ = wages in sector i.

$1-a(i)$ = elasticity of output with respect to labor (estimated from the I-O matrix).

$Y(i)$ = sector output, generated from final demand and the I-O matrix.

$L(i)$ = sector employment, also generated through a production function and the I-O matrix.

Absorptive wages, on the other hand, are determined by dividing total sector value-added by the sector labor input.

At present BACHUE-2 considers all labor to be homogenous in quality, but Working Paper 5 describes an approach which allows for two skill categories, persons with a secondary education or above being classified as skilled labor and others as unskilled labor.[51] Because we believe a realistic simulation model of migration in Korea must recognize differences in the behavior of population sub-groups with different levels of educational attainment, we feel it is useful to present in detail the algorithm for generating skilled and unskilled wages that is proposed by the BACHUE researchers.

First, it is assumed that skilled labor comprises a single labor market with skilled labor employed only in the modern sector and at a single wage level. The skilled labor wage is initially determined from empirical data on wages by occupation and educational attainment by occupation. On the basis of this estimated skilled labor wage, the elasticities of output with respect to skilled labor are estimated assuming a Cobb-Douglas production function in each sector. Formally:

$$\hat{b}(i) = \bar{w}(s) \cdot L(s,i)/Y(i)$$

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51/ R. Wery, et. al. (1974), op. cit., pp. 46ff.

where $\hat{b}(i)$ = the estimated elasticity of output with respect to skilled labor.

$\bar{w}(s)$ = initial estimate of the skilled labor wage.

$L(s,i)$ = initial complement of skilled labor in sector "i".

$Y(i)$ = initial output of sector "i".

In subsequent periods the skilled labor wage, $w^*(s)$, is obtained in equilibrium with $\bar{L}(s)$, the aggregate demand for skilled labor. This is achieved by beginning with an ex ante estimate of labor demand based on the previous period wage; that is

$$\hat{\bar{L}}(s) = \hat{L}(s,1) + \ldots + \hat{L}(s,i) + \ldots + \hat{L}(s,n)$$

with $$\hat{L}(s,i) = \hat{b}(i) \cdot \hat{Y}(i)/w(s)$$

where $n$ = the number of industrial sectors in the model.
$w(s)$ = the skilled labor wage rate in the preceding period.
$\hat{Y}(i)$ = the total estimated output of sector "i" in the period.
$\hat{b}(i)$ = the estimated elasticity of output in sector "i" with respect to skilled labor, as previously calculated.

From this initial estimate of the aggregate demand for skilled labor, the actual wage to skilled labor during the period, $w^*(s)$, is adjusted according to the formula

$$w^*(s) = w(s) \cdot \left[ 1 + h \frac{(\hat{\bar{L}}(s) - SL(s))}{\bar{L}(s)} \right]$$

where $SL(s)$ = the ex ante supply of skilled labor as determined by a variety of factors.

$h$ = a scalar damp factor "set at a number which experience shows will achieve convergence".

and other variables are as previously defined.

The nature of the algorithm for determining skilled labor demand and skilled labor wage makes it possible to reiterate to an equilibrium, full-employment wage in a single period, or to recognize that wage adjustment is often sticky, so that in the short-run there can be skilled worker unemployment or excess

demand and long-run adjustment is through the supply function of skilled labor.

The wage for unskilled workers in the modern sector is calculated analogously to the case in which homogeous labor quality is assumed. However, the production function from which the wage function is derived contains two classes of labor inputs. That is

$$Y(i) = A(i) \cdot K(i)^{a(i)} \cdot L(s,i)^{b(i)} \cdot L(u,i)^{1-a(i)-b(i)}$$

where $A(i)$ = a constant

$K(i)$ = the physical capital complement of sector "i".

$L(s,i)$ = the utilization of skilled labor in sector "i".

$L(u,i)$ = the utilization of unskilled labor in sector "i".

$a(i), b(i)$ = production elasticities with respect to physical capital and skilled labor. These can be assumed to remain at their estimated initial values, or be varied over time.

It follows that the unskilled labor wage in sector "i", $w(u,i)$, is simply

$$w(u,i) = \frac{\partial Y(i)}{\partial L(u,i)} = (1-a(i)-b(i)) \cdot Y(i)/L(u,i) .$$

Although future versions of the BACHUE series of models may incorporate two skill classifications, there is no discussion in Working Paper 5 (or by Byerlee and Halter (1974)) of the treatment of female wages. Females do not, however, receive the same wage as males with similar levels of educational attainment, and the expansion of female employment in the manufacturing sector during the early stages of development suggests that some means must be adopted to distinguish male and female modern wage rates even if it is only the assumption of a fixed or sliding ratio between the two.

The question of whether or not the modelling of migration requires disaggregation of wages by age as well as by sex and educational attainment level depends on the slope of age-wage profiles in the "real world" to which the model seeks to correspond. It also depends on the behavioral assumptions with respect to the decision to migrate which are incorporated in the model.

If the decision to migrate is assumed to be "purposive-rational," rather than "short-run hedonistic," then a model in which the economic component of the decision to migrate centers on a comparison of lifetime income expectations makes more sense than a model in which only current wages are considered. In fact, current or age-specific wages may be misleading if, as Gary Becker has argued, on-the-job-training (OJT) is a form of investment paid for, at least in part, by the worker himself through wages which short-fall marginal productivity during the training period. Clearly the movement of labor from a sector of higher wages to one in which current wages ar lower is not irrational if the difference in the present value of the training received in the latter exceeds that receivable in the former by more than the difference in wages.[52/]

Since on-the-job-training tends to be concentrated in the early working years, the years during which migration is also concentrated, the choice between one decision model and another is not trivial. In both developed and developing countries the possibility for investment in oneself through on-the-job-training is an important factor in the choice of occupation or in the decision to commit labor to a particular industrial sector. Although technology in the modern sector of a developing country is likely to be less sophisticated than in the developed country, the very fact that production processes tend

52/ Gary Becker, Human Capital: A Theoretical and Empirical Analysis with Particular Reference to Education (New York: NBER, 1964). Chap. 2.

to be less automated and are often a hybrid combination of capital-intensive stages using imported equipment and labor-intensive stages using craft-like techniques means that efficient production requires a great deal of essentially unstandardizable knowledge even if it is not primarily knowledge of a strictly technical sort. Moreover, in the less developed nation the small but emergent modern sector enjoys at least a short-run monopoly position as a producer of modern on-the-job-training--while persons trained in the sector hold a similar position in the short-run as the suppliers of modern, human-capital intensive labor services. Within the frame work of human investment theory, quasi-rents accruing to holders of scarce skills would raise the rate of return on modern OJT and lead to a bidding up of the price of modern OJT. This would result in greater disparity between wages and marginal productivity and increase the slope or convexity of the age-wage profile in a given occupation compared to that in the more developed countries. At the same time, however, higher rates of discount applied to future earnings, and a more rapid rate of training obsolescence might tend to reduce the slope of the wage-age profile with respect to that in a more developed country.

The shape of the age-wage profile in the various sectors of the Korean economy and the extent of human capital investment through on-the-job-training are questions lying beyond the ambit of migration analysis, but one implication of these issues is that age-specific wages may not properly capture the economic component of the decision to migrate. From a behavioral perspective however, we don't believe it is necessarily worthwhile to attempt to estimate the discounted current value of expected life time income streams.[53] Even in a

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53/ See pages 74-75 for an extension of this argument.

mature economy with a fairly complete data base the modelling of future wage expectations and the choice of discount rates imposes a number of important conceptual problems.[54] In a country undergoing rapid economic and social change these problems are clearly aggravated.

54/ Cf. Chennareddy Venkareddy, "Present Values of Expected Future Income Streams and their Relevance to Mobility of Farm Workers to the Non-Sector in the United States, 1917-62", unpublished PhD dissertation, Michigan State University, Department of Agricultural Economics (1965). Esp. pp. 28-49.

# IV. ECONOMETRIC MODELS OF GEOGRAPHICAL MOBILITY

## The General Structure of Econometric Models

In most models of dualistic development migration is treated as a mechanism which works to equalize the marginal productivity of labor in all regions. Labor demand is assumed to be largely unaffected by factors other than labor price. The market effects and agglomeration effects accompanying labor redistribution are typically ignored. In contrast, research focusing on migration itself has very often been spurred by curiousity about why labor supply adjustment to inter-regional or inter-occupational productivity differentials is so sluggish, the reasons underlying the persistence of those differentials, and the failure of incomes to rise in areas with high rates of population loss. Most econometric analysis of migration is cross-sectional, rather than longitudinal, in part due to the absence of adequate time-series data, especially in developing countries. Although the application of cross-sectional results to multi-period simulation models raises important theoretical problems, this compromise is made in both the BACHUE-2 and PDM models.

Econometric models of migration can be broadly divided into stock adjustment models founded on theories of the labor market, and behavioral models founded on theories of rational decision-making by individuals. Virtually all econometric models of each type, however, are of the general form

$$M = Q\left[f(E_i, E_j),\ g(S_i, S_j),\ h(G_{ij})\right]$$

where $M$ = the dependent variable, a measure of net or gross migration.
$f(E_i, E_j)$ = a function including economic variables at origin "i" and destination "j".
$g(S_i, S_j)$ = a function including social and demographic variables at origin "i" and destination "j".
$h(G_{ij})$ = a function of spatial variables reflecting the geographical juxaposition of origin "i" and destination "j".

It is convenient to organize this discussion on the basis of the treatment and composition of each of these components. Although there are many common elements between alternative models, comparisons of the "goodness of fit" are virtually meaningless because of wide differences in the nature and treatment of the independent variables and in the form of the dependent variable. Only rarely does a study show the results of different formulations using the same data base, and valid comparison of the results of various studies is limited at best to a comparison of which variables were found to be significant and the signs of the associated coefficients.

## The Dependent Variable

### Net Migration

From a labor supply adjustment perspective, net migration into or out of an area is the most logical focus of analysis. While total net migration (or the net migration rate) is in general very highly correlated with the amount (or rate) of employment expansion*, the use of such simple models for forecasting purposes is limited by the assumption that local employment expansion is unaffected by the size and structure of the local labor force. More elaborate net migration models try to avoid simultaneity problems either by excluding employment growth as a independent variable or using net migration within particular streams rather than for areas as a whole (see Fabricant model discussed below).

In general, models focusing on gross migration show better performance than those focusing on net migration, suggesting that the assumptions underlying the behavioral approach are a better approximation to reality than

* Roger Norton regressed net in-migration on the change in manufacturing employment in all Korean cities over 50,000 for the period 1960-66 with the following results:

$$NM = -12.1 + 5.05\ EE_m \qquad R^2 = 0.770$$

See "Formal Approaches to Regional Planning in Korea," published in I. Adelman, ed., Practical Approaches to Development Planning - Korea's Second Five Year Plan (Baltimore, John Hopkins Press, 1968).

those on which the labor supply adjustment approach is founded. Although his intention is only in part the comparison of net and gross migration formulations, Greenwood's results with U.S. inter-state migration data show a net migration formulation explaining half or less of the variance explained by a comparable gross migration model.[55] A large scale simulation model such as KASM is, of course, more interested in the net effect of population mobility than the gross flows per se; unfortunately however, no study of which we are aware has sought to test the accuracy of gross migration models in explaining net migration.

In juxaposition to the classical theory of labor mobility in which migration works in a straight-forward manner to equalize regional unemployment and wage rates, the growing literature on regional development and the problems of backward regions[56] lends weight to the disequilibrium model of labor mobility derived from Keynesian arguments. According to this view

> ... net change in migration in an area (has) multiplier effects on total income in the area analogous to those due to net changes in investment. At the same time, it seems that capital (is) likely to move in the same direction as labor. This could be due to changes in market size, a greater availability of skilled labor, or simply to the more expansionary climate evoked by a prosperous area as opposed to a depressed one.[57]

In the same vein, Perloff has suggested that the classical model of labor mobility is seriously flawed by a failure to recognize essential differences in the character of in- and out-migration. In-migration, Perloff argues, draws

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55/ Niles M. Hansen has been among the most prolific researchers in this area. See his Rural Poverty and the Urban Crisis: A Strategy for Regional Development (Bloomington: Indiana University Press, 1970).

56/ Michael J. Greenwood, "Lagged Response in the Decision to Migrate: A Reply," Journal of Regional Science Vol. 12, No. 2 (Aug. 1972).

57/ Harold Lind, "International Migration in Britain," Chapter 4 in Sociological Studies 2: Migration (Cambridge, Cambridge UP, 1969) edited by J.A. Jackson. (p. 76).

on a wide territory and might be expected to continue until wage levels are equalized, but out-migration depends most fundamentally on the propensity of the population at origin to migrate and secondarily on local labor market conditions. As migration draws off the most mobile and most productive, the remaining population is increasingly disfavored in terms of human resources, enjoys lower total disposable income, and is in general increasingly unattractive to expanding firms as either a final market or a source of labor.[58]

Perloff's argument receives support from a large number of sociological studies which indicate that, in general, the greater the absolute net migration in one direction relative to the total turnover (or, in formal terms, the higher the migration "efficiency") the greater the disparity in the patterns of age, sex, and educational selectivity between the two cross-flows. Furthermore, Vanderkamps' work on return migration suggests that the higher the efficiency ratio, the larger the proportion of returning natives in the in-migration stream to the population losing area -- hence less actual "new blood."[59]

Some net migration models attempt to avoid simple population adjustments by using as a dependent variable something other than absolute net migration or total net in- or out-migration rates. In constructing one of the more interesting migration models, Ruth Fabricant begins with a gross migration formulation based on a migration decision model and transforms it into a net migration model in which the dependent variable is the difference between cross-flows, each weighted by the ratio of the destination population

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58/ H. Perloff, E. Dunn, E. Lampard, Regions, Resources and Economic Growth (Philadelphia: Resources for the Future, 1960).

59/ J. Vanderkamps, "Migration Flows, their Determinants and the Effect of Return Migration," Journal of Political Economy, Vol. 79:5 (Oct.-Nov., 1971).

to the sum of origin and destination populations.* Fabricant introduces the adjusted variable to avoid the estimation difficulties inherent in using a limited variable in which most of the observations lie close to the boundary, and does not explain the logic underlying these weights. However , they imply the expectation that under complete equilibrium random movement from each area to the other would be directly proportional to the size of the origin populations -- that is, there is constant net migration from the larger to smaller area unless constrained by economic and social differentials.

Other arguments are also possible, however. For example, it could be argued that under equilibrium conditions the expected cross-flows, $M_{ij}$ and $M_{ji}$ , will be directly proportional to the origin populations and inversely proportional to the number of local opportunities, which under equilibrium conditions might be assumed to be proportional to population.

An adjusted measure of net migration employed by Shio and Kono in their analysis of inter-prefectual migration in Japan in 1956 and 1961[60/] is built on the concept of "relative stream velocity," which Bogue, Shryock and Hoermann found to make a marked improvement in the results of the simple analytical models applied in their examination of subregional migration in the U.S.[61/] The "relative stream velocity" is defined, using our notation,

* In the standard notion of this paper, Fabricant's dependent variable is therefore:

$$\left[M_{ij} \cdot \frac{P_j}{P_i + P_j}\right] - \left[M_{ji} \cdot \frac{P_i}{P_i + P_j}\right]$$

60/ Shigemi Kono, Mitsuru Shio, Inter-Prefectural Migration in Japan, 1956 and 1961: Migration Stream Analysis (New York; Asia Publishing House, 1965).

61/ D.J. Bogue, H.S. Shryock, S.A. Hoermann. "Subregional Migration in the United States," 1935-1940," Volume I. Streams of Migration between Subregions (Oxford, Ohio: Miami University, 1953).

as $$V_{ij} = \frac{M_{ij}}{P_i} \cdot \frac{P_j}{P_t} \times 100 = 100 \cdot \frac{M_{ij} \cdot P_t}{P_i \cdot P_j}$$

where $P_t$ = population of origin plus that of all potential destinations, i.e. the total population of the migration system.

The net migration measure used by the Shio and Kono is simply

$$v_{ij} = V_{ij} - V_{ji} = 100 \frac{P_t}{P_i \cdot P_j} (M_{ij} - M_{ji}).$$

With this form of adjusted dependent variable expected equilibrium net migration is zero, but expected net migration under any regime of inter-regional differentials is directly related to the size of the total migration system. There has been insufficient analysis of time-series migration data to permit a judgement on whether adjustments for total population size are needed and whether this particular form is appropriate.

Kono and Shio also tried an alternative form of dependent variable, $v_{ij} \cdot D_{ij}$ -- that is, "net relative stream velocity" multiplied by the distance between the two areas. This produced much less satisfactory results, however.

Adjusted measures of migration have frequently been used in geographic and demographic studies of migration, many of which have been directed at identifying simple persistent regularities in population movements.

Among geographers, migration has most generally been treated within the framework of gravity and potential concepts of human interaction. Using models drawn from Newtonian physics, the central concept is that expected migration (or other form of interaction) between two populations under ceteris paribus conditions is directly related to some multiplicative function of their populations (or some measure of activity levels) and

inversely related to some function centering on the distance or "spatial friction" between them.* Were such regularities identifiable, then migration data could be adjusted for these predictable relationships to more clearly focus on the influence of other social and economic factors. Yet while the direct relationship between migration volume and destination populations and the inverse relationship between migration volume and migration distance are persistent and apparently universal, the underlying causes of these relationships remain obscure.

Perhaps at the extreme of efforts to standardize for systematic differences in origin and destination population size and spatial juxtaposition is the method proposed by Ralph Thomlinson for controlling for seven spatial variables, including size and shape of origin and destination areas, population distributions in the origin and destination, and distance moved.[62/] Whatever the form of adjustment or standardization however, it must be recognized that controlling for one or another variable, whether it be demographic, spatial or socio-economic, implies that the independent effect of that variable is unequivocally understood. When the a priori logic

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* The most fundamental concept in the gravity and potential approach is that of the "energy" of interaction between two centers, "i" and "j" In its initial form, this was defined as

$$E_{ij} = k\frac{P_i P_j}{D_{ij}}$$

but if the modifications introduced by subsequent researchers are taken into consideration, the generalized form of the "energy" concept becomes

$$E_{ij} = k \cdot \frac{(\sum \phi_i)P_i^b \cdot (\sum \phi_j)P_j^c}{D_{ij}^a}$$

where $\phi_i$, $\phi_j$ = a variety of weighting factors for the populations at "i" and "j", respectively

a, b, c = system constants, or alternatively, functions of other variables.

See: Gerald P. Carrouthers "A Historical Review of the Gravity and Potential Concepts of Human interaction", Journal of the American Institute of Planners 22 (Spring, 1956).

62/ Ralph Thomlinson "A Model for Migration Analysis" Journal of the American Statistical Association, Vol. 56:295 (1961).

underlying one form of adjustment is not inherently clearer or more convincing than that of an alternative form, a measure of uncertainty enters the interpretations of the estimated parameters. In multiple regression analysis it seems preferable as a general rule to use only simple rate measures and treat other population and spatial factors as independent variables in the model.

Gross Migration

Several forms of dependent variables are commonly used in gross migration models founded on behavioral assumptions. The choice of whether lifetime, migration, (born in "i" and living in "j"), period migration (living in "j" at present and resident in "i" t years previously), or total moves (registered moves from "i" to "j" during period t) is used is often determined by the nature of the available data, rather than from theoretical considerations. When available, total registered moves between areas is probably the most desirable measure of migration given the reasoning underlying the behavioral approach. More typically, one must be content with lifetime or period gross migration data based on change of residence criteria.

The absolute level of gross migration has been used as the sole dependent variable by Beals, Levy and Moses (1967),[63] and as an alternative dependent variable by Sahota (1968)[64] and Ichimura (1965).[65] More commonly, the gross migration rate ($M_{ij}/P_i$) is used, as by Levy and Wadycki (1972).[66]

63/ R.E. Beals, M.B. Levy and L.N. Moses "Rationality and Migration in Ghana," The Review of Economics and Statistics, Vol. XLIX (Nov. 1967), p. 480-486.
64/ G.S. Sahota "An Economic Analysis of Internal Migration in Brazil," Journal of Political Economy, VOL. 76 (March/April 1968), pp. 218-245.
65/ S. Ichimura "An Econometric Analysis of Domestic Migration and Regional Economy," Regional Science Association, Papers and Proceedings Vol. XVI (1965).
66/ M.B. Levy and W.J. Wadycki "A Comparison of Young and Middle-aged Migration in Venezuela," The Annual of Regional Science Vol. VI:2 (December 1972) pp.73-85.

The rate can be calculated for total gross migration, or calculated with both migration and base population referent to a specific population sub-group. Most of the studies using this form of the dependent variable argue that it measures the probability of migration. This is not precisely accurate since in general the base population is the initial total or sub-group population at origin. When the measure of population movement is interval migration ($M_{ij}$ as defined earlier in this paper), however, the average population-at-risk is not the initial origin population, but the average number living in "i" during the period who (a) were living in "i" at the beginning of the period and (b) survived until the end of the period. Assuming an even rate of outflow of gross migrants, an appropriate estimate of the population at risk, $P_i^*$, is

$$P_i^* = P_i(2) - \sum_{j \neq i}^{j} M_{ji} + \frac{1}{2} \cdot \sum_{j \neq i}^{j} M_{ij}$$

where $P_i(2)$ = the origin population at the end of the migration interval

$M_{ji}, M_{ij}$ = the population living in j,i at the end of the migration interval that was living in i,j at the beginning of the migration interval.

Another common dependent variable is the share of a particular stream in total out-migration from each area--in the notation used in this paper, $M_{ij}/M_{i.}$. Sjaastad has argued[67] that this form of dependent variable eliminates many of the factors which would cause differences in aggregate mobility and better reflects the influence of economic and social differentials between areas and the true travel and information costs associated with distance.

67/ L.A. Sjaastad, "The Costs and Returns of Human Migration," Journal of Political Economy, Vol. LXX:5 (Oct. 1962) part II.

Following Sjaastad, the allocation variable has been used by Greenwood (1969),[68] and Levy and Wadycki (1974).[69]

By was of illustration of the potential biases in this approach, consider that the probability of moving from "i" to "j" is the product of the probability of moving from "i" and the conditional probability of moving to "j" given one is moving from "i." In formal terms:

$$P(M_{ij}) = P(M_{i.}) \cdot P(M_{.j} \mid M_{i.}) .$$

If $P(M_{i.}) = f(X_i, \bar{X_i})$, where $X_i$ represents origin characteristics and $\bar{X_i}$ represents the average characteristics of places other than the origin, while $P(M_{.j} M_{i.}) = g(Y_j, \bar{Y_j})$ where $Y_j$ represents characteristics of place "j" and $\bar{Y_j}$ characteristics of potential destinations other than "j", then analysis of $P(M_{i.})$ or $P(M_{.j} \mid M_{i.})$ alone is meaningful only if there is independence or only slight correlation between the Xs and Ys. If several variables are common to both probability functions, estimation of only one of these functions gives a biased estimate of the effect of the common variables on "migration."

Sociological evidence suggests that there may be considerable simultaneity between the above two probability functions due to the effect of the distribution of past out migrants from an area on the rate and distribution of current migration. Numerous studies have described the institutional factors underlying the phenomenon of "chain migration" wherein migrants are drawn from one area to another by means of the social networks encompassing linking the population at destination with that at origin.[70] Bogue has argued that

68/ M.B. Levy and W.J. Wadycki "What is the Opportunity Cost of Moving?" Reconsiderations of the Effect of Distance on Migration," Economic Development and Cultural Change, Vol. 22:2 (Jan. 1974), pp. 198-214.

69/ M.J. Greenwood, "An Analysis of the Determinants of Geographic Labor Mobility in the United States," The Review of Economics and Statistics Vol. 51 (May 1969), pp. 189-194.

70/ J. MacDonald and L. MacDonald "Chain Migration, Ethnic Neighborhood Formation and Social Networks" Social Research 29(4) (Winter 1962).

"There is a series of stages in the development of any migration stream. From initial invasion it develops into a phase of settlement which at its peak becomes routine, institutionalized."[71] Bogue further contends that as a corollary the selectivity of a migration stream declines as the stream becomes established. Harley Browning's long term study of migrants into Monterey, Mexico appears to substantiate this thesis.[72] Past patterns of migration may affect the choice of destination, as strongly suggested in the work of Greenwood (1970)[73] and Levy and Wadycki (1973);[74] they may also influence total out-migration by entering as weights in the assessment of aggregate opportunities lying outside the origin, or as constraints on the perceived "action space" which defines the set of relevant alternative locations.

Until migrant behavior is better understood analysis should probably first address the gross migration rate, $M_{ij}(a)/P^*_i(a)$, where $M_{ij}(a)$ is the number of migrants in population sub-group a, and $P^*_i(a)$ is the average population-at-risk at "i" in sub-group a. In extended studies, however, it would also be fruitful to consider both $M_{i.}(a)/P^*_i(a)$, the out-migration rate without respect to destination, and $M_{ij}(a)/M_{i.}(a)$, the destination distribution of total gross out-migration.

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71/ As quoted by C.J. Jansen (ed.) Readings in the Sociology of Migration (Oxford: Pergamon Press, 1970), p. 16.

72/ H.L. Browning, "Migration Selectivity and the Growth of Large Cities in Developing Societies," Chapter VIII in National Academy of Science, Rapid Population Growth: Consequences and Policy Implications Vol. II (Baltimore: Johns Hopkins Press, 1971).

73/ M.J. Greenwood, "Lagged Response in the Decision to Migrate," Journal of Regional Science, Vol. 10:3 (Dec. 1970).

74/ M.B. Levy and W.J. Wadycki, "The Influence of Family and Friends on Geographic Labor Mobility: An International Comparison," The Review of Economics and Statistics, Vol. LV:2 (May 1973).

A separate question concerns the desireability of analysing the total gross migration rate, stratifying the migration data by population sub-groups and applying the same model to each, or stratifying and treating different sub-populations with different models. These issues will be discussed later in this paper.

The Treatment of Independent Variables

As already noted, the independent variables of econometric models can typically be divided into an "economic" component the construction of which is tied to formal economic theory, and what Fabricant calls a "barrier function" including social and spatial factors assumed to inhibit or facilitate mobility. The variables in the "barrier function" are by and large less carefully thought out than those in the economic component.

Most recent econometric models of migration have been cast in log-linear form under the assumption that the factors underlying migration work multiplicatively. The log-linear form also permits the regression coefficients to be directly interpreted as elasticities. Alternatively, the model can be cast as a simple linear function. Where the two forms have been compared the logarithmic form generally provides a somewhat better overall fit, but the differences are not marked. Occasionally, more complex or mixed forms have been used. Sahota (1968), for example, uses a logarithmic transformation of a model in which distance and regional dummy variables are entered as exponentials. According to Sahota,

$$\frac{\hat{M}_{ij}}{M_{i.}} = f(E)\cdot g(S)\cdot e^{(a\sqrt{D_{ij}} + a_{oo} + \sum a_{oi}O_i)} .$$

where $f(E)$ = function of wage and employment variables in multiplicative form.
$g(S)$ = function of social variables in multiplicative form.
$D_{ij}$ = distance between "i" and "j".
$O_i$ = a dummy variable for the region in which the destination state is located.

Another exceptional form is used by Rempel,[75] who includes linear forms of distance and relative amenity variables in a model in which all other variables are treated as logarithmic transformations.

The Economic Sub-Function

In most of the models considered in this chapter the researchers are most concerned with the response of migration to economic variables, and the structure of the economic sub-function embodies explicit or implicit hypotheses about the decision to migrate or the adjustment mechanism of the labor market. Following the lead of Lowry(1966), Greenwood (1970) and Levy and Wadycki (1972, 1973) both enter origin and destination wage and employment measures as discrete variables, so the economic component is of the form

$$f(E) = W_i^{a_1} . W_j^{a_2} . U_i^{a_3} . U_j^{a_4}$$

where $W_i, W_j$ = wage levels at the origin and destination, respectively.
$U_i, U_j$ = unemployment levels at the origin and destination, respectively.

Alternatively, the homogeneity assumption that $a_1 = -a_2$, and $a_3 = -a_4$, may be employed. When the homogeneity assumption is not employed the coefficients on destination variables are typically significant and with the expected sign, while the coefficients on the origin variables are often statistically insignificant and with the wrong sign. Employment and wage variables at both origin and destination are also fairly sensitive to the model specification, particularly to the inclusion of a migrant stock variable, discussed below.

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75/ Henry Rempel, Labor Migration into Urban Centers and Urban Unemployment in Kenya (unpublished PhD dissertation, Dept. of Economics, Univ. of Wisconsin, 1970) Chap. IV.

When the dependent variable is migrant allocation, the appropriate interpretation of the independent influence of origin variables is not clear since it is presumably the relationship among alternative destinations which is a determining factor in the choice.

Frequently the absolute value of the coefficient on destination wage or employment differs significantly from the coefficient on origin wage or employment, and it is not clear what the expected relationship between these values should be even within a model using gross migration rate as the dependent variable. In fact, consideration of discounts for risk and incomplete information suggest that the elasticities may not be symetrical--there may, for instance, be a relatively weak negative response to destination unemployment rates which are lower than origin rates, but a strong negative response to rates which are above destination rates.

Differential patterns of migration selectivity between streams may also affect estimates of overall responsiveness to economic variables. Sahota (1968),[76] using $M_{ij}/M_{i.}$ as the dependent variable, finds that absolute elasticities of migration with respect to origin and destination wage levels are very similar for male migrants age 30-59, but that male migrants age 15-29 are much more responsive to destination wages than to origin wages. Levy and Wadycki (1972),[77] using the same dependent variable, found comparable results and, in addition, indications that female migration at whatever age is not significantly correlated in the expected direction with either origin or destination economic variables. Systematic differences in the response to economic variables by migrant sub-groups may partially explain the often ambiquous

[76] Sahota (1968) op. cit.
[77] Levy and Wadycki (1972) op. cit.

results of unstratified models, since cross-currents (eg. rural-urban and urban-rural) can differ significantly in their age and sex distributions.

The Fabricant model doesn't incorporate wage and unemployment variables directly, but models the migration decision as a behavioral response to the difference between expected labor supply-labor demand gaps in the origin and destination. Under Fabricant's assumptions wage adjustment to excess supply or demand is assumed to be sticky, with labor force adjustment taking place in the short-run through changes in the unemployment rate. An unusual behavioral assumption of the model is that labor adjustment to inter-regional differentials in wage and employment rates is sluggish because each potential migrant while encouraged to migrate to areas where the excess of labor demand over ex ante supply is large, is discouraged by the expectation that many competitive migrants will be drawn to areas where wage rates are high and unemployment rates low.

In its tested form Fabricant's basic model is

$$M_{ij}(t) = \lambda\left[\frac{d_j^*(t) - S_j^*(t)}{S_j(t-1)} - \frac{d_i^*(t) - S_i^*(t)}{S_j(t-1)}\right] + G(\emptyset) + C$$

where $M_{ij}(t)$ = interstate migration of males in labor force over age 15.

$d_j^*(t), d_i^*(t)$ = expected labor demand in period t in "j" and "i" respectively. In testing the model it is assumed this equals ex post employment.

$S_j^*(t), S_i^*(t)$ = expected supply of labor in "j" and "i" in period t.

$S_j(t-1), S_i(t-1)$ = realized supply of male labor in previous period

$\lambda$ = parameter; responsiveness to differential labor demand-supply gaps.

$G(\emptyset)$ = "barrier function" including social and other factors assumed to spur or inhibit migration.

In addition, Fabricant assumes that expected supply, i.e. the

level of competition each migrant expects to face, is a linear function of the relationship of local wage and employment levels to those in all other locations during the previous period:

$$\frac{S_i^*(t)}{S_i(t-1)} = k + a_1 \left[ \frac{W_i(t-1)}{\bar{W}_i(t-1)} - 1 \right] + a_2 \left[ \frac{U_i(t-1)}{\bar{U}_i(t-1)} - 1 \right]$$

where $W_i(t-1), \bar{W}_i(t-1)$ = the average wage in "i" and in all places other than "i" at t-1.

$U_i(t-1), \bar{U}_i(t-1)$ = the unemployment rate in "i" and the average unemployment rate in all places other than "i" at t-1.

$k$ = constant reflecting long term adjustment of expected to actual supply.

$a_1, a_2$ = coefficients of adjustment with the expected values $a_1 > 0$, $a_2 < 0$.

By substituting the expected supply function into the basic model and applying the weights described earlier, Fabricant derives an adjusted net migration model* which in overall structure is not dissimilar to a number of other models except for the fact that the estimated coefficients are products of the underlying

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* In its complete form, the Fabricant model is

$$\frac{P_j M_{ij}}{P_i + P_j} - \frac{P_i M_{ji}}{P_i + P_j} = \lambda \left[ \frac{N_j(t)}{S_j(t-1)} - \frac{N_i(t)}{S_i(t-1)} \right] + a_1 \lambda \left[ \frac{W_i(t-1)}{\bar{W}_i(t-1)} - \frac{W_j(t-1)}{\bar{W}_j(t-1)} \right]$$
$$+ a_2 \left[ \frac{U_i(t-1)}{\bar{U}_i(t-1)} - \frac{U_j(t-1)}{\bar{U}_i(t-1)} \right] + b_1 Q.D_{ij} + b_2 Q.D_{ij}^*$$
$$+ b_3 \left[ \frac{P_j R_{ij}(t-1) - P_i R_{ij}(t-1)}{P_i + P_j} \right] + Q.C$$

where notation is as given in text and

$N_j(t)$, $N_i(t)$ = realized male employment in period t in "j" and "i".

$R_{ij}(t-1), R_{ji}(t-1)$ = fraction of total lifetime out-migrants from "i", "j", living in "j", "i", at t-1.

$D_{ij}$ = distance between capital cities of "i" and "j".

$D_{ij}^*$ = length of contiguous borders between states "i" and "j". A proxy for short-range migration.

$Q$ = a weight = $(P_j - P_i)/(P_i + P_j)$

$C$ = constant.

parameters. Also, the model includes not only origin and destination wage and employment variables, but a measure of alternative opportunities as well.

An explicit model relating rural-urban migrant behavior to urban wages and unemployment in developing countries has been developed by Michael Todaro.[78] In trying to explain the persistently high levels of urban employment in sub-Sahara Africa, Todaro suggests that in the largely undifferentiated and highly fluid market for unskilled African labor the probability that an individual will find a job in the "modern sector" (where super-marginal minimum wages are enforced) is chiefly a function of the length of time he spends in the urban sector. Under these labor market conditions,* which have been discussed in detail by Josef Gugler,[79] the present value to a potential migrant of the expected urban-rural income differential is

$$V(0) = \sum_{t=0}^{n} \left[P(t)Y_u(t) - Y_r(t)\right].e^{-rt}\, dt - C(0)$$

where $P(t)$ = the probability of being employed in the "modern" sector as of period t.
$Y_u(t)$ = the modern sector or institutional urban wage in period t.
$Y_r(t)$ = the rural sector earnings that could be realized in period t.
$n$ = the number of periods in the migrant's planning horizon.
$r$ = the subjective discount rate.

In the Todaro model the probability of being employed in the modern sector by period $t$ is

$$p(t) = \pi(1) + \sum_{x=2}^{t} \prod_{s=1}^{x-1} (1 - \pi(s))$$

where $\pi(s)$ = the probability of being selected from the stock of urban unemployed in the period s.

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78/ M.P. Todaro, "A Model of Labor Migration and Urban Unemployment in Less Developed Countires," American Economic Review, Vol. 59 (March, 1969), p. 138-48.

79/ See, for example, "On the Theory of Rural-Urban Migration: The Case of Sub-Saharan Africa," in J.A. Jackson (ed.) (1969) op. cit.

Practically, Todaro defined (s) as the ratio of new job openings (i.e. modern sector employment expansion) to the number of aspirants, i.e. to the number of urban unemployed or marginally employed in period s. One important short coming of the Todaro model is that in urban Africa labor turnover is very high due to a considerable proportion of the Africa labor force being target workers or "conditional" urban workers whose essential social and consumptive orientation is towards the rural sector.[80] Turnover rates may be a function of the likelihood of regaining modern employment after a period of absence from the urban sector (as Gugler suggests), but it nonetheless increases the probability of gaining employment in any period, thereby raising "equilibrium unemployment" under the Todaro model. The Todaro model also does not explicitly consider the income that can be earned in the urban non-modern sector which reduces the opportunity costs of waiting for a modern sector job.[81] Still, the model does make a considerable contribution to the theory of the economic aspects of the decision to migrate by explicitly noting the inter-relationship between wage and unemployment variables, and the role of the urban "traditional" sector or non-modern sector as a "holding tank" for aspirants to modern sector jobs.

Rempel has attempted to test the migrant response to Todaro's expected income variable using survey data gathered among urban in-migrants in Kenya. The economic component of the Rempel model can be written:[82]

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80/ Gugler (1969) op. cit.

81/ The basic Todaro model has been expanded to include both petty employment and transfers from the urban employed to the urban under-employed. See J.F.S. Levi, "Migration from the land and urban unemployment in Sierra Leone." Oxford Bulletin of Economics and Statistics V. 35(4) (Nov. 1973).

82/ Rempel (1970), op. cit., Chap. IV.

$$F(E) = a_1 \cdot (V_i(t) - V_j(t)) + a_2 \cdot V_i(t)$$

with

$$V_i(t) = \sum_{k=1}^{4} \frac{Y_i(t-k)}{(1+r)^k}$$ = current value of forgone rural earnings for the next four quarters foregone by those migrating in period t.

$$V_j(t) = \sum_{k=1}^{4} \frac{Y_j(t-k)}{(1+r)^k}$$ = current value of anticipated urban earnings during four quarters after migration by those migrating in period t.

where $Y_i(t-k)$ = the average income in origin "i" during period t-k among men who migrated to "j" in periods t through t-k.

$Y_j(t-k)$ = the average income in urban destination "j" in time period t among men who migrated to "j" in time period t-k.

$t$ = the time period of migration (in quarters)

$r$ = an appropriate discount rate - Rempel uses the rate on consumption loans.

(In addition, Rempel considers moving costs to be properly a component of the economic function, but since he has no data on these costs, he simply introduces distance as a cost-proxy in the manner of other models.

Rempel justifies this approach to the calculation of expected rural and urban earnings on the grounds that "potential migrants perceive their expected income in "i" in terms of their own past income experience in "i" and the past income experience in "i" of other recent migrants from "i". In fact, the form used implies that migrants during period "t" expected their potential their potential rural income in the (t-k)th quarter period after migration to be equivalent to the average rural income in "i" in the (t-k)th period by those who moved after the (t-k)th period. The expected future rural income streams are thus a mirror image of experienced past rural income streams. For expected future urban income streams it is assumed that the income in the 1st, 2nd, 3rd and 4th quarters after migration will be equivalent to the average income during the quarter in which migration takes place of men who have been in the destination 1,2,3 and 4 quarters respectively. No satisfying explana-

tion of these unusual behavioral assumptions is presented, and the analysis is seriously compromised by the fact that the data on rural and urban wages is collected from a sample of migrants who are presently in the urban sector. This introduces the possibility that the data collected from longer term migrants reflects the experience of those for whom the differential between urban and foregone rural wages has been sufficient to induce them to stay in the urban sector, whether because they have done particularly well in the city, or had particularly limited rural prospects. Because (or perhaps inspite) of these biases, Rempel does not find the expected income differential to be statistically significant in his empirical results. Kim Seyeul uses a model with virtually an identical economic component as Rempel's to study migration between the rural and urban sectors of North Cholla province in Korea, and his findings are similarly inconclusive.[83/]

As an alternative to the above models which focus on migrant response to current employment and wage prospects, the human capital investment approach to migration postulates that potential migrants will move if the present value of expected future income streams in some other region exceeds the present value of expected future income streams in the present region of residence by more than the costs of migration. Human capital investment theory was first extended to the problem of labor migration by Larry Sjaastad,[84/] who noted that the labor adjustment model of migration was in sharp conflict with actual migration

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83/ The Economic and Social Determinants of Rural-Urban Migration in Korea: A Case Study of North Cholla Province (unpubl. Ph.D. dissertation, Univ. of Hawaii, Dept. Agricultural Economics, 1973).

84/ Sjaastad (1962), op. cit.

rates and the persistence of inter-regional wage differentials. Sjaastad recognized the heterogeneity of labor markets between areas, hypothesised that "migration is a search for opportunities in higher paying occupations", and sought to "treat migration as an investment increasing the productivity of human resources--on investment which has costs and which also renders returns."[85] While the goal of Sjaastad's work was to "determine the return to investment in migration rather than to relate rates of migration to income differentials," his more important contribution was the cogent explanation in terms of human capital investment theory of such observed patterns as the strong age and education selectivity of migration. . Some extensions and modifications of Sjaastad's theory were subsequently contributed by Gary Becker, particularly with regard to the timing of migration within the life cycle.[86]

In attempting to estimate the rate of return to migration, Sjaastad emphasizes, the costs of migration are not limited to the costs of moving, but also include the investment costs of undertaking a new occupation or careet. Sjaastad's main conclusion, in fact, is that "migration cannot be viewed in isolation; complementary investments in the human agent are probably as important or more important than the migration process itself."[87]

Recently Samuel Bowles has tested certain of the implications of the human capital investment theory of migration --in particular the declining responsiveness with age to given differences in the present value of origin

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85/ The literature on the human capital approach to migration has been reviewed by Mary Jean Bowman and Robert G. Myers,"Schooling, Experience and Migration ; Human Capital Changes"JASA 62 No. 319 (9.1967) p. 875-879.

86/ Gary S. Becker Human Capital, A Theoretical and Emprical Analysis with Special Reference to Education (New York: NBER, 1964) esp. p. 48f.

87/ Sjaastad (1962) op. cit., 92f.

and destination income streams, and the increased responsiveness with higher levels of education--and appears to find confirming evidence for these hypotheses.[88]

All of the models noted above abstract from or make simplifying assumptions about the process of structural transformation and the changing attitude toward different economic and social roles which underly rural-urban migration in both developed and developing countries. Although economists perceive migration as a movement from areas or sectors with lower levels of productivity to areas or sectors with higher levels of productivity, migrants typically envision migration as a process, not necessarily a once-and-for-all change of residence, leading to more promising career paths and lifestyles. Although these long-run considerations are explicitly taken into account in the human investment approach, in reducing the potential migrant's decision

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88/ The original Bowles model was

$$\frac{NM_{sn}(a)}{P_s(a)} = b_0 + b_1 Y(a) + b_2 A \cdot Y(a) + b_3 S \cdot Y(a) + b_4 P$$

where $NM_{sn}(a)$ = net south-north migration in population subgroup "a" (96 subgroups, representing all combinations of 8 age categories, 6 schooling categories, and 2 races).

$P_s(a)$ = southern base population in each of 96 subgroups.

$Y(a)$ = log of expected lifetime income differential in $1000 (based on discount rate of 6% per annum and a 1% gain per year in productivity).

$A$ = age which defines the subgroup.

$S$ = number of years of schooling which defines the subgroup.

$P$ = a measure of the extent of poverty: fraction of male workers in subgroup in south earning under $1000 in 1959.

cf. Samuel Bowles "Migration as Investment: Empirical Tests of the Human Investment Approach to Geographical Mobility." Review of Economic and Statistics, Vol. LII (4) (Nov. 1970).

William Apgar, however, has been critical of the use of the net migration rate and of the division of the income differential by 1000, which alters all the coefficients in an interactive model of this sort. He offers an alternative formulation using Fabricant-type weights, and employing the square roots of the income differential, rather than logs, to capture non-linearities.

cf. Wm. Apgar, "Migration as Investment: Some Further Considerations" Discussions Paper No. 64, Harvard University Program in Urban and Regional Economics (May, 1970).

model to one in which the dominant elements are perceived future income streams and a personal discount rate, the assumption is at least implicitly made that the migrant is a rationalist-idealist decision maker in an environment of perfect knowledge.

Even in countries not under-going rapid change, however, carrer choices are characterized by a great deal of uncertainty concerning both individual capacities and future patterns of economic development. (Frank Knight early pointed out the difference between such uncertainty and "risk" in which the probabilities of alternative outcomes are known and the probable utility of alternative choices calculable). It is also unlikely that information feedback in the labor market is sufficiently rapid that general equilibrium can be reached in the absence of perfect knowledge. Individual adjustment is limited since individual career paths may entail substantial embodied human capital investment and job or occupational changes after the early working years may involve the forfeiture of considerable investment in training, etc.

Depending on goals and circumstances, game theorists suggest that there are numerous alternative strategies for handling absolute uncertainty, and Ruth Mack has characterized the central problem of planning in an uncertain environment as "how to minimize the costs of uncertainty in terms of the net expected utility of purposive, deliberate conduct."[89] From this perpsective, it can be suggested that potential migrants(as well as non-migrant career choosers) initiate their choice not on the basis of expected returns in specific alternative careers, but with the intent of maximizing the likelihood of relatively high permanent status, economic and otherwise, within the peer group with which they

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89 See Otis Dudley Duncan "Methodological Issues in the Analysis of Social Mobility," in Smelser and Lipset (eds.) Social Structure Mobility and Economic Development (Chicago: Aldine Publishing Co., 1966).

identify --recognizing that neither the perceived peer group not the values held towards statuses need remain constant over a lifetime.

In contemporary Korea, there appears to be broad concensus within all strata of society that the future will not belong to peasant agriculturalists, and a career in small scale agriculture is viewed by many rural youth as a fall-back lifestyle if other aspirations cannot be realized or are judged unrealistic. In Korea, as in the U.S. and other countries, the shift of the labor force from the agricultural to non-agricultural sector is realized less through the departure of established workers from agriculture than from a decline in the proportion of each cohort of new entrants into the labor force choosing agricultural careers.

Human capital investment theory provides a cogent explanation for such a pattern. All occupations require a greater or lesser amount of human capital investment either thorugh formal education or on-the-job-training. The longer period over which the returns to such investments can be realized and the opportunity costs of delaying in making such investments provide incentives for (worker-paid) human capital investments to be concentrated in the early working years. Fewer human capital investments are made in the later working years, and these tend to be increasingly specific to an individual firm or industry, so that a larger share of the costs of such investments are borne by the firm rather than the worker himself.[90] Since younger workers face a longer period over which their training can become obsolete they have a particular incentive to invest in skills which

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90/ Gary S. Becker, (1964) op. cit., Chapter 2.

are very generally applicable to those sectors of the economy which are perceived to be most advanced and dynamic. And because they have not yet made a large investment in a particular career path, the capital losses through inter-firm or inter-occupational mobility are typically less for younger workers.

Richard Nelson has argued that modern production techniques in dualistic economics are concentrated in large scale firms,[91] and it is here also that the concentration of opportunities for advanced and dynamic human capital investment should be expected. Such opportunities should also be available, albeit to a lesser degree, in small firms which are linked to large firms through sub-contracting arrangements, etc., Moreover, even the so-called "bazaar sector" of the dualistic urban economy may offer experience in dealing with customers, book-keeping, etc., which has some degree of transferability to the modern sector.

For young males entering the labor force, especially those with at least a secondary education, immediately obtainable wages may be less important than the opportunity to make investments in skills likely to be of long-term relevance to the modern sector. Since such investments are likely to be paid by the workers themselves through wages which are less than their potential marginal productivity, age-specific wage rates may greatly under-state the real difference in the value of economic opportunities in different regions and sectors.

Inclusion within the economic function of variables which approximate the availability of perceived availability of desired human capital investment

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91/ R.R. Nelson, T.O. Schultz, R.L. Slighton Structural Change in a Developing Economy: Columbia's Problems and Prospects (Princeton: Princeton U.P., 1971) pp. 103-127.

opportunities is thus an alternative to the use of the present-value of future income streams as a means of incorporating the logic of human capital investment theory into the econometric analysis of migration. Within this framework, we would tentatively suggest the inclusion of the following variables: (a) the ratio of wages received by mature workers in the modern sector to the earnings of mature workers in the agricultural sector; (b) the rate of growth of the gap between the earnings of mature workers in the two sectors in the recent past; (c) the expansion of employment in 'modern technique-using firms' relative to the number of potential candidates for these positions already in the sector or region; (d) short-term expected wages in the urban sector for the particular migrant sub-group; and (e) the likelihood of receiving relevant training in the non-modern urban sector. In applying such a model, stratification by educational attainment, as well as by age and sex seems desirable, with appropriate modifications made in the independent variables.

Operationalizing the above economic function poses numerous problems, of course. The urban "modern" sector must be identified, and the approaches taken in the BACHUE-2 and Byerlee-Halter models have already been discussed. Tentatively, mature workers might be defined as those age 35-45. To the expansion of employment in the urban modern sector it may be desireable to add an estimate of the number of superannuated workers leaving the sector, and as a simplification assume that once in the modern sector workers leave only through death or retirement. Serial data on the number and age of workers by industry and firm size may suggest the extent to which recruitment of new workers to the modern sector is largely from the cohorts of new entrants to

the labor force (as in Japan)--this information in turn may be used to define the relevant body of potential candidates to these positions. Because of the difficulty of establishing actual rates of involuntary unemployment, especially among adolescents and young adults, expected short-term income is probably best calculated on the basis of age-specific activity rates--employment divided by the cohort populations--in the modern and non-modern urban sectors, excluding the military and school population from the denominator. If age-specific earnings in farming cannot be readily determined, it may be necessary to use some proxy measure--perhaps a weighted average of hired labor wages in agriculture and non-agricultural, non-modern wages in the rural sector.

A similar decision model can also be applied to older male migrants. If it is possible to separate off-farm from other rural out-migrants (and it is not possible with Korean census data), the expectation is that among off-farm migrants the relative importance of the variables reflecting human capital investment opportunities will decline with the age of the migrant while the importance of short-term expected income differentials will increase. If off-farm migration can not be separated out, the results will be influenced by the proportion of older migrants who are in fact moving within the modern sector, or within the non-modern, non-agricultural sector. In fact, if the sector of origin can not be determined, it is probably unwise to run the analysis on aggregated observations including both rural-urban and urban-rural movement because of the probable differences between the two cross-currents in the pre-migration complements of human capital investment even within the same age-sex-education sub-groups.

Several of the econometric models discussed above either neglect to consider female migration, or find that female migration is less responsive to (aggregate) economic variables than male migration. This finding is not surprising. In Korea, for example, virtually all women have been married by age 30, and the migration of married women is typically as family members accompanying a migrating husband. Three economic factors are probably relevant to the migration of married women, which is essentially a question of whether they migrate with their husbands or stay where they are either permanently (if male migration is seasonal) or temporarily (ie. the wife delays migrating to join her husband). These are: (a) the husband's level of income; (b) the value to the household of housekeeping services provided by the wife; (c) the potential income that can be earned by women as secondary workers minus that foregone at the place of origin. If identifiable widows or divorced or separated women are an important component of rural-urban female migration, it might be advisable to treat this group separately.

Young unmarried women of working ages might be expected to be more responsive to economic variables than married women. But since, at least in Korea, unmarried women see themselves as target or temporary workers, they are expected to be less responsive than males to variables representing capital investment opportunities, and more response to short-term expected wages.

The Non-economic Sub-functions

The non-economic variables in migration models fall into what Fabricant calls a "barrier function," and what we have already referred to as social and spatial sub-functions. The key non-economic variables are distance, population

size (destination and origin), age structure, levels of educational attainment or rates of school enrollment, and what has been called the "migrant stock" variable.

Distance is almost always found to have a significant retarding effect on inter-regional migration volume. Sjaastad, Greenwood, Sahota, and Beals, Levy, and Moses have all noted that distance has a much greater inhibiting effect on migration than can reasonably be explained by the costs of moving alone, however. Consequently, a central issue in migration studies has been the question of what the relationship between migration and distance actually means.

S.A. Stouffer early contended that distance was less a proxy for cost than a measure of the alternative opportunities intervening between the origin and destination.92/ Later he added the concept of competition from other migrants for destination opportunities. Testing "intervening opportunities" hypothesis difficult by the problem of appropriately defining "intervening opportunities," and while the initial model provided a good fit to U.S. migration in 1935-1940, subsequent applications have in general been less rewarding.

Alternatively, it has been argued that distance is a proxy for the costs of information about alternative economic opportunities. Although it can be assumed that the density and reliability of information received through the

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92/ The editor's introduction to Jansen (1970), reviews studies using the Stouffer model and the volume includes one such study, E.C. Isbell's "Internal Migration in Sweden and Intervening Opportunities." Stouffer hypothesies that the probability of moving a given distance is directly related to the ratio of opportunities at that distance to the total of all intervening opportunities. Under the assumption of a uniform density of opportunities, this reduces to the statement that the ratio between the volume of migration from a common origin to two different destinations is the inverse of the ratio of their respective distances from the origin. (cf. G.A.D. Carrouthers (1956) op. cit.).

public media will decline with distance, and that the cost of obtaining information through direct observation will rise, the general assumption is that friends and relatives already living in other regions will be the most important source of information.[23]

Consequently, it is argued that the "migrant stock"--persons born in the origin and living in the destination at the beginning of the migration interval--should be expected to be a significant determinant of current migration.

Although the distance variable in migration models may be correlated with more complex factors, the discussion of alternative interpretations is often unsatisfactory. The argument that distance is more than a proxy for travel costs is based at least implicitly on the assumption that migration entails a once-and-for-all move from origin "i" to destination "j", and that total migration costs are encompassed by that associated with a single move. This assumption is clearly not appropriate where seasonal migration is an important component of the migration statistics. And even when the move is intendedly permanent, we would argue that migrants anticipate making periodic return trips to maintain social contacts and to carry out family or community responsibilities. Particularly in developing countries where migration is often a lengthy process of shifting commitments from one community and life-style to another, it is not uncommon for rural-urban migrants to make several return trips a year.

Transportation costs may increase only linearly with distance (as in the case of railroad fares in South Korea), but the opportunity costs associated with making return trips from a more distance location are likely to increase

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23/ P. Nelson, "Migration, Real Income and Informations," Journal of Regional Science, Vol. 1 (Spring, 1959) pp. 43-74.

at more than a linear rate because of the problems of scheduling longer periods away from the place of employment.

Thus although distance may indeed be a proxy for factors other than the cost of moving, the recurring travel costs imposed by separation are themselves not insignificant.

The second issue with respect to the role of distance concerns the juxtaposition of a given destination relative to that of all other destinations. In one sense this is what Stouffer's intervening opportunity model seeks to capture, at least in part. By considering only those alternatives which lie between a particular destination and the origin however, the Stouffer model implies either of two behavioral premises--that migrants depart without a fixed destination and are "captured" by available opportunities on the way, or alternately, that migrants search out alternative opportunities beginning with those in places nearest the origin and stop searching when they find a satisfactory opportunity. (The latter suggests Simmon's model of the satisfying decision maker.) In a general sense, however, it can be suggested that if a model fails to take into account the total spatial array of alternative opportunities, much of the apparent effect of distance may simply be an artifact of the particular spatial arrangement of the places in the migration system being studied. To put the problem another way, although the spatial arrangement of $n$ places is uniquely defined by $n(n-1)/2$ observations on the distances between each possible pair of places, the effects of distance on migration between these places estimated from a model which includes only origin and destination characteristics and the intervening distance may not hold for an alternative arrangement of these places, all else being equal.

There is some fragmentary evidence which appears to support this contention this contention. For instance, Don Price in reviewing efforts to relate distance to migration noticed that the slope of the decline of migration volume with distance differed with the direction from the origin in which the movement took place.[94] Furthermore, Greenwood's estimated elasticities of inter-state migration with distance for each state show an interesting pattern: states within the same region of the country show rather similar elasticities, and the absolute values of the (negative) elasticity generally increases with the distance of the state from the major urban corridors (Greenwood, 1970)

Two recent econometric models have attempted to include the effects of alternative opportunities on migration and choice of destination. Levy and Wadycki (1974) attempt to approximate the effect of intervening opportunities in the analysis of out-migrant allocation patterns from states in Venezuela by including, along with origin and destination variables, the highest average wage rate, largest population size and lowest unemployment rates available in states lying closer to the origin than the given destination. All three proxy variables proved significant at the 0.01 level and sharply reduced the negative coefficient on the distance variable. Alonso (1971) has included indices of both alternative opportunities and competitive origins in a model of inter-metropolitan migration flows in the United States.[95]

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94/ D.O. Price "Distance and Direction as Vectors of Internal Migration, 1935-40", Social Forces, 27:1 (Oct. 1948), cited by Carrouthers (1956) op. cit.

95/ Wm. Alonso "The System of Intermetropolitan Population Flows," Institute of Urban and Regional Development, Working Paper No. 155, (Aug. 1971) University of California, Berkeley.

The Alonso model is unusual and is best given in full:

$$M_{ij} = A_0 . P_i^{a_1} . g_i^{a_2} . P_j^{a_3} . g_j^{a_4} . y_j^{a_5} . h_j^{a_6} . D_{ij}^{a_7} . O_i^{a_8} . C_j^{a_9} . u$$

$$\text{with} \quad O_i = \sum_{j \neq i}^{j} P_j^{a_3} . g_j^{a_4} . y_j^{a_5} . h_j^{a_6} . D_{ij}^{a_7}$$

$$C_j = \sum_{j \neq i}^{i} P_i^{a_1} . g_i^{a_2} . D_{ij}^{a_7}$$

where
- $M_{ij}$ = gross migration flow from metropolis "i" to metropolis "j" (1955-60)
- $P_i, P_j$ = 1955 populations of "i" and "j", respectively.
- $g_i, g_j$ = population growth rates during preceding five years in "i" and "j", respectively
- $y_i, y_j$ = per capita incomes at beginning of period, in "i" and "j".
- $h_i, h_j$ = annual "degree days" at "i" and "j" (days below 72°F, weighted by the short-fall in degrees).
- $D_{ij}$ = great circle distance from "i" to "j" in kilometers.
- $O_i$ = index of opportunities.
- $C_j$ = index of competition.

In the Alonso model the total opportunities available to the population at "i" is indexed as $O_i$ and sums the attractiveness of all destinations given the same variables and elasticities which influence migration from "i" to "j". In a similar manner, the index $C_j$ measures the total competition from all origins for opportunities at "j". Since destination and origin variables enter these indexes with the same elasticities as are estimated for the model as a whole, the model has to be estimated reiteratively. Alonso finds origin income and degree days to be insignificant and excludes them from the model. All coefficients are significant at the 0.01 level except for origin growth rate, which is significant at 0.05, and the model yields an $R^2$ value of 0.82.

An alternative approach which avoids the necessity of reaching a solution reiteratively could be built upon the geographer's concept of population potential

and introduce as an independent variable the relative potential of a destination "j" on an origin "i" with respect to the total potential of all destinations on "i". Geographers define the population potential of "j" on "i" as[96]

$$V_i(j) = k\frac{P_j}{D_{ij}}$$

so that the relative potential of "j" on "i" would be

$$V_i(j) \Big/ \sum_{j \neq i}^{j} V_i(j) \qquad = (P_j/D_{ij}) \Big/ \sum_{j \neq i}^{j} (P_j/D_{ij}).$$

While computationally simpler than the Alonso model, it imbodies the assumption that potential is inversely related to distance raised to the first power, and directly related to destination population, also raised to the first power, while ignoring all other social or economic influences.

"Migration stock" has been included as a variable in several models on the grounds that, as Philip Nelson argued several years ago,[97] the strong inverse relationship between distance and migration volume arises from a confluence of factors which affect both real income and information flows. On the one hand, separation from relatives and friends is a non-monetary cost of migration which increases rapidly with distance and a decline in the probable opportunities to visit--an alternative to the "recurring costs" argument made earlier. The presence of "relatives and friends" in a destination area tends to reduce these psychic costs. Moreover, since the most meaningful information about a destination is likely to be provided by persons already

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96/ Walter Isard, Methods of Regional Analysis: An Introduction to Regional Science (Cambridge: MIT Press, 1960), Chap. 11 "Gravity, Potential and Spatial Interaction Models."

97/ P. Nelson (1956) op. cit.

in the social network of an individual, the distribution of "relatives and friends" also has an important influence on the availability and evaluation of information about alternative destinations. These factors favor movement to places where "relatives and friends" already are, and an initial incentive to move to places close to the origin will, ceteris paribus, be amplified over time by virtue of the concentration in these areas of earlier out-migrants from the origin.

Nelson also notes that since the distribution of "friends and relatives," is a function of past migration, it is also a function of all variables, economic and otherwise, which influenced past migration. Building on this, Greenwood (1970) has formally argued that if migrant stock is excluded as a variable, the estimated correlation between current migration and current socio-economic differentials may be biased since, though the intermediation of the migrant stock, current migration is in part a lagged response to past inter-regional differentials. Specifically, if there is serial correlation between past and current inter-regional differentials, then the exclusion of the migrant stock variable will result in an over-estimation of the responsiveness of migrants to current inter-regional differentials.

Different versions of the "migrant stock" variable have been employed. Whereas Fabricant uses the fraction of total lifetime migrants from "i" who are living in "j" at the beginning of the migration interval, Greenwood (1970) uses the actual number of lifetime migrants from "i" to "j" at a date prior to the migration interval,[28/] and Levy and Wadycki (1973) in applying the Greenwood

28/ Greenwood had to choose between lifetime migration data as of the end of the interval on which his migration data was based and data from a decade earlier. To avoid simultaneity problems he chose the latter.

model to Venezuela use the number of male lifetime migrants over age 15 who had arrived in a destination state prior to the one-year interval for which migration data was collected in the 1961 census.

In both the Greenwood and Levy and Wadycki studies the inclusion of the migrant stock variable sharply reduces the negative coefficient on the geographical distance variable and raises the multiple correlation coefficient. In fact, the migrant stock variable appears to work too well--in regressions in which it is included the multiple correlation coefficients are almost always over 0.80, and reach ± 0.94 in Greenwood's study. Both Greenwood and Levy and Wadycki found the migrant stock variable to be the most important in terms of independent addition to $R^2$. There are several disturbing aspects of Greenwood's results, however. As expected, the regression coefficients on economic variables were reduced by the introduction of the migrant stock variable, but both in the aggregate (Greenwood, 1969), and for a large number of individual states (Greenwood, 1970) the coefficients on destination income levels changed from positive to negative, and became statistically insignificant. Moreover, with migrant stock included the similarity in the distance coefficients among states in the same region was considerably reduced.

It should be noted that both Greenwood and Levy and Wadycki test the importance of the migrant stock variable in models in which the dependent variable is out-migrant allocation, not the gross migration rate. Given the form of the model, their results are also consistent with an hypothesis which is different from the one they suggest. Much sociological literature, some of it noted elsewhere in this paper, suggests that the search behavior of potential

migrants may be very strongly biased toward regions where past out-migrations live and about which information is available, either through letters, visits or via returned migrants. The distribution of out-migrants adjusts only slowly, as new, more promising migration streams evolve and older, no longer promising streams wither; short-run fluctuations in the pattern of inter-regional socio-economic differentials may result in changes in the total number of out-migrants rather than in sharp changes in the allocation pattern. Under this hypothesis the finding that aggregate destination wage or income levels are not significantly correlated with the distribution of out-migrants between destinations is less surprising since those who move may be responding to particular rather than aggregate opportunities. 99/

Whatever the explanation of the role of the migrant stock variable, it must be recognized that as presently formulated it is a very poor proxy for either "information" flows or social network distribution. First, it should be recognized that under either argument the migrant stock logically influences the migration only of the population native to the origin, not that of the <u>total</u> origin population; in some urban areas of developing countries the native-born may account for less than half of the total population. Second, at least two "nativity channels" may be important for transmitting information about "j" to "i": the channels linking those born in "i" and living in "j" with those still in "j" and the channels linking the natives of "j" still in "j" to the natives of "j" who have moved to "i". And while "relatives and friends" may provide temporary lodging, and assist in finding employment for the potential migrant

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99/ One possible test of this hypothesis would entail regressing total out-migration rates on the weighted average of the ratio of alternative destination variables and origin variables, using as weights the ratio of those born in the origin and living in each destination to the total population born in the origin. In making the test one may wish to exclude from the dependent variable (the total out-migration rate) those out-migrants not originally native to the area.

or new immigrant, "migrant stock" is also likely to be correlated with opportunities for rural dwellers to visit the city and with the number of returnees--two sources of information that have emerged as important in several studies. Unless reformulated the migrant stock variable precludes differentiating between the several factors that it crudely proxies.

The generally higher rates of mobility among the more educated and the educational selectivity of rural-urban migrants has been well documented in demographic and sociological studies of migration, but the inclusion of aggregate educational attainment variables or educational enrollment variables in econometric models has not yielded unambiquous findings. The overall level of educational attainment by the population in a region has been included as an independent variable by Sahota (1968), Beals, Levy and Moses (1967) and others. While almost always statistically significant, the signs of the coefficients are not consistent. Levy and Wadycki (1974b)[100] have noted that coefficients on aggregated educational attainment variables may confound two phenomenon the generally mobilizing influence of higher levels of educational attainment on the one hand, and the amenity value of an educational system which provides easier access to higher levels of training on the other. Shultz has tried to overcome these problems by running regressions separately on different cohorts and including among the independent variables both cohort-specific educational attainment rates and primary and/or secondary school enrollment rates. The results revealed the same difficulties as with

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100/ M.B. Levy and W.J. Wadycki "Education and the Decision to Migrate: An Econometric Analysis of Migration in Venezuela" (1974b) to appear in Econometrica.

aggregate models, possibly due to correlation between enrollment rates and attainment rates at older ages. If school facilities at higher levels are concentrated in urban centers then enrollment rates are correlated with a great variety of variables, such as occupational distribution, which makes the urban population generally more mobile than the rural population.

There is also the possibility that the less well educated may be reluctant to move to an area in which labor is generally better educated for fear of not being able to compete, while in some instances the better educated may be reluctant to leave areas where they enjoy a monopoly. The only approach to incorporating education into econometric models which produces reasonably clear-cut results is to initially stratify the sample by sex, age and educational attainment level. (See Levy and Wadycki, 1974b). It is important, however, that migrants be statified by pre-migration educational attainment. This poses a particular problem in the analysis of mobility during the late adolescent years in which both migration and higher education are concentrated.

Variables other than those already noted have also been employed. Sahota (1968) includes degree of urbanization in his model of inter-state migration; conceptually, this poses some of the same problems of interpretation as educational variables unless observations are stratified by stream type since it is impossible to distinguish between the attraction of urban amenities and the greater mobility of the urban population. Models have also included density (Sahota, 1968), a measure of housing shortage (Kono and Shio, 1965), indexes of income inequality (Sahota, 1968; BACHUE-2, 1974), the level of industrialization (BACHUE-2), and various measures of urban amenities (Rempel, 1970; Kim, 1973; BACHUE-2, 1974).

These variables have not proved to be consistently important or in the expected direction. Their inclusion also greatly aggravates the problem of multicollinearity and they are probably best avoided until the clearly important variables are better specified and understood.

## COHORT MOBILITY MODELS OF OFF-FARM MIGRATION

### The Structure of Farm—Non-Farm Mobility

Econometric models focusing on geographical mobility suffer from two major limitations when applied to the problem of parameterizing a simulation model of off-farm migration. First, the analysis is almost always limited to cross-sectional data from a single period. However, both Kono and Shio (1965), who applied the same model to data for two different years, and Ichimura (1965), who ran regressions on both cross-sectional and time-series data, found that regression coefficients differed significantly between periods. Second, most econometric models of migration, including those applied to developing countries, reveal an "urban" or at least non-agricultural bias: by assuming that economic motivations are subsumed in the short- or long-run responsiveness to wage and unemployment differentials these models abstract from structural and institutional factors which contrain mobility between the agricultural and non-agricultural sectors.

Peasant farming entails skills and knowledge — embodied human capital— which is of little relevance to non-agricultural activities. Even when farm incomes are very low the salvage value of a farmer's skills in the urban sector may be less than their marginal value in the agricultural sector.[101] With

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[101] The notion of salvage value as operative in the withdrawal from and recruitment to agriculture has been formally discussed by Glen L. Johnson See G.L. Johnson and C.L. Quance (eds.) The Overproduction Trap in U.S. Agriculture (Baltimore: Johns Hopkins Univ. Press, 1972).

reference to U.S. farmers, Marion Clawson has noted that[102]

> Men do not withdraw from farming, even under considerable provocation, they simply refuse to enter it when prospects are not good. This is further evidence that the salvage value is low for a farmer whose education, training and dedication are to agriculture. Having made his choice and spent a major part of his adult life as a farmer, he is reluctant or unable to leave, even in the face of low returns. On the other hand, not yet having choosen or begun a life occupation, and with the prospects of hard work and low income staring him in the face, he leaves the farm for employment elsewhere.

This pattern is not limited to developed countries. Both census data and fragmentary survey data suggest that in Korea farmers are underrepresented among rural out-migrants; that household out-migration among farm households is concentrated absolutely and relatively among tenants and independent owners with less than 1000 pyeong (.99 acres) of land; and that out-migration of members from farm households largely consists of adolescents and young adults not yet committed to small-scale agriculture.[103]

Farm skills in peasant or small-scale agriculture may also be specific to the soil, micro-climate, and marketing structure of a closely circumscribed locale. Moreover, insofar as an individual farmer is dependent on labor sharing arrangements and communal irrigation facilities, a not unimportant component of his stock of human capital is vested in his place in the community in which production activities and production decisions take place. Consequently, farmers as an occupational group are typically less mobile inter-locally than

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[102] "Aging Farmers and Agricultural Policy," Journal of Farm Economics Vol. 45 (1) (Feb. 1963), p. 27.

[103] Yoon Jong-joo A Study on Fertility and Outmigration in a Rural Area, Seoul Women's College, 1971.

other workers and the salvage value of farm skills may be no more in agriculture outside the local in which they were cultivated then it is in the non-agricultural sector.

The manner in which farm skills are transmitted and the close dependence on the production community makes it almost inevitable that peasant farmers, even more so than modern farmers, come by their calling through inheritance. Even if other barriers to mobility into farming were absent, the cost of securing land for an "adequate" farm would contrain the entry of those who could not somehow arrange to inherit holdings.[104]

While mature farmers may be reluctant to sell out and commit themselves completely to the non-agricultural sector, they, or members of the their families, may undertake seasonal migration to the urban sector. Since in Korea much of the demand for unskilled laborers in construction and other areas occurs between the months of March and December, labor is drawn away from the village during the agricultural cycle. This is not simply a matter of the withdrawal of potential agricultural workers from families who have a permanent labor surplus. The supply of available labor varies over the course of the family development cycle and most farm households can typically anticipate periods in which family labor supplies will shortfall or exceed that which can be absorbed by current holdings. Although adjustment to this transitional mismatch through sale, purchase, leasing or letting of land is possible, such adjustments are usually quite lumpy and may be constrained by cultural values and the current state of the local land market. Simpler and more precise adjustment can be

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104/ John S. Nalson Mobility of Farm Families: A Study of Occupational and Residential Mobility in an Upland Area of England, (Manchester: Manchester University Press, 1968). Nalson discusses the inheritance and the farm search process in a semi-marginal farming region cf pp. 118ff.

affected by buying or selling labor to households who are experiencing a labor surplus or deficit with respect to their own holdings. Family labor supplies typically peak when the first-born reach their late teens or early twenties,[105] and what begins as the temporary withdrawal of transitionally surplus young adult labor[106] may become permanent off-farm migration.

Since the adjustment of farm labor supply to labor demand works through the entrance rate of farm boys into farming, and only secondarily through the mobility of mature agricultural workers into or out of full-time farming, short-run adjustment is very sluggish. This is aggravated by the limited amount of inter-regional mobility within the agricultural sector, so that adjustments, both short- and long-run, must occur largely through the choices made by local agricultural workers and their sons. Moreover, if secondary school education is available to farm youths and is a prerequisite to success in the urban sector, effective commitment away from agriculture may be determined by conditions which influence educational choices five or more years prior to full-time entry into the labor force.

Due to the various constraints on rapid labor force adjustment to farm economic conditions, the pattern of withdrawal and reduced commitment to agriculture during the course of economic development tends to be quite regular. Both developed and developing countries reveal a pattern of gradual withdrawl

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105/ Ibid., p. 54, 249f.

106/ Korean census data on migration records a considerable amount of urban-rural backflow among young adults, which we believe largely reflects intentional returns rather than "failed migrants," as is frequently suggested.

from farming over time by members of a single birth cohort who are already committed to agriculture, and the much more rapid fall in the rate of entrance to farming among successive cohorts.[107] At the same time, the experience of Japan suggests that where existing land is intensively cultivated and the potential for expanding agricultural land limited, there is convergence toward a quasi-stable number of farm households.

The regularity of this pattern suggests that it may be possible to approach the simulation of off-farm migration through a model of cohort withdrawal from farming. At the very least, extrapolation under alternative assumptions of historical patterns of cohort withdrawal provides an alternative means of exogenous estimation which can be compared to exogeneous estimates of rural-urban geographical mobility.

Cohort Models of Farm—Non-Farm Mobility

Hjort and Tolley have presented a supply elasticity model for relating cohort-specific rates of change in the number of farm operators to changes in the total number of farm operators.[108] In modified notation, this is:

$$\frac{x_a(t)}{y_a(t-1)} = A_a \cdot \left[ \frac{\sum^{a} x_a(t)}{\sum^{a} x_a(t-1)} \right]^{B_a}$$

where

$x_a(t)$ = the number of farm operators in age group "a" at time t.

$y_a(t-1)$ = the number of farm operators of the same birth cohort "a" one period earlier—except that when "a" is age 25 and under at time t, $y_a(t-1)$ is the number of farmers at time t-1 in the birth cohorts age 35-45 at time t (ie. the number of farm operators in the cohorts to which the fathers of those in age group "a" are presumed to belong).

$A_a$ = age specific increment or decrement rates in the absence of a change in the total number of farmers.

$B_a$ = the elasticity of change in age-specific rates with respect to a change in the total number of farmers.

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[107] Clawson (1963), op.cit.; D. Kanel "Farm Adjustments by Age Groups, North Central States—1950-1959," Journal of Farm Economics, Vol. 45(1) (Feb. 1963). Korean data, while confounded by definition changes, reveals a roughly similar pattern.

[108] G.S. Tolley and H.W. Hjort, "Age-Mobility and Southern Farmer Skill-Looking Forward for Area Development," Journal of Farm Economics, Vol. 45(1) (Feb. 1963) pp. 31-46.

Hjort and Tolley estimated the age specific coefficients for both white and non-white southern farmers based on observations for the years 1920, 1930, 1940, 1950, and 1959, and found that the model fit the mobility of non-white farmers very well except in the oldest age bracket, but that the fit for white farmers was substantially poorer at all ages with few of the regression coefficients significantly different from zero at the traditional levels of significance.

Two limitations of the model are that it ignores mortality, which may account in part for the increasingly poorer fit with age, and that it requires for purposes of projection an ex ante estimate of the change in total number of farmers.

An alternative cohort mobility model is supplied by E.W. Johnston. As reported by C. Venkareddy,[109] this is:

$$\frac{f_{it}}{S_{it}} = \alpha_i . Z_t^{\beta_i} . U_{it}$$

where

$f_{it}$ = number of farmers age "i" in time t.

$S_{it}$ = number of survivors to time t of those age "i" in time t who were in the rural population in period t-1.

$Z_t$ = the ratio of farm to non-farm earnings in time t.

$\alpha_i$ = age-specific mobility rates in the absence of income changes

$\beta_i$ = age-specific elasticity of mobility with respect to the ratio of farm and non-farm earnings.

The Johnston model takes mortality into account, but is limited by the assumption that farmer mobility is determined by short-run income expectations. Extending and modifying the Johnston model, Venkareddy has attempted to relate the changing number of farm workers in the U.S. between 1917 and 1962 to the

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109/ Chennareddy Venkareddy, Present Values of Expected Future Income Streams and Their Relevance to Mobility of Farm Workers to the Non-Farm Sector in the United States, 1917-62 (unpublished PhD dissertation, Dept. of Agricultural Economics, Michigan State Univ., 1965), p. 15. The author draws the model from

E.W. Johnston, The Supply of Farm Operators (unpublished PhD dissertation, North Carolina State University, 1963).

changing differential between lifetime farm incomes and the lifetime incomes in the non-farm occupations to which off-farm migrants in the U.S. have generally transfered. Formally, the Venkareddy model[110] is

$$\log \frac{N_t}{N_o} = a_o + a_1 \log R_{25}^{M,C} + a_2 \log R_{45}^{L,T} + a_3 t + u$$

where

$N_t$ = total number of agricultural workers in year t.

$N_o$ = total number of agricultural workers in 1917.

$R_{25}^{M,C}$ = ratio of present value of lifetime income in manufacturing (M) or construction (C) at time t for a 25 year old worker to its base value in 1917 divided by the ratio of present value of lifetime income in farming at time t for a 25 year-old worker to its base value in 1917.

$R_{45}^{L,T}$ = ratio of present value of lifetime income in laundries (L) or retail trade (T) at time t for a 45 year-old worker divided by the ratio of present value of lifetime income informing at time t for a 45 year old worker to its base value in 1917.

Since the dependent variable is the ratio of the total number farm workers in year t to the number in 1917, the model is essentially a farm labor supply model which abstracts from social and demographic processes.

Several combinations of the income indexes are used and a simple linear form of the model is also tested. Although the regression coefficients are significantly different from zero and the multiple correlation coefficients very high, there is an unexpected positive sign on the index of relative income in laundries and retailing. The author offers a structural explanation, but inspection of the income index series suggests strong multicolinearity

110/ Venkareddy (1965), op. cit., p. 104-105.

between the two income terms. Moreover, the inclusion of a gross time proxy confounds the model as a whole. We suspect, in view of the very slight variance in the two economic indices over the period, that it is this variable which largely accounts for the high $R^2$ values achieved with the model.

As an alternative to the approaches taken in the preceeding models, a cohort mobility model of off-farm mobility based on behavioral assumptions might take as the dependent variable the change between periods in the proportion of the cohort engaged in farming and include as independent variables: (a) a proxy for the probability of succeeding to an adequate farm; (b) a proxy for permanent income expectations in farming versus the non-farm sector; (c) a measure of overall access to the urban sector; (d) a measure of social ties to the urban sector akin to the "migrant stock" variable already mentioned; (e) a proxy for the availability of non-agricultural or quasi-agricultural employment in the rural sector; (f) a measure of changing agricultural labor demand patterns due to technological change or changing crop mix.

Ideally, a cohort mobility model should be estimated on the basis of time series data. Where adequate time series data is not available, a modified form of the model could be run on regional observations since inter-regional agricultural mobility is quite limited. Under such circumstances it would be advisable to run the model on as many time periods as data is available for and examine the longitudinal variance of the estimated coefficients.

Practically, the model outlined above is relevant only to the male agricultural population. The number of females over age 30 in farm households is probably best estimated through a regression against the number of males in the cohorts to which their husbands presumably belong. For women under 30

a cohort mobility approach may be useful, with emphasis on urban and rural non-agricultural employment opportunities for women, and the mobility behavior of the male cohorts from which their husbands will be drawn.

One potential difficulty in applying a cohort mobility model is that agricultural workers are not all characterized by the same level of commitment to agriculture--tenants, owner-cultivators, part-time farmers, and full-time farmers may all be expected to respond differently. Since there is potential for mobility back and forth between these sub-groups, it may be worthwhile to run the analysis separately for each.

# VI. CONCLUSIONS AND WORK PLAN

This working paper has reviewed the treatment of migration in models of dualistic development, and has examined the theoretical foundations, structure, and limitations of a variety of models of inter-regional migration or cohort mobility between the agricultural and non-agricultural sectors. It remains to summarize our conclusions on the applicability of these theories and models to the problem of simulating off-farm migration in Korea and to lay out a plan of work aimed at the development of a more realistic model of off-farm migration for incorporation into the population component of the Korean Agricultural Sector Model.

## Conclusions

Migration data is collected on a regional basis and information on pre-migration occupation is typically not available. For example, the 1970 Korean census provides estimates of 5-year movement between the urban (shi) and rural (gun) areas of each province, and while indicating the present occupation of migrants does not provide an indication of pre-migration occupation. Parameters estimated from inter-regional mobility models may not be appropriate to the farm-household population if the fraction of the population in non-farm households is considerable in the rural areas of certain regions. Since the non-farm household population component may also be changing over time, failure to distinguish between off-farm and rural our migration aggravates the problems of applying the results of cross-sectional analysis to a longitudinal simulation.

Many of the behavioral models of migration fail to come to grips with the structure of the decision to migrate; human capital investment theory suggests that exclusive emphasis on current wages and unemployment may be unwarranted or even misleading. When educational attainment levels are rising rapidly and the expansion of modern sector employment is significant, as in South

Korea, much migration between the rural and urban sector occurs in connection with choices between lifelong occupational and career patterns. In addition, the often crude specification of such variables as "migrant stock" and distance precludes a meaningful test of the effects of social network or the spatial juxtaposition of economic activities.

It is imperative that analysis be conducted separately for different age-sex educational attainment groups. Not only can the responsiveness to a particular variable be expected to vary between population sub-groups, but the actual structure of the decision to migrate can also be expected to differ. Disaggregation is also important so that the application of cross-sectional results to time series simulation is not confounded by changes in the demographic structure of the agricultural and non-agricultural populations.

Within the basic stratification of the population by age, sex and educational attainment, sub-groups can be divided into "autonomous" and "dependent" migrants. Although the former can be fruitfully considered within an econometric framework of analysis, the mobility behavior of the latter are probably most realistically determined by tying them to the number of autonomous migrants.

On the basis of these conclusions, we have decided that a highly disaggregated and varigated approach to the analysis and simulation of off-farm migration is likely to be most fruitful, although it will be able to claim little in the way of elegance. The skeleton of this approach is discussed within the work plan outlined below.

Plan of Future Work

The scheduling of future work on the analysis of off-farm migration in Korea and the simulation of off-farm migration within the population component of KASM will follow the development of the model as a whole during the next six

to eithteen months. We envision this development process as encompassing three phases.

Phase 1 extends over the next three months, while KASM is still in its version-2 mode. Version 2 differs from Version 1 described in the user's manual in that the three cropping regions have been replaced by a single national agricultural sector, and two new components have been incorporated: a) a market-price mechanism which determines consumer and producer prices, and b) a resource allocation component which allocates resources to agricultural production at the aggregated farm firm level by means of recursive linear programming. During phase 1 the migration related research will focus on a) making new estimates of the recent rates of off-farm migration, b) examining the selectivity characteristics of this movement, c) studying the economic and social structure of the farm household population and d) investigating patterns of off-farm migration in Japan during its period of rapid development after 1910.

Phase 2 extends from the third through sixth months during which time KASM Version 3 is expected to become operational. In this version the model will include Abkin's NECON model for the non-agricultural sector; NECON will generate employment and wages in 15 non-agricultural sectors. During this phases migration analysis will center on the specification and econometric estimation of autonomous migrant mobility, culminating in the linking of a migration model to KASM Version 3.

Phase 3, extending beyond the sixth month, will parallel further development of KASM such as incorporation of the proposed flexible regionalization capacity.[111]

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[111] This entails maintaining a data bank at a high level of areal disaggregation. For Korea this would be at the level of the 140 guns. Flexible regionalization will permit the researcher to aggregate up to the level that is most efficient for the problem at hand. The researcher will also be able to specify the criteria on which aggregation is made.

With the reintroduction of regionalization into the model the explicit recognition of space is likely to become important not only for the purposes of modelling migration but also to capture spatial factors influencing farm gate prices and the pattern of land utilization.

Phase 1

Direct data on the amount of off-farm migration is not available for Korea. It is thus necessary to make certain assumptions if indirect measures of off-farm migration are to be considered a valid basis on which to build a simulation model that is capable of generating the net movement out of the agricultural labor force in each period.

First, we assume that the entire potential labor force is encompassed within the "farm-household population" as reported in the Korean agricultural and population censuses. By assumption we thus exclude the possibility that persons not in the farm household population could be drawn into the agricultural labor force during time of peak demand. Since agricultural census data is collected as of December 1, the reported farm household population may differ from the peak season population but we believe there is likely to be some balancing between members who have returned from urban construction work and those that have moved off the farm after the harvest.

A second assumption is that all members of farm households above 10 years of age are potentially available to make at least some labor contribution to the agricultural sector. It may be desireable to take age, sex, education, and level of commitment outside agriculture into account in actually setting these maximum potential supply levels.

A third assumption, one which we hope to examine more carefully on the basis of the Economic Planning Board's current employment survey, is that among farm households with non-agricultural income it is the household head who

functions as the primary farm operator and who maintains the household's commitment to the agricultural sector. Consequently we assume, that the withdrawal from farm household population of a mature male household head implies the permanent withdrawal of the rest of the household as well.

A final assumption is that movement into farm operator status is exclusively from the population living in farm households and working at least part-time in agriculture, and that retirees from operator status remain in the farm household population unless associated with an out-migrant household.

The initial estimates of recent net off-farm migration will be calculated through the census surrival ratio approach applied to the cohorts of the farm-household population of the 1960 and 1970 Agricultural Census and the 1966 Population Census. This estimation procedure requires several adjustments and approximations but the results can then be compared with estimates of rural-urban migration according to the same method which are already available and thus checked for reasonableness. If the estimates do appear to be reasonable, it would be worthwhile to apply the same model at the provincial level, assuming little inter-regional mobility within agriculture.

Under our assumption that there is negligible mobility into the farm household population from the nonfarm household population, this is in fact an estimate of gross off-farm migration as well, and as such can be used to establish gross migration rates, at least among those population sub-groups for which these assumptions appear valid. At present we are reasonably confident that these assumptions will hold for males and females age 30-60 at the beginning of each intercensal period.

Among the age groups age 15-30 we are less confident that these assumptions will hold due to the existence of short-term sojourning outside of the agricultural sector by both males and females in these ages. It is nonetheless possible to

compare these net migration estimates with net migration estimate for the entire rural sector in these age groups, and under a set of more or less restrictive assumptions derive rough estimates of net and gross migration rates between the agricultural and non-agricultural sectors.

It should be noted that the adjustments, approximations, and assumptions utilized to generate our estimates of off-farm migration overstep the accepted, if conservative, methodological boundaries of standard demography. We feel, however, that the alternative of assuming that rural-urban migration rates are an adequate approximation of farm-nonfarm mobility is an even more serious error. Since one of the authors is already using published and unpublished census data (accessed through the Korea Development Institute) to analyse rural-urban migration between 1965 and 1970, these finding will serve as a check or benchmark for the off-farm mobility estimates.

Phase 2

The second phase of the migration research will center on the specification and estimation of econometric models of off-farm mobility. These too will parallel concurrent research on rural-urban migration Two types of models will be estimated.

The first model will be a rural-urban migration model using the 1970 census data on inter-regional migration between 1965 and 1970 as the dependent variable and including among the independent variables an economic component which incorporates human capital investment theory as well as short-run wage and employment variables. We also hope to improve upon the distance and social network variables along the lines discussed in the body of this paper.

The second model will be a nonspatial off-farm mobility model using the estimates of off-farm migration in each province for the periods 1960-65 and 1966-70 as the dependent variables and include among the independent variables a general measure of access to the urban sector, a measure of local rural non-farm employment opportunities, etc. Whereas the inter-regional migration model can be estimated separately for each age-sex-educational attainment class, the more limited number of observations on cohort mobility will require grouping of observations across age groups with age included as an independent variable.

Under both models the movement of dependent population sub-groups will be related to the movement of the autonomous sub-groups through a simple linear regression model.

It is our intention to combine the results of these two models into a simulation of the off-farm migration process without being very sure at the moment as to how this amalgamation might be achieved. In any case, the results will provide alternative perspectives on the migration question and alternative empirical foundations an which the simulation in the population component can be based.

Phase 3

If it seems desireable to extend the migration model to link with later versions of KASM which will allow "flexible regionalization," one of the most fruitful elaborations is likely to be in the area of incorporating spatial variables within the model, perhaps necessitating a sub-routine for regionalizing the urban population (central-place theory provides the theoretical basis for this). A second, equally important area is the relationship between migration and size of farm holding, while a third is the interaction between part-time

and full-time farming. Although we will examine these areas as part of the general backround work during the first phase of the research, we do not anticipate being able to incorporate these into the simulation within the time-frame of the current work plan.

An annotated bibliography of major source is appended to provide an overview of the data base on which the subsequent work will be based.

# APPENDIX: BASIC DATA SOURCES FOR THE STUDY OF OFF-FARM MIGRATION IN KOREA

The following sources contain information which is directly or indirectly relevant to the problem of modelling and estimating off-farm migration in Korea.

Census and Census-related Reports

- 1970 Population and Housing Census Report (Economic Planning Board).

  Full enumeration report presents general census information. In addition, the two following volumes based on the 10% sample survey are particularly relevant:

  Vol. 4-3: Population Migration.
  Estimates of internal migration between 1965 and 1970 based on change of residence data. Origins and destinations aggregated by rural and urban sectors of each provincial level unit, yielding 11 urban (shi) and 9 rural (gun) sectors. Published data includes: 20 X 20 matrix of lifetime migration between these sectors by sex and 5-year age grouping; 20 X 20 matrix of 5-year movements by sex; 4 X 20 matrix of inter- or intra-provincial movement by rural or urban origin into each of the 20 sectors by age and sex for the period 1965-70; 4 X 4 matices of intra- and inter-provincial rural-urban and urban-rural movement for 1965-70 by age, sex, current occupation, and educational status.

  Vol. 4-1: Economic Activities
  Economic status, industry, and occupational distributions by age, sex, for city (shi), town (up)and village (myeon) sectors. Also occupation by age, sex, educational attainment.

- 1966 Population Census Report (Economic Planning Board).

  An abbreviated census. No migration data. Does include population characteristics and age-specific educational attainment levels for the "farm household population." Also occupation distribution for the urban and rural sector of each province by age and sex.

- Some Findings from the 1966 Special Demographic Survey (Economic Planning Board, 1968).

  Estimates of movements between the rural and urban sectors of each province during period 1961-1966 based on change of residence data collected from 8296 households covered in a supplemental survey to the 1966 census. Broken down by age and sex.

- A Comprehensive Study of the 1966 Population Census (Economic Planning Board, 1970).

  Includes estimates of net migration for the rural and urban sector of each province for the period 1961-66. These appear to be census survival ratio estimates, but apparently without adjustments for boundary changes.

- 1960 Population and Housing Census Report (Economic Planning Board).

  No migration information other than that which can be derived from provincial place of birth data. Includes educational attainment rates by age (10-year cohorts), sex, for the city, town, and village populations of each province. Also occupation and industrial distribution of population by 5-year cohorts in each city, town, or village population.

- 1970 Agricultural Census (Ministry of Agriculture and Fisheries).

  Characteristics of farm household population; agricultural and non-agricultural employment of the farm household population by age and sex. Family size, educational attainment levels by size ofholdings, full-time or part-time farming status.

- 1960 Agricultural Census (Ministry of Agriculture and Fisheries).

  Considerably less population detail than 1970 Agricultural Census, but contains basic data on farm household population. Some definition changes and changes in aggregation procedures complicate comparison with later censuses.

Government Yearbooks

- The Yearbook of Migration Statistics (Economic Planning Board). Issued since 1970. Gross inter-provincial and inter-sectoral migration based on civil registrations. No age breakdown, but does give migration volume for each gun, and number of registrations by month. Data includes reason for moving (i.e., household move, marriage or adoption, work, education, or other). Data is affected by periodic drives to expand civil registration system, and to register delinquent reporters.

- Korea Statistical Yearbook (Economic Planning Board).
  Annual information on farm management including labor inputs by holdings size, farm household income and expenditures, etc.

- Yearbook of Agricultural and Forestry Statistics (Economic Planning Board).

  Basic information on farm household population. Less detail than census sources.

- Monthly Survey of Farm Households (MAF Statistics Bureau)

  Basically an income-expenditure, cropping patterns and yields survey. Repeated coverage of some farms for up to a year means it may be possible to collect information on out-migrants from farm households and on departed households from existing data files.

Other Government Publications

- Survey Report on Circulation Conditions of Labor Force (Office of Labor Affairs).

  Several reports published since 1970. Includes some information on inter-occupational mobility by educational level, entrance to and exit from various occupations and industries by age, sex and educational status.

- A Study on the Regional Characteristics of Rural-Urban Migration in Relation to Industrial-Urban Development in Korea, 1966-1968 (Ministry of Agriculture and Fisheries, 1971).

- Report of the 1970 Real Wage Survey (Korea Industrial Development Research Center, 1971)

  Results of a survey of 1200 firms, 20,000 wage employees. Gives wages by industry, occupation, firm size, age, sex and educational attainment of workers.

- 1974 Employment Survey (Economic Planning Board).

  A survey presently in process. Covers 120,000 households throughout the nation. Will provide detailed information on the education and employment statues of farm household members. Also collects information on amount of farming and non-farming income, and farm size.

- Population Distribution and Internal Migration in Korea (EPB (BOS), 1966)

  Includes census survival ratio estimates of net rural-urban migration by province. May include substantial error.

Other Publications

- Republic of Korea Regional Physical Planning, Vol. 4: Population and Employment. (OTAM-Metra, June 1971).

  Report prepared for the United Nations. Includes projections of the urban hierarchy and the urban population by region.

- The Journal of Population Problems (Periodic. The Institute of Population Problems).

  This journal has included several articles on migration, and the Institute has also published a study entitled "A Study of the Effects of Rural- Out-migration on Rural Development and Their Measures (1971)

  Prof. Yoon Jong-joo of Seoul Women's College is one of the senior researchers of the Institute and has done considerable work on rural out-migration and urban in-migration. Some of his survey results have been put on IBM cards and it may be possible to subject this to additional analysis.

- Bulletin of the Population and Development Study Center (Periodic. The Population and Development Study Center, Seoul National University).

  This journal has published several studies of rural-urban migration during the 1960s done by Yu Eui-young. These have largely centered on census survival ratio estimates of net migration into the urban sector. The center has also conducted several studies of rural fertility patterns and some of the rural household data collected in connection with these studies may be relevant to problems of off-farm migration.

# BIBLIOGRAPHY


Abkin, Michael H. "On A National Macro Model Linking Korean Agriculture and Non-Agriculture." KASS Working Paper 74-3. Seoul: NAERI/MSU, Aug. 22, 1974.

Alonso, William. "The System of Intermetropolitan Population Flows" Institute of Urban and Regional Development. Working Paper No. 155. Berkeley: University of California, Aug., 1971.

Apgar, William. "Migration as Investment: Some Further Considerations." Discussion Paper No. 64. Harvard University. Program in Urban and Regional Economics (May, 1970).

Beals, R.E., Levy, M.B. and Moses L.N. "Rationality and Migration in Ghana." The Review of Economics and Statistics, Vol.XLIX (Nov. 1967), pp. 480-486.

Becker, Gary. Human Capital: A Theoretical and Empirical Analysis With Particular Reference to Education. New York: NBER, 1964.

Bogue, Donald J. "Internal Migration." In The Study of Population, Chapter 21. Edited by P.M. Hauser and O.D. Duncan. Chicago: University of Chicago Press, 1959.

Bogue, D.J., Shryock, S.A. Hoermann. "Subregional Migration in the United States, 1935-1940." Volume I, Streams of Migration between Sub-regions. Oxford, Ohio: Miami University, 1953.

Bowles, Samuel. "Migration as Investment: Empirical Tests of the Human Investment Approach to Geographical Mobility." Review of Economics and Statistics, LII (Nov. 1970).

Bowman, Mary Jean and Robert G. Myers. "Schooling, Experience and Migration: Human Capital Changes." JASA 62 (September 1967) pp. 857-879.

Browning, H.L. "Migration Selectivity and the Growth of Large Cities in Developing Societies." Chapter VIII in National Academy of Science, Rapid Population Growth: Consequences and Policy Implications Vol. II. Baltimore: Johns Hopkins Press, 1971.

Byerlee, Derek, and Halter A.N. "A Macro-Economic Model for Agricultural Sector Analysis." American Journal of Agricultural Economics, 56 (Aug. 1974).

Beegle, J.A., Carroll T.W., et al., KASS Special Report 6: Population, Migration, and Agricultural Labor Supply. Seoul: NAERI/MSU, (n.d.).

Carrouthers, Gerald P. "A Historical Review of the Gravity and Potential Concepts of Human Interaction." Journal of American Institute of Planners, 22 (Spring 1966).

Cho, Lee-jay. "Korean Population: Trends and Prospects." Paper prepared for the ILCORK Conference on Population and Its Societal Impacts, Pusan, Korea, Feb. 21-24, 1974.

Choe, Sang-chul. "Dual Economic Approach to Regional Inequality and Migration Process (The Case of Korea)." Paper presented at a seminar jointly sponsored by USIS and Seoul National University, Seoul, Korea, April 30, 1974.

Clawson, Marion. "Aging Farmers and Agricultural Policy." Journal of Farm Economics 45 (Feb. 1963).

Craig, John E. Jr. "Evaluation of the Demographic Component, Korean Agricultural Sector Study." Socio-Economic Analysis Staff, International Statistics Program, U.S. Bureau of the Census. Typescript. Washington, D.C.: March 15, 1974.

Duncan, Otis Dudley. "Methodological Issues in the Analysis of Social Mobility." In Social Structure Mobility and Economic Development. Edited by Smelser and Lipset. Chicago: Aldine Publishing Co., 1966.

Eldridge, Hope T. "A Cohort Approach to the Analysis of Migration Differentials. Demography 1 (1964).

"Extracts from Population as a Variable in the Economic Development Press with Special Emphasis on Relationships with the Agricultural Sector." Handout prepared for presentation by Purdue research team at a contract review session held at the U.S. Bureau of Census, International Statistics Program, March 27, 1974.

Forester, Jay W. Urban Dynamics. Cambridge: The MIT Press, 1961.

Greenwood, M.J. "An Analysis of the Determinants of Geographic Labor Mobility in the United States." The Review of Economics and Statistics Vol. 51 (May 1969), pp. 189-194.

_____. "Lagged Response in the Decision to Migrate." Journal of Regional Science, 10 (Dec. 1970).

_____. "Lagged Response in the Decision to Migrate: A Reply." Journal of Regional Science 12 (Aug. 1972).

Gugler, Joseph, "On the Theory of Rural-Urban Migration: The Case of Sub-Saharam Africa." In Sociological Studies 2: Migration. Edited by J.A. Jackson. Cambridge: Cambridge Univ. Press, 1969

Hansen, Niles M. "Rural Poverty and the Urban Crisis: A Strategy for Regional Development." Bloomington: Indiana University Press, 1970.

Ichimura, S. "An Econometric Analysis of Domestic Migration and Regional Economy." Regional Science Association, Papers and Proceedings XVI (1965).

Isard, Walter. "Methods of Regional Analysis: An Introduction to Regional Science." Cambridge: The MIT Press, 1960.

Jansen, C.J. "Readings in the Sociology of Migration." Oxford: Pergamon Press, 1970.

Johnson, G.L. and Quance C.L. (eds.). "The Overproduction Trap in U.S. Agriculture. Baltimore: Johns Hopkins Univ. Press, 1972.

Johnson, R.H. "Comments on Regional Aspects of the Third Five-Year Plan." In Basic Documents and Selected Papers of Korea's Third Five-Year Plan (1972-1976). Edited by S.H. Jo and S.Y. Park. Seoul: Sogang University Press, 1972.

Johnston, B.F. "Sectoral Interdependence, Structural Transformation, and Agricultural Growth" In Subsistence Agriculture and Economic Development. Edited by Clifton R. Wharton, Jr. Chicago: Aldine, 1969.

Johnston, E.W. "The Supply of Farm Operators. Ph.D. dissertation, North Carolina State University, 1963.

Jorgenson, Dale W. "The Role of Agriculture in Economic Development Classical Versus Neo-Classisical Models of Growths." Subsistence Agriculture and Economic Development, Chapter 11. Edited by Clifton R. Wharton, Jr. Chicago: Aldine, 1969.

Kim, Se-yeul. "The Economic and Social Determinants of Rural-Urban Migration in Korea: A Case Study of North Cholla Province." Ph.D. dissertation, Univ. of Hawaii, Dept. of Agricultural Economics, 1973.

Kim, Y.S., Kim. K.H. and K.T. Wright. "Crop Production Data and Relationships. KASS Special Report 8. Seoul: NAERI/MSU, 1972.

Kono, Shigeni and Mitsuru Shio. "Inter-Prefectural Migration in Japan, 1956 and 1961: Migration Stream Analysis. New York: Asia Publishing House, 1965.

Kuznets, Simon. "Economic Growth and the Contribution of Agriculture: Note on Measurement." Agriculture and Economic Development. Edited by C. Eicher and L. Witt. New York: McGraw-Hill, 1964.

Lee, Kyu-sik. "Labor Force Behavior in Korea." Paper presented at the ILCORK Conference on Population Growth and Its Societal Impacts. Pusan, Korea: Feb. 21-24, 1974.

Levi, J.F.S. "Migration from the Land and Urban Unemployment in Sierra Leone. Oxford Bulletin of Economics and Statistic 35 (Nov., 1973).

Levy, M.B. and W.J. Wadycki. "A Comparison of Young and Middle-aged Migration in Venezuela." The Annual of Regional Science VI (December 1972) pp. 73-85.

_____. "The Influence of Family and Friends on Geographic Labor Mobility: An International Comparison." The Review of Economics and Statistics LV (May 1973)

_____. "What is the Opportunity Cost of Moving? Reconsiderations of the Effect of Distance on Migration." Economic Development and Cultural Change 22 (Jan. 1974), pp. 198-214.

_____. "Education and the Decision to Migrate: An Econometric Analysis of Migration in Venezuela" to appear in Econometrica.

Lind, Harold. "International Migration in Britain." In Sociological Studies 2: Migration, Chapter 4. Edited by J.A. Jackson. Cambridge: Cambridge Univ. Press, 1969.

MacDonald, J. and L. MacDonald. "Chain Migration, Ethnic Neighborhood Formation and Social Networks." Social Research 29 (Winter 1962).

Manetsch, Thomas J. and Tom W. Carroll. User's Manual for the Korean Agricultural Simulation Model -- Version I. KASS Special Report No. 9. Seoul: NAERI/MSU, June, 1973.

Mincer J. "Labor Force Participation and Unemployment: A Review of Recent Evidence" in Prosperity and Unemployment. New York: Wiley & Sons, 1966.

Nelson, John S. "Mobility of Farm Families: A Study of Occupational and Residential Mobility in an Upland Area of England. Manchester: Manchester University Press, 1968.

Nelson, P. "Migration, Real Income and Informations." Journal of Regional Science. 1 (Spring 1959) pp. 43-74.

Nelson, R.R., T.P. Schultz, and R.L. Slighton. "Structural Change in Developing Economy: Columbia's Problems and Prospects. Princeton: Princeton Univ. Press, 1971.

Oshima, Harry. "The Ranis-Fei Model of Economic Development: A Comment." In Agriculture and Economic Development. Edited by C. Eicher and L. Witt. New York: McGraw-Hill, 1964.

Pai, Gregory G.Y. "Rural to Urban Migration and Squatter Settlements with Special Reference to Seoul, Korea." Manuscript, Aug. 1973.

Park, Rae-young. "Population Pressure on Labor Force in Korea." Paper presented at ILCORK Conference on Population Growth and Its Societal Impacts. Pusan, Korea: Feb. 21-24, 1974.

Perloff, H., E. Dunn, E. Lanpard. Regions, Resources and Economic Growth. Philadelphia: Resources for the Future, 1960.

Price, D.O. "Distance and Direction as Vectors of Internal Migration, 1935-40. Social Forces 27 (Oct. 1948).

Ranis, G. and J.C.H. Fei. "A Theory of Economic Development." The American Economic Review 51 (Sept. 1961).

_____. "Agrarianism, Dualism and Economic Development." In The Theory and Design of Economic Development, pp. 3-40. Edited by I. Adelman and E. Thorbecke. Baltimore: The Johns Hopkin Press, 1966.

Rempel, Henry. "Labor Migration into Urban Centers and Urban Unemployment in Korea. Ph.D. dissertation, Dept. of Economics, Univ. of Wisconsin, 1970.

Rodgers, G.B. "An International Cross-Section Analysis of Mortality." Typescript. Geneva:ILO, May, 1974.

Ruttan, Vernon W. "Comment: Two Sector Models and Development Policy." In Subsistence Agriculture and Economic Development. Edited by Clifton R. Wharton, Jr. Chicago: Aldine, 1968.

Sahota, G.S. "An Economic Analysis of Internal Migration in Brazil." Journal of Political Economy, 76 (March/April 1968), pp. 218-245.

Sandee, Jan. "A Programming Model for a Dual Economy." The Role of Agriculture in Economic Development. Edited by E. Thorbecke. New York: Universities - NBER, 1969.

Spengler, Joseph T. "Demographic Factors and Early Modern Economic Development." Daedalus (Spring, 1968).

Sjaastad, L.A. "The Costs and Returns of Human Migration." Journal of Political Economy, LXX (Oct. 1962) Part II.

Thomlinson, Ralph. "A Model for Migration Analysis." Journal of the American Statistical Association 56 (1961).

Todaro, M.P. "A Model of Labor Migration and Urban Unemployment in Less Developed Countries." American Economic Review 59 (March 1969), pp. 138-48.

Tolley, G.S. and H.W. Hjort. "Age-Mobility and Southern Farmer Skill-Looking Forward for Area Development." Journal of Farm Economics 45 (Feb. 1963) pp. 31-46.

Vanderkamps, J. "Migration Flows, Their Determinats and the Effect of Return Migration." Journal of Political Economy 79 (Oct.-Nov. 1971).

Venkereddy, Chennareddy. "Present Values of Expec'ed Future Income Streams and their Relerance to Mobility of Farm Workers to the Non-Sector in the United States, 1917-62." Ph.D. dissertation, Michigan State University, Department of Agricultural Economics, 1965.

Wery, R. G.B. Rodgers, M.D. Hopkins. "BACHUE-2: Version-I, A Population and Employment Model for the Philippines. Population and Employment Working Paper No. 5, Geneva:ILO (July 1974).

Yoon, Jong-joo. "A Study on Fertility and Outmigration in a Rural Area, Seoul Women's College, 1971.