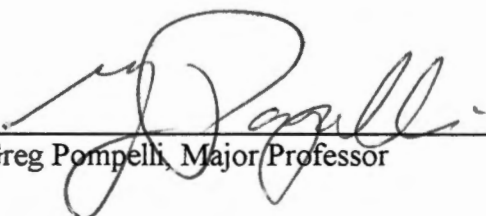


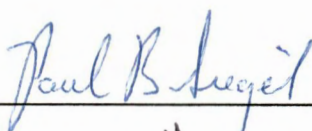
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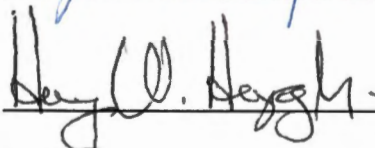
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Greg Pompelli, Major Professor

We have read this dissertation
and recommend its acceptance:







Accepted for the Council:



Associate Vice Chancellor
and Dean of The Graduate School

**THE EFFECT OF OFF-FARM ECONOMIC ACTIVITIES ON
RURAL-URBAN MIGRATION IN BRAZIL**

A Dissertation
Presented for the
Philosophy Doctor
Degree
The University of Tennessee, Knoxville

Ricardo C. Lima
December, 1994

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thesis
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DEDICATION

This dissertation is dedicated to my wife Celeste, and my daughter Mariana

ACKNOWLEDGMENTS

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ABSTRACT

Rural-urban migration models commonly assume that rural income and employment are mainly derived from the farm economy. Many studies of rural labor markets in developing countries, however, have indicated that a significant portion of rural employment occurs in nonfarm activities. The present study incorporates the rural nonfarm economy in the traditional rural-urban migration framework, as a determinant of rural labor relocation. Brazil was used as a case study due to the economic and demographic changes experienced by this country during the period between 1960 and 1980. The migration model was estimated in a system of regression equations, which used cross-state aggregate data for Brazil.

The results showed that rural income was negatively related rural out-migration, and that urban income in the Southeast region influenced rural-urban migration positively. In respect to the rural nonfarm economy, the study showed that the farmers' share of non-agricultural earnings was positively related to rural income in the lower agricultural average product regions. The findings also showed that education and rural infrastructure were positively related to rural income; and that agricultural modernization policies influenced rural income negatively. It was concluded that rural out-migration in Brazil during the period between 1960-1980 was influenced by the rural-urban earnings differential, and that the rural nonfarm economy was an important deterrent of rural out-migration in the lower agricultural average product regions. Also, the policies toward agricultural modernization during the period considered displaced farm labor, and, consequently, induced rural out-migration.

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CHAPTER 1

INTRODUCTION

The economic development literature started considering the process of human migration in the labor-surplus models proposed by Lewis (1954), and Ranis and Fei (1961). According to those models economic development produces a rural-urban labor productivity differential capable of driving a large portion of the rural labor force out of agriculture. Rural-urban migration, though, was expected to be part of the process of economic development, and decrease as the income differential between industry and agriculture decrease.

The first formal presentation of a migration decision model for an individual was done by Sjaastad (1962), which became known as the *human capital model (HCM)*. The *HCM* is based on the assumption that migration is a process that entails benefits and costs for the potential migrant, who would relocate if benefits exceeded costs over a given planning horizon. The applicability of the *HCM* in developing countries, however, required some adaptations due to peculiarities of the process of labor relocation in those countries, such as a rural-urban migration trend, and high rates of urban unemployment. The first migration models formulated to describe human relocation in developing countries were developed by Todaro (1969) and Harris and Todaro (1970).

In the Todaro and Harris-Todaro framework it was the expected value of rural-urban income differential and the initial cost of migration which determined the decision to relocate. The model assumed that the stream of labor migration in developing countries was mainly from rural to urban areas, and that rural migrants considered the rate of urban unemployment when making their expectations of future urban earnings. The Todaro/Harris-Todaro model, hereafter referred as the *urban employment probability*

model (UEP), was later expanded to consider the urban subsistence sector as influencing the urban employment probability and, consequently, migration decision (Cole and Sanders, 1985; Fields, 1975). An implicit assumption of both the labor-surplus models of economic development and the *UEP* models of migration, was that agriculture was the source of income in the rural sector. A number of empirical studies, however, have shown that the rural economy in developing countries is composed of agricultural and non-agricultural activities (Liedholm, 1973; Anderson and Leiserson, 1980; and Haggblade, Hazell, and Brown, 1989). Therefore, the traditional approach of rural-urban migration should be expanded to consider rural nonfarm income as a possible determinant of migration decisions by individuals residing in rural areas of developing countries.

The following sections of this chapter will outline a discussion of the economics of labor migration, and the rural determinants of human relocation in developing countries. This study focuses attention on the process of rural-urban migration in Brazil during the period of 1960 to 1980. Therefore, an introductory discussion of the economic changes in Brazilian agriculture, and its consequences on labor migration, will also be presented. Finally, this chapter will outline some methodological considerations and objectives of the present case study.

The Economics of Labor Migration

The *HCM* represented the first attempt to formally present an economic explanation for an individual's decision to migrate. According to the model, the income differential between places of origin and destination, and the initial cost of migration, were the main motivations for labor relocation. An individual's decision with respect to migration was treated as an investment increasing the productivity of human capital,

which had costs and which also rendered returns (Sjaastad, 1962).¹ Personal characteristics of migrants and psychic factors were also viewed in the *HCM* as influential to migration decision. Individuals with different age and educational background, for instance, would have different responses with respect to their migration decisions when exposed to the same earnings differential between places of origin and potential destination. The subjective calculation of the pecuniary returns to labor migration discounts the difference between future value of income streams at origin and destination, and compares it to the initial cost of migration. According to the model, the potential migrant would decide to move if the present value of future income streams exceeds the initial cost of migration.

The human capital approach was used as the basis for contemporary origin-destination models of migration. Those models usually attempt to measure the influence of individual characteristics (education, age, skills, etc.), and place characteristics (population, average income, rate of unemployment, amenities, etc.) at origin (i) and destination (j) on the propensity to migrate (Greenwood, 1969; Fields, 1979; Herzog and Schlottman, 1981). The origin-destination models generally incorporate characteristics of places of origin and potential destination, but do not restrict i or j to be a particular sector of the economy. That is, places of origin and destination are not assumed to be necessarily rural or urban. The reason is that origin-destination models have been mainly used in migration studies in developed countries, where the stream of labor migration does not necessarily follow the rural to urban pattern. The use of the human capital approach in studies of migration in developing countries, however, required some adaptations to meet the reality of the labor markets, and the human relocation pattern in

¹Migration is considered an *investment increasing the productivity of human capital* in the sense that a migrant with a given stock of human capital can “invest” a certain amount of resources to relocate (cost of migration) to a place where her/his level of education and skills would render higher income, due to differences in labor productivity.

such areas. The main objectives of the Todaro model are: (1) to formulate an economic behavioral model of rural-urban migration, and (2) to introduce the urban employment probability as an influence on expected urban income and, consequently, the decision to migrate (Todaro, 1969). The rural-urban migration models, though, can be viewed as an special case of the origin-destination models, where i is constrained to be rural and j is constrained to be urban, and the probability of finding employment at j is influential on migration decision.

The assumption of a rural to urban pattern of labor migration in developing countries has its foundation in the early labor-surplus models of economic development (Lewis, 1954; Ranis and Fei, 1961), according to which labor was transferred from agriculture to industry during the process of economic development. The *UEP* model, however, brings up the question of whether or not the typical unskilled rural migrant can find a higher-paying urban employment. According to the Todaro model (Todaro, 1969), rural migrants are randomly selected for a urban-modern job according to an employment probability which, is defined as the product of the rate of urban employment times the rate of urban-modern sector job openings.

The *UEP* models were later expanded to account for heterogeneity of individual migrants, and of labor markets. The role of non-economic factors such as education, skills, information, etc., have been increasingly included in theoretical and empirical studies of migration (Barnum and Sabot, 1977; Fallon, 1983; Todaro, 1982). Another frequent concern in empirical studies of migration in developing countries is the role of the urban-subsistence sector. Fields (1975) defined an urban job search model in which the subsistence sector gives free entry to rural in-migrants, while the modern sector hires according to an employment probability. The urban-subsistence sector does not impose barriers to entry, and there is no stable employer-employee relationship. Rural-urban migrants, though, look for employment in the subsistence or modern sector depending on

their relative chance of getting a modern sector job. Individuals with higher chances of getting a modern sector job would engage in full time employment search in this sector; while individuals with lower chances of getting a modern sector job would get an employment in the informal sector and engage in part time job search in the modern sector. A similar approach is used by Cole and Sanders (1985), according to which migration is viewed as a dual phenomenon. Rural migrants endowed with more human capital consider employment opportunities in the urban-modern sector (*U-M*), while those less endowed with human capital consider job opportunities in the urban-subsistence sector (*US*).

The rural-urban migration models have expanded the analysis of the urban labor market, but have lacked of a more detailed description of the rural economy. The following section will introduce a discussion on the sources of rural income and employment opportunity, and its importance to migration decisions of rural individuals.

The common assumption of rural-urban migration models that rural income is solely derived from agriculture may ignore some important sources of income for rural residents.² Empirical evidence has shown that the rural economy is not entirely comprised of farm activities (Anderson and Leiserson, 1980; Chuta and Liedholm, 1990; and Haggblade, Hazell, and Brown, 1989). These studies described the rural economy as being composed by farm and nonfarm activities. Farm activities were characterized by Haggblade, Hazell, and Brown (1989) as crop and livestock, while nonfarm activities were characterized as all other rural enterprises, such as food processing, marketing, transportation, repairing, etc. The present study, therefore, assumes that the rural household derives income (cash and non-cash) from farm and nonfarm economic

²The term income is used in the present study to represent inflows of cash and non-cash benefits for the household. Non-cash benefits are goods and services produced and consumed in the household such as food, handicrafts, repairing, etc.

activities. According to this analytical framework, the potential rural migrant has a wider range of income and employment possibilities comparing to the traditional *UEP* approach. The calculation of the present value of rural income should include income opportunities from both farm and nonfarm sources. The decision to migrate, therefore, is considered in the present study as a function of rural farm and nonfarm incomes, urban income, and the initial cost of migration.

Rural Development and Migration in Brazil: 1960-1980

The strategy of agricultural development pursued by Brazilian government after the mid-sixties was oriented towards the use of capital intensive technology. This policy aimed to increase exports, as well as to enlarge the supply of raw material for domestic industry. Agricultural modernization was expected to produce an overall invigorating impact throughout the economy, stimulating growth in other sectors (Mendes, 1987). This section will briefly outline the main characteristics of the process of agricultural modernization in Brazil during the second half of the sixties and the seventies, and its consequences for rural-urban migration.

According to Martine (1987) the major mechanism used by the public sector to carry out the process of agricultural modernization was agricultural credit; which was basically used to buy modern inputs such as seeds, machines, fertilizers, etc. The policy indeed influenced the pattern of agricultural growth in Brazil. The impact of the policy, however, was mainly restricted to the south-eastern and southern regions, and to medium and large scale producers. Kageyama and Graziano da Silva (1983) showed that, during the period of 1970 to 1979, the annual rate of growth of Brazilian agricultural product was negative for bean and manioc, and statistically non-significant at the 5% level for rice and corn. As for large scale and export crops, soybean, orange, sugar-cane, and

tobacco, for instance, grew at annual rate of 22, 13, 6, and 6 percent, respectively. During this period, therefore, the increase in total Brazilian farm product was mostly due to expansion of large scale and export crops.³

The increasing use of capital intensive technology in agriculture resulted in farm labor displacement. Also, increasing the returns to commercial agricultural production induced an expansion of the farm land of medium and large scale producers, which was accomplished by the purchase of small-holders' land, and by taking back farm land from renters and sharecroppers (Graziano da Silva, 1981). The impact of this policy in the rural labor market was a decrease in the proportion of stable employment, and an increasing proportion of temporary and unstable jobs (Martine, 1987).

Structural changes in the Brazilian economy during the sixties and seventies also occurred in the urban sector. Development policies were also intended to induce urban industrial growth. According to Martine (1992), investment on urban infrastructure was an important instrument used by the public sector to induce industrial growth. The post-1964 governments created public agencies to finance urbanization, such as the Federal Service for Housing and Urbanism (SERFHAU), and the National Housing Bank (BNH). The strategy of urban development was to increase the level of urban infrastructure and low-cost housing to attract the capital and manpower necessary to develop industry.

The combined effect of decreasing the demand for steady employment in agriculture (push effect), and increasing employment opportunities in urban areas (pull effect), caused the greatest out-flow of rural migrants of Brazilian history. The number of rural residents in Brazil who left rural areas to live elsewhere amounted to about 13 million from 1960 to 1970, and about 16 million from 1970 to 1980. This process of rural-urban migration was more intense on the Southeast and South regions, which

³Large scale and export crops include soybeans, oranges, sugar-cane, tobacco, cacao, coffee, peanuts, and cotton, as in Kageyama and Graziano da Silva (1983).

exhibited the highest levels of agricultural modernization and urban industrial growth of the country (Martine, 1987).

Objectives and Methodology

The objective of the present study is to develop a model of migration to estimate the determinants of rural-urban labor relocation in Brazil during the period between 1960 and 1980. The proposed model intends to expand the traditional approach of rural-urban migration models, according to which rural income is considered to be derived solely from agricultural production. Rural nonfarm economic activities are thus assumed to represent a complementing source of income for the rural household, and, consequently, to influence individuals' decision to migrate out of rural areas.

According to the migration theory discussed earlier in this chapter, the decision to migrate is determined by the individual's perception of the net present value of the flow of future benefits from migration, and the cost of relocation. The individual's perception of such costs and benefits, however, is not usually empirically observed. The potential migrant's behavior towards migration, therefore, is commonly approximated by indirect measures. The flow of future net benefits, and the cost of relocation, are generally a function of economic characteristics of the labor markets at origin and destination (income, employment opportunities, etc.); the flow of information between origin and destination; demographic characteristics (population, urbanization, etc.) and individual characteristics (age, education, skills, etc.); and the effect of policies (land reform, housing policy, etc.). These observed measures, therefore, are commonly used in empirical studies of migration to approximate the potential migrant's perception of the costs and benefits of moving.

The variables used to approximate the determinants of migration depend on the type of data used in empirical estimation. When survey data is available, it is possible to estimate an individuals' behavior towards migration. Survey data on migration, however, is not often available. In such cases, it is common the use of secondary data such as census or other government statistics. Individual behavior toward relocation, then, is approximated by using aggregate measures of migration. The present study will use census data to model rural migrants' behavior in Brazil during the period between 1960 to 1980.

The functional form of migration models varies according to the type of proxy measures used to approximate migrants' behavior. The empirical estimation of the proposed migration model includes explanatory variables likely to be endogenously determined to the model. In such case, a system of simultaneous equations is the recommended estimation procedure (Greene, 1993). Examples of migration models estimated using simultaneous equation system, are: Hay (1980), Cole and Sanders (1983), and Kislev and Siegel (1987). In general, those models considered rural and urban income to be endogenously determined in the system. Cole and Sanders also considered the probability of urban employment as an endogenous explaining variable. Kislev and Siegel used rural wages and the average farm product as a measure of rural earnings, both of which were endogenously determined in the system.

The proposed migration model, then, will be estimated using a system of simultaneous equations in which migration is determined as a function of urban income (U), rural income (R), the cost of migration ($COST$), average years of schooling of the rural population (EDU), average age of the rural population (AGE), percentage of rural population living in households with radios ($INFO$), and the Gini coefficient for farm land concentration ($GINI$). Rural income, R , is assumed to be endogenously determined as a function of the average farm product (AP), EDU , the percentage of farm income

obtained in nonfarm activities (*RNFINC*), the percentage of rural labor force not living or taking steady job on farm (*RNFPOP*), the percentage farm land cultivated with export crops (*EXPO*), and the percentage of rural households with access to electricity (*ELET*). The variable *AP* is assumed to be endogenous, and determined as a function of *EDU*, *EXPO*, *ELET*, and *GINI*. The data set is composed of cross state information for Brazil during the period between 1960 and 1980. The rate of migration is based on rural outflows of migrants for the periods of 1960 to 1970 and 1970 to 1980, while the other variables are year-specific observations for 1970 and 1980.

Results

The proposed rural-urban migration model was estimated as a system of regression equations, using three stages least squares technique. The system was set up with three equations: a migration equation, which included rural income as an endogenous explanatory variable; a rural income equation, which included average farm product as endogenous explanatory variable; and an average farm product equation. Two models were estimated: model I was the basic migration model which include all the variables hypothesized in the methodology to influence migration decision; and model II incorporated coefficient's shifters in order to account for regional differences on the slope of selected variables. The results showed that rural migrants respond positively to increasing urban wage, and negatively to increasing rural wages; which is in accordance with the empirical studies of migration reviewed. Rural-urban migration was also showed to be positively associated to the average years of schooling (on model II) and the average age of the rural population. The average agricultural product and the average years of schooling of the rural population were positively associated, and highly correlated, to rural income. The percentage of state rural population working on non-

agricultural activities, which was approximated by the variables *RNFPOP*, was negatively correlated to rural income, in contrast to which was expected. A possible explanation for this outcome was that *RNFPOP* was not a proper approximation for employment opportunities on the rural nonfarm economy, but only for labor supply in this sector; and as such, was negatively correlated to the rural wage. The percentage of farm land cultivated with large scale and export crops was found to be negatively correlated to rural income, as hypothesized. This negative relationship can be understood as an indication that the process of agricultural modernization during the seventies in Brazil, which reached mainly large scale and export crops, was labor displacing and caused rural income to fall. The average product in agriculture was positively correlated with rural infrastructure, which was approximated by the variable *ELET*, and the average years of schooling (on model I).

The introduction of shifters in the variables' slope showed regional differences on the determinants of labor migration. A dummy variable introduced in coefficient of *U* for the Southeast region (*U-SE*) showed that the *pull effect* of urban income on rural-urban migration was stronger in this region. Regional difference in the slope of the variable *RNFINC* was also examined by using two parameter shifters, one for the North and the other for the Northeast on the rural income equation. The results showed that *RNFINC* influence rural income positively in the lowest income regions of the country, which suggests that the farmers' share of nonfarm income in Brazil is more important for producers on lower income strata. The influence of land ownership concentration, the *GINI* variable, on the average farm product was showed to be negative on the North and Northeast, and positive in the remaining regions. Considering that land ownership concentration in Brazil during the seventies was mainly motivated by public incentives for large scale and export agriculture (Graziano da Silva, 1981), the results suggest that the increase in size of large farm land operations was used for production purposes in

regions where the process of agricultural modernization was more intense (Southeast, South, and West-Central); while, in regions where the modernization was less intense (North and Northeast), this farm land enlargement was used for other purposes — such as speculation in the land market.

CHAPTER 2

REVIEW OF THE LITERATURE

Models of Labor Migration

The economic theories of labor migration have become an important segment of the development economics and regional science literature. The Human Capital Model has been adapted to explain labor migration in developing economies, where economic changes in the rural and urban sectors have driven large flows of migrants out of rural areas. The following sections present the basic features of the Human Capital model, a discussion on the Urban Employment Probability model, and a review of empirical evidence of the determinants of labor migration.

The human capital model (HCM)

One of the earliest attempts to devise an economic explanation for labor migration was the Human Capital Model (HCM). According to the HCM, the process of human migration entails private costs and benefits for the potential migrant, who decides upon relocation based on the net stream of future gains from moving (Sjaastad, 1962). The cost of migration is generally incurred during the process of moving and adapting to the new environment, while the stream of benefits is received over time. The stream of benefits is considered a function of the individual's remaining working-time after migration, thus age at relocation becomes an important determinant factor of migration. As age increases the time left for the potential migrant to achieve positive net benefits shortens. Also, possession of additional education and training increases human capital.

Migrants might not only incur relocation costs, but also training and education costs. These costs become particularly important in the case of rural-to-urban migration, when migrants often change not only their residences, but also their occupations. The distance between places of origin and destination is also regarded in the HCM as an important determinant of human relocation, which is usually used as a proxy for non-money cost of migration.⁴ The HCM, therefore, can be represented in a rural-urban migration setting by the following expression:

$$PV = \sum_{t=1}^T \frac{W_U(t)}{(1+r)^t} - C_0 - \sum_{t=1}^T \frac{W_R(t)}{(1+r)^t} \quad (2.1)$$

where PV is the net present value of migration, t is the time period considered, T is the migrant's remaining working horizon after migration decision, r is the rate of discount, W_R is the rural income, W_U is the urban income, and C_0 is the initial cost of migration. The first term on the right-hand side of equation 2.1 is the discounted present value of future urban income, the second term is the initial cost of migration, and the third term is the discounted present value of future rural income. When $PV > 0$ the discounted value of future urban income exceeds the discounted present value of future rural income plus the initial cost of migration, rural migrants will be likely to move out. When $PV = 0$ potential migrant are indifferent in respect to migration, and when $PV < 0$ rural migrants are expected not to move out. The rate of discount is generally a function of personal characteristics, and may vary according to how individuals value future benefits. Lower income individuals, for instance, may have a greater consumption time preference, and

⁴Sjaastad (1962) considers two types of non-money cost of migration: first is the opportunity costs, that is, the earnings foregone while traveling and searching for a new job; and the second is the psychic cost involved in leaving family and friends.

discount future values more than higher income individuals. The migrant's remaining working horizon depends on the individual's age at the time of migration.

The HCM, however, does not incorporate the probability of a given migrant being unemployed at origin or destination. The absence of such information weakens the applicability of this model considering the presence of high rates of urban unemployment, which is frequently the case of large urban centers in developing countries. However, in the Todaro model of rural-urban migration (Todaro, 1969; and Harris and Todaro, 1970), urban unemployment is incorporated as a factor influencing human relocation. That is, rural migrants are assumed to weight the urban income by the probability of being employed in the city.

The urban employment probability model (UEP)

Todaro (1969) modified the basic HCM by recognizing that employment in urban areas is not assured. Todaro assumed that the urban unemployment rate was relevant to rural-urban migrants calculating the probability of getting a job on the city.⁵ The model then weights the discounted present value of future urban real income flows by the probability of acquiring a job in this sector to calculate the discounted present value of the expected urban income. Todaro assumes that urban workers are randomly selected from the pool of urban job seekers according to an urban employment probability $P(t)$.⁶ The model assumes that most migrants have similar demographic and educational

⁵According to Williamson (1991) urban unemployment in LDCs became a concern on the economic development literature during the sixties, when large-scale households survey showed high rates of unemployment in urban centers throughout the Third World.

⁶Given N the total employment in the urban sector, S the total urban labor force, γ the rate of urban job creation, and t the time period considered, the probability of being selected for an urban job at time t , $\pi(t)$, is defined by Todaro (1969) as: $\pi(t) = \gamma N(t) / [S(t) - N(t)]$. Todaro's general formulation for $P(t)$, therefore, is: $P(t) = P(t-1) + [1 - P(t-1)]\pi(t)$.

characteristics, and thus, $P(t)$ does not vary among urban-modern job seekers (Todaro, 1980). The Todaro model can be represented by the following expression:

$$PV = \sum_{t=1}^T \frac{P(t)[W_{U(t)}]}{(1+r)^t} - C_0 - \sum_{t=1}^T \frac{W_{R(t)}}{(1+r)^t} \quad (2.2)$$

where the $P(t)[W_{U(t)}]$ represents the expected urban income. Like the *HCM*, migration is assumed to occur when $PV > 0$. Potential rural migrants are assumed to be indifferent to migration when $PV = 0$, and are expected to stay at origin when $PV < 0$.

Cole and Sanders (1985) expanded the Todaro model by including an urban-subsistence (U-S) sector in the analysis. This sector is characterized by a low capital-labor ratio, and labor is not required to have much human capital. The probability of finding a job in the U-S sector is assumed to be approximately one. This, according to Cole and Sanders, explains why less educated people migrate from rural to urban areas despite their very low probabilities of finding a urban-modern (U-M) sector job. Rural to urban migration is regarded as a dual phenomenon in which migrants endowed with more human capital consider job opportunities in the U-M sector, while those endowed with less human capital consider job opportunities in the U-S sector. Although unskilled, rural laborers migrate to the U-S sector where employment is fairly assured, and make some human capital investments to prepare for an U-M employment opportunity later. The Cole and Sanders extension of the basic Todaro model can be represented by the following expression:⁷

⁷Equation 2.3 and figure 2.1(a) are interpretations of Cole and Sanders (1985). In the original paper, Cole and Sanders assume that unskilled rural migrants consider employment opportunities in the US sector, while skilled rural migrants consider employment opportunities in the UM sector. Therefore, PV for unskilled migrants considers W_{US} in the urban sector, while PV for skilled migrants considers $P(t)W_{UM}$ in the urban sector.

$$PV = \sum_{t=1}^T \frac{P(t)[W_{UM(t)}] + [1 - P(t)]W_{US(t)}}{(1+r)^t} - C_0 - \sum_{t=1}^T \frac{W_R(t)}{(1+r)^t} \quad (2.3)$$

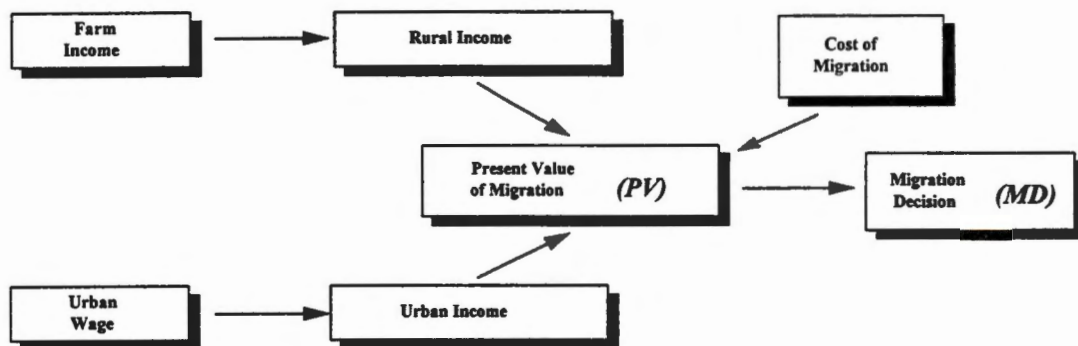
where W_{US} is the urban subsistence income.

Figures 2.1 (a), (b), and (c) present a schematic representation of the rural-urban migration models discussed above. In the HCM migration decisions are based on the present value of migration, while in the other models migration decisions are based on the expected present value of migration. Harris and Todaro considered income opportunities in the rural and urban-modern sectors, while Cole-Sanders considered that urban income originated in both U-M and U-S sectors. Employment was assumed to be assured in the U-S sector, that is, job probability in this sector is equal to one. In the U-M sector, however, employment is assumed to occur according to an employment probability. The next section presents some empirical evidence of migration studies using both the simple human capital approach, and the urban employment probability model.

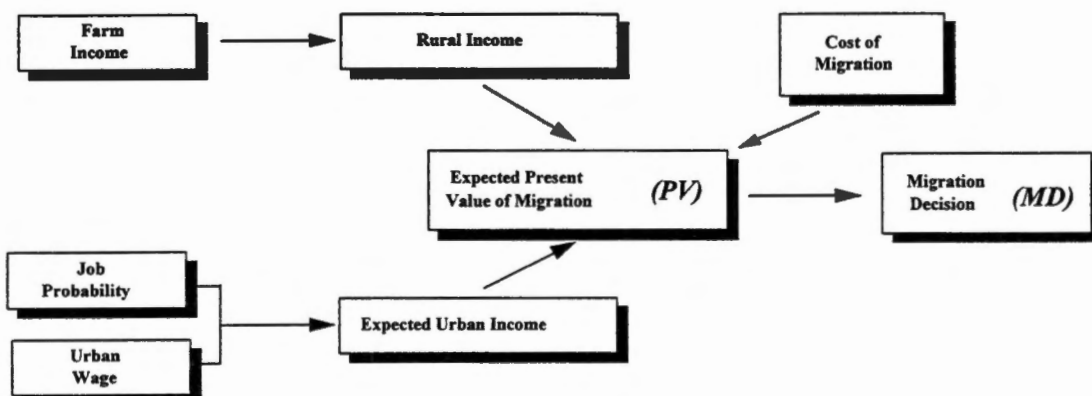
Empirical Applications

The decision to migrate (MIG), according to the equations 2.1, 2.2, 2.3, defined in the previous section, can be represented in a general form as a function of the net present value of the future urban income (V_u), the net present value of future rural income (V_r), and the initial cost of migration (C_0), as follows:

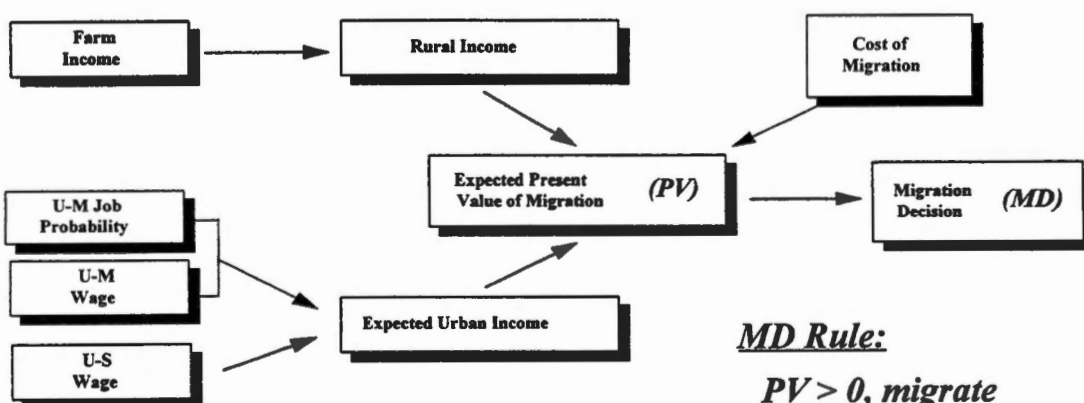
$$MIG = f(V_U, V_R, C_0) \quad (2.4)$$



(a) Human-Capital Model



(b) Harris-Todaro Model



(c) Cole-Sanders Model

MD Rule:

*$PV > 0$, migrate
 $PV = 0$, indifferent
 $PV < 0$, stay*

Figure 2.1 - Schematic representation of rural-urban migration models.

where,

$$V_U = g(W_U, T, r, p(t)) \quad (2.5)$$

$$V_R = h(W_R, T, r) \quad (2.6)$$

$$C_0 = l(TC) \quad (2.7)$$

and TC is transportation cost. Table 2.1 shows the variables considered to influence migration decision in theoretical models of migration, and the corresponding observed variables used as proxies.

Empirical studies of labor relocation usually consider migration decisions as a function of economic factor, demographic characteristics, information flow, and policy factors. The migration function can be expressed in terms of observed variables as follows:

$$MIG = f(U_{UM}, U_{US}, u, R, AP, EDU, SK, AGE, INFO, D, LAND, POL, ASSET) \quad (2.8)$$

where the right-hand side variables are defined in table 2.1. Some of the observed factors determining migration in equation 2.8, however, may be endogenously determined in the model. That is, some of the explanatory variables may be determined as a function of other explanatory variables. In such cases, simple least squares regression do not yield consistent estimators, and the estimation procedure recommended is system of regression equations (Greene, 1993).

Some studies have tried to account for simultaneous equation bias by modeling migration in a recursive system of equations. Kislev and Siegel (1987) estimated the agricultural average product (P_a) separately as a function of a set of predetermined variables, and used the fitted value of P_a in the migration equation using two-stages-

Table 2.1 - Variables used in migration studies.

Unobserved variables (theoretical models)	Observed variables (empirical models)
W_{UM}	urban modern sector wage (U_{UM}), years of schooling (EDU), training and skills (SK), flow of information ($INFO$);
W_{US}	urban subsistence income (U_{US});
W_R	rural wage (R), years of schooling (EDU); average product in agriculture (AP), land distribution ($LAND$), agricultural policies (price policy, technological change, etc.) (POL);
TC	distance between origin and destination (D);
T	migrant's age (AGE);
r	migrant's assets ($ASSET$);
$P(t)$	urban unemployment rate (u);

least-squares (2SLS). Cole and Sanders (1983) also used 2SLS to account for simultaneity in the migration model. The explanatory variables considered to be related to the error term in the structural migration equation were urban wage, probability of migration, and proportion of agricultural labor force earning less than a given threshold. Hay (1980) defined a theoretical migration model as a system of regression equations. The migration function was estimated twice; first using observed values for all explaining variables, and then using fitted values for rural earnings in a 2SLS type of model. The results from the two methods were compared and the conclusion was that the coefficients of the latter estimation were basically of the same magnitude and level of significance of the former. This indicates that rural income was not endogenously determined in the model.

The most common economic factors considered in migration decision are income and employment opportunities at the origin and destination. In the case of rural-urban migration the expected rural and urban incomes are considered major economic determinants of relocation. Those variables have been used in many different forms in migration equations. Barnum and Sabot (1977), for instance, tried urban income (W_u) and rural income (W_r) as separate variables, the relative ratio (W_u/W_r), and the absolute difference ($W_u - W_r$). No statistically significant difference was found between the specifications using the relative ratio and the absolute difference. The use of W_r as separate variable yielded low significance estimators. Kislev and Siegel (1987), working with cross-country data, tried two different proxy variables of urban and rural income differential: the relative ratio of urban and rural wages (W_u/W_r), and the relative ratio of rural and urban average products (P_u/P_a). The latter specification was shown to be statistically more significant. Bhattacharyya (1985), in a study of migration in India, also found the rural wage statistically insignificant at 10 percent significance level with respect to migration.

With respect to measuring urban employment probability, different variables have been used. Barnum and Sabot (1977) defined this variable as the product between the net rate of growth of urban employment and the ratio of the employment to unemployment rates. The variable was used jointly with urban wage, as urban expected wage, and separately. The latter specification was shown to produce better statistical results. Cole and Sanders (1983) also included the urban employment probability as a separate variable in the migration equation. The proxy used was the percentage of population twelve years of age and older who actively participated in the labor force during the period considered. The variable had a statistically significant coefficient and was positively related to migration.

Though frequently included in migration models, precise measures of the initial cost of migration are difficult to obtain. Most studies represent the initial cost of migration by the use of proxy variables. The most common approximation for cost of migration has been the distance between origin and destination (Barnum and Sabot 1977; Herzog and Schlottmann, 1981; Levy and Wadycki, 1974). This measure not only approximates money-costs but, also the non-pecuniary costs of migration (e.g. psychic cost).⁸ A different proxy for cost of migration used by Cole and Sanders (1983) was investment per worker in the urban informal sector.⁹ This variable was statistically significant and negatively related to migration. In general, the cost of migration has been shown to be an important deterrent to labor relocation.

⁸According to Herzog and Schlottman (1981) the psychic cost of migration, which is a positive function of friends and relatives as origin and a negative function of friends and relatives at destination, increases with the distance moved.

⁹The study assumes that the most relevant cost of relocation for the unskilled migrant is the amount of capital the individual has to put together to provide herself/himself a working place in the U-S sector.

The flow of information between places of origin and destination is likely to influence migrants' perceived value of migration, and consequently their decisions to relocate. Empirical models of migration, therefore, have considered proxy measures of information flows as influences on migration propensity. Hay (1980) used a dummy variable based on whether potential migrants knew someone in the urban areas whom they thought could help them to find a job. The information variable had a statistically significant coefficient, and was positively related to rural-urban migration. Greenwood (1969) used the number of persons born at origin and living at destination, defined as "migrant stock" (MS_{ij}), as an approximation for information flow.

Individual migrants generally have different backgrounds and personal characteristics, and as such respond differently to the influence of the determinants of migration. The individual's level of education, for instance, is commonly regarded in migration studies as an influential factor affecting relocation decisions, which is due to higher returns to human capital in urban areas compared to rural areas in LDCs (Hay, 1980). The frequently used measure for education is the potential migrant's average number of years of schooling.¹⁰ Another way to include education in the migration function is to divide the data in education levels, run a regression to each sub-group, and observe the differences in estimated coefficients between educational subgroups (Barnum and Sabot, 1977; and Levy and Wadycki, 1974). In general, education was found to be significant and positively correlated to migration decision in almost all empirical studies reviewed (Banerjee, 1991; Hay, 1980; Herzog and Schlottmann, 1981). According to Hay (1980), the positive influence of education on rural-urban migration decisions is explained by higher returns to education in urban areas. Sahota (1968), however, found a

¹⁰Greenwood (1969) uses the median number of years of school completed by residents at origin and at destination.

negative relationship between the level of education and the propensity to migrate. The explanation presented by Sahota was that schooling in rural areas would induce entrepreneurial farmers not to migrate to cities but to stay in agriculture and develop scientific farming. The basis for with this reasoning is that to develop “scientific farming” the potential migrant needs more than education. That is, it would be necessary for a group of policies implemented to increase the returns to education in rural areas, such as incentives to the development of rural economic activities which required higher productive labor. Another measure of education frequently used in migration studies is the number of persons enrolled in schooling at places of origin and destination (Levy and Wadycki, 1974; and Schultz, 1971). The objective of this variable is to measure migrants’ responses to education opportunities. Levy and Wadycki (1974) found a statistically significant and positive relationship between migration and education opportunity only at place of destination. The authors argued that, because education opportunities represent a possibility for additions to future income streams, migrants value this factor highly. Schultz (1971) found a statistically significant relationship between education opportunity and migration at both origin and destination. The results for place of destination, however, were more significant.

Another demographic characteristic of individuals likely to influence migration decisions is age. The influence of age on migration decisions, however, depends on the individual’s age. The ambiguity results from the fact that as age increases there is a positive education and training effect, that is, older people are more likely to have more training and working experience; and a negative planning horizon effect, that is, older people have a shorter economic life-time left. For younger persons the training effect dominates the planning horizon effect, while for older individuals the planning horizon effect is dominant (Hay, 1980). The hypothesized relationship between age and migration was described by Hay as an inverted U-shaped curve. That is, the probability

of migration increases with age in the first years of the individual's working horizon, but eventually decreases. To account for those two effects the author an individual's age to capture the positive effect, and an individual's age squared to capture the negative effect. The statistical tests confirmed the inverted U-shaped curve hypothesis. Herzog and Schlottman (1981) included age in the migration model as a shifter for the slope of the variables distance between origin and destination, information flow, and income. Analysis of the cross-partial derivatives of those variables with respect to age led to the conclusion that the negative influence of distance between origin and destination on migration tends to decrease with increasing age, and the positive influence of information flow on migration increases with increasing age. In other words, older persons worry less about distance between origin and destination (psychic cost) and more about information flow than the younger ones.

Rural-urban migration is also frequently regarded as being influenced by structural changes in the rural milieu as a result of public policies. The influence of agricultural policies on factors such as land distribution and technological change, are likely to affect the decisions of the farmers to quit or to continue farming. Hay (1980) included a land variable which was defined as the amount of operated farm land by producer. This variable was found to be statistically significant and positively correlated to the probability of migration. Banerjee (1991) used a dummy variable to represent land use (one if the producer owned the land and zero otherwise). The variable was statistically significant and negatively related to migration propensity. Both results suggest that land represented an important asset to the farm population, which influenced their expected net present value of future earnings and, consequently, their decision to relocate. Cole and Sanders (1983) found a strong relationship between poverty earnings in agriculture and land ownership in rural Mexico. The authors, however, emphasize that this finding should not be taken as an argument against further efforts to implementing

land reform, and that poverty among land owners in Mexico is more likely to be due to official neglect of the small-scale agricultural sector. Kislev and Siegel (1987) found a negative relationship between land use and the average product per worker in agriculture; which suggests that an increase in land use, keeping all other production factors constant, will result in a decrease in the average product per agricultural worker. Kislev and Siegel also found that the use of machinery and irrigation, and the production of livestock were positively correlated to the average farm product.

Table 01 presents a summary of the empirical studies of migration reviewed in the current study. The determinants of migration were grouped into four categories: economic characteristics, demographic factors, information flows, and policy effects. The factors included were only those shown to be statistically significant in each model. The economic characteristics represent approximations for migrants' expected earnings at origin and destination, and the cost of relocation. In the studies reviewed, the cost of migration was represented by the distance between origin and destination, which was also used to measure non-money costs of relocation such as psychic costs. Demographic factors were considered pertinent to individuals, such as age and education; and also those referring to places of origin and destination, such as level of urbanization and population. The category information flow refers to any factor likely to give migrants information about the general conditions of economic factors and amenities at destination. The policy category included various factors associated with public policies which are likely to influence the individual's propensity to migrate.¹¹

According to the theoretical and empirical models of migration reviewed previously, the rural household obtains income and employment from farm activities alone. The present study will consider farm and rural nonfarm activities as influencing a

¹¹Land ownership, public expenditures, agricultural modernization.

Table 2.2 - Summary of the empirical models of migration discussed

Models	Determinants of Migration							
	EP	Economic Factors	Sign	Demographic Characteristics	Sign	Information Flow	Sign	Policy Factors
	SEE							
Banerjee (1991)		U job preference (manual or non-manual);	(+)	Age, Education, Marital status;	(+) (+) (-)			Land ownership; (-)
Barnum and Sabot (1977)	SEE	U income, R-U Income differential, Cost of migration, U employment probability;	(+) (+) (-) (+)	Education, Urb;	(+) (+)			
Bhattacharyya (1985)	SEE	U income, Cost of migration, U employment probability, Average agricultural product, U cost of living;	(+) (-) (+) (+) (-)	Urb;	(+)			
Cole and Sanders (1983)	SES	U income, U employment probability, Poverty income in Ag., Cost of migration, U-M AP, % state manufacturing output AP of corn	(+) (+) (-) (-) (+) (+) (-)	Urb, Crude birth rate, % of state Population born in other state;	(+) (+) (+)			Land ownership, Local public expenditures; (-) (+)
Greenwood (1969)	SEE	Personal income (j/i), Cost of migration; Unemployment (i);	(+) (+)	Education (i,j), Urbanization (j/i);	(+, -) (+)	Information;	(+)	
Hay (1980)	SES	R income;	(-)	Education, Skills, Age, Age ² ;	(+) (+) (+, -)	Information;	(+)	Land ownership; (-)

Table 2.2 - (continued)

Determinants of Migration									
Models	EP	Economic Factors	Sign	Demographic Characteristics	Sign	Information Flow	Sign	Policy Factors	Sign
	SEE								
Herzog and Schlottmann (1981)		Personal income (j), Cost of migration;	(+) (-)	Education, Age, Family size Urbanization (j/i);	(+) (+) (-) (+)	Information;	(+)		
Kislev and Siegel (1987)	SES	AP (urban)/AP (rural)	(+)	Education, Ratio of shares of urban and rural populations, Labor force in Ag.;	(-) (+) (+)			Land use, Machinery, Irrigation, Livestock production;	(+) (-) (-) (-)
Levy and Wadycki (1974)	SEE	Average wage (i, j), Unemployment (j), Cost of moving;	(-, +) (-) (-)	Population (j), Urb (i, j), Education opportunity (j);	(+) (-, +) (+)				
Sahota (1968)	SES	Per capita income (j/i), Two-years rate of growth of per capita income (j/i), Cost of migration;	(+) (+) (-)	Education opportunity (i), Population density (j/i), Urb (i/j);	(-) (+) (+)				
Schultz (1971)	SEE	Ag. income (i), Cost of migration;	(-) (-)	Education (i), Population growth (i);	(+) (+)				

Note: at origin (i), at destination (j), at origin and at destination (i, j), ratio of destination over origin (j/i), rural (R), urban (U), agriculture (Ag.), average product (AP), natural rate of growth of the population (NGP), urbanization (Urb), estimation procedure (EP), single equation estimation (SEE), simultaneous equation system (SES), and Sign refers to the sign of the estimated coefficient in respect to migration.

rural households' income and, consequently, migration decision. The next section presents a discussion on the rural economy in which nonfarm activities are introduced as a factor influencing rural household's labor allocation and total income.

The Rural Economy

The rural sector was depicted in the earlier models of economic development as primarily composed by the farm activities.¹² One of the first studies to consider farm and nonfarm activities as part of the rural sector was by Hymer and Resnick (1969).

According to Hymer and Resnick (1969, p. 493)

Theoretical models of underdeveloped countries often postulate an agrarian sector allocating its labor between two major activities, agriculture and leisure or non-work. The empirical evidence of anthropologists, economic historians, and agronomists suggests, however, that the time devoted to agricultural production and leisure often accounts for only portion of total labor time. The remainder is spent in a variety of processing, manufacturing, construction, transportation, and service activities to satisfy the needs for food, clothing, shelter, entertainment, and ceremony.

For Hymer and Resnick's (H-R) model it was assumed that the rural economy produced two types of goods: tradable agricultural commodities, denoted by F goods; and non-agricultural commodities, denoted by Z goods. The Z goods, according to H-R, are low value home-made products which are non-tradable outside the rural economy. Examples of Z goods are: processing of food and fuels, spinning, weaving of textiles, metal working, manufacture and repair of tools and implements, pottery, transport and distribution, etc.

Liedholm (1973) suggests that budget studies from Africa have shown that Z-goods are not generally low quality as assumed by Hymer and Resnick. According to

¹² See, for example, Lewis (1954), Jorgenson (1961), Ranis and Fei (1961).

Liedholm Z-goods are not homogeneous, and could be characterized as inferior¹³ or normal depending on their degree of specialization and market involvement. Three general categories of Z-goods, then, are specified in the study as follows:

1. non-traded home production for own use;
2. traded production undertaken as a secondary occupation;
3. traded production undertaken as a primary occupation.

Category number one involves goods likely to be “inferior”, and thus which are presumably to decline in consumption as rural income grows. Goods in group two are expected to have a slightly higher income elasticity of demand, but the lack of specialization makes them vulnerable to imported goods. The goods in third category are those with a higher degree of specialization, and consequently are more able to compete with imported goods. Therefore, as income grows the rural economy displaces nonagricultural goods with low elasticity of demand (group one, and some commodities in group two) and increase production and consumption of nonagricultural goods with higher elasticity of demand (some commodities in group two, and group three) (Liedholm, 1973). This classification of the Z-sector is consistent with the empirical evidence presented by Liedholm and Kilby (1989), and Ranis and Stewart (1993) for selected countries from Africa and Asia.

The present study assumes that the rural economy is composed of farm and nonfarm economic activities. The farm economy produces basically crops and livestock, while the rural nonfarm economy produces all other goods and services in the rural sector. In the farm sector, households are assumed to maximize utility (U) as a function of household consumed agricultural staple (χ_a), market-purchased commodity (χ_m), and leisure (χ_l), as follows (Singh, Squire, and Strauss, 1986):

¹³Liedholm consider inferior those goods which decline in consumption when consumers' income increase.

$$U = U(\chi_a, \chi_m, \chi_l) \quad (2.9)$$

which is subject to a cash income constraint equal to

$$p_m \chi_m = p_a(Q - \chi_a) - w(L - F) \quad (2.10)$$

where p_m and p_a are respectively the prices of the market-purchased good and the agricultural staple, Q is the household production of staple, w is the market wage (which represents the opportunity cost of labor), L is the total labor demand, and F is the family labor input. The model assumes that all three prices — p_m , p_a , and w — are exogenously determined. The difference between household production (Q) and household consumption (χ_a) of the agricultural staple is the marketed surplus. When the demand for labor is greater than the supply of family labor, it will be necessary to hire labor. On the other hand, when the supply of family labor is greater than demand for labor ($\chi_l > 0$) it will be possible to employ labor off-farm. The total household cash income, therefore, will be equal to the money value of the surplus agricultural staple plus the money value of the difference between hired labor and family labor employed off-farm. The money value of the total farm household in-cash and in-kind income (y) can be represented by the following expression:

$$y = p_m \chi_m + p_a \chi_a + w \chi_l \quad (2.11)$$

here χ_l can be allocated to either leisure or working in nonfarm activities. Therefore, total farm income will be a function of family labor allocated on farm and nonfarm economic activities.

The present study assumes that the rural nonfarm economy also provide employment opportunities for rural residents not primarily engaged in farm activities. According to Oshima (1986) the rural nonfarm economy can be separated, for analytical purposes, into:

1) seasonal and irregular work.

2) full-time, regular work;

where the first category includes labor intensive manufacturing, hand-crafts, food processing, etc., while the second group includes capital intensive manufacturing, nearby town offices, civil servants, administrators, teachers, etc., Figure 2.2 is a schematic representation of the sources of rural income. The farm sector provides income opportunities from crop and livestock production, while the rural nonfarm sector provides income opportunities from all other types of economic activities on rural areas. In figure 2.2 rural nonfarm activities are divided in two sub-sectors: those characterized by seasonal and irregular labor demand [*nonfarm (1)*], and characterized by full-time regular employment [*nonfarm (2)*]. *Nonfarm (1)* is composed of economy activities with some production or consumption linkages with agriculture, and thus are likely to show a cyclical pattern of labor demand. Those activities, therefore, can be regarded as a seasonal source of labor for farm households. In the case of *nonfarm (2)* activities the production process do not depend on seasonal factors (e.g. weather, inputs from farm production, etc.), and thus labor demand is likely to be more constant through time. The *nonfarm (1)* sector, though, provides part-time off-farm employment for farm households, while the *nonfarm (2)* sector provides full-time employment for other rural residents.

According to empirical evidence the percentages of rural nonfarm income and employment varies from country to country over a wide range. Chuta and Liedholm (1990), in a survey involving eighteen countries from Asia, Africa, and Latin America,

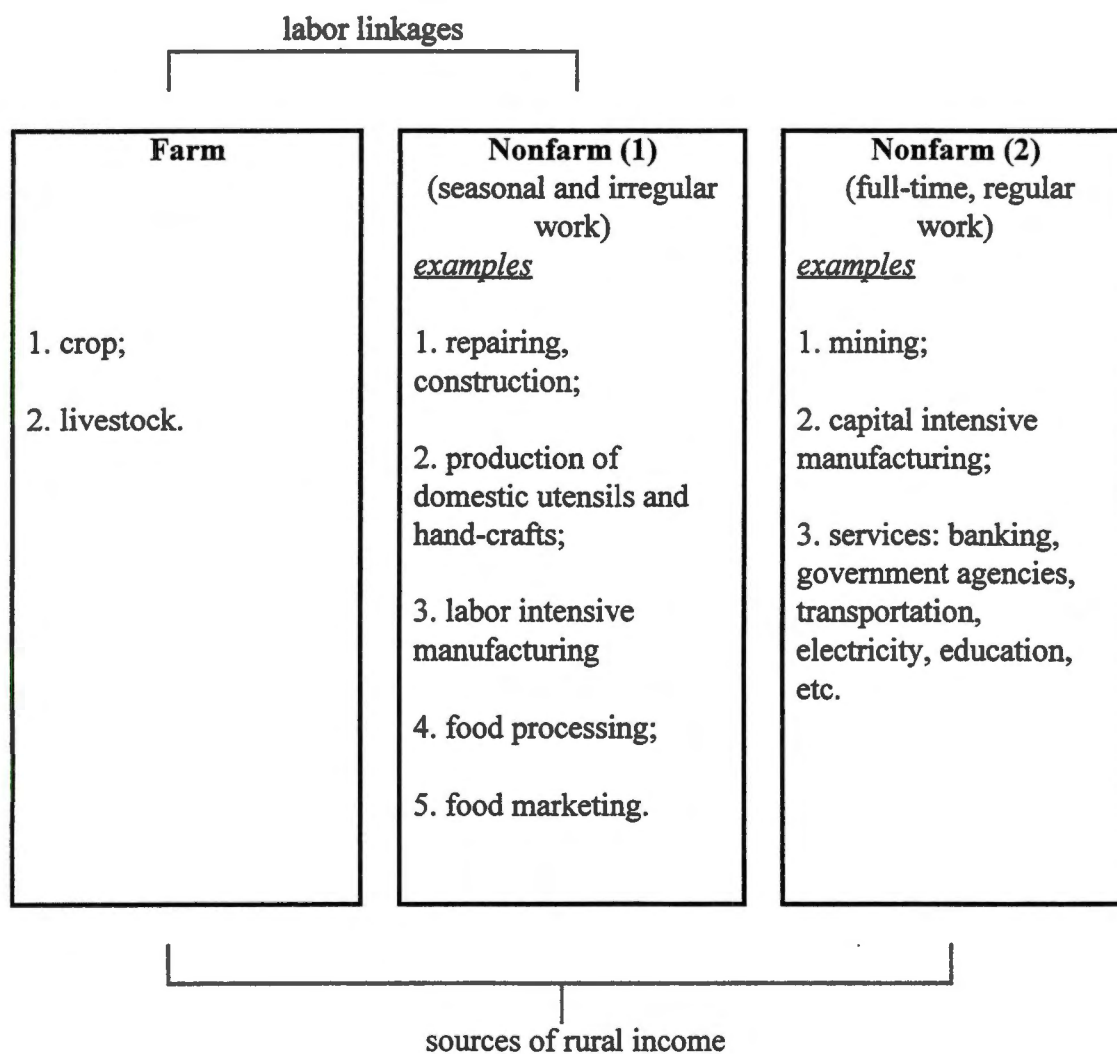


Figure 2.2 - Sources of rural income

showed that the percentage of rural labor force primarily employed in rural nonfarm activities ranges from 14% in Guatemala to 49% in Taiwan. In terms of income share, the survey indicates that nonfarm earnings account for over one-fifth of the total rural household income.

This evidence presented by Chuta and Liedholm (1990) is consistent with the data presented by de Janvry and Sadoulet (1989), for different regions in Latin America, according to which the share of farmers household's income obtained off-farm ranges from 21% in *Garcia Rovira* (Colombia) to 77% in *Cajamarca* (Peru). With respect to the share of the rural economically active population (EAP) working in the nonagricultural sector, the study showed a range varying from 15.2% in Brazil, for the year of 1970, to 80.8% in Puerto Rico, for the year of 1970 (See tables 2.3 and 2.4).

Another aspect worthy of notice in de Janvry and Sadoulet (1989) is the time trend of the employment share of nonfarm activities in respect to the total rural employment. Except for Peru, all other countries exhibited increasing shares of rural nonfarm employment during the period surveyed. In the case of Mexico, the share of rural working force on the rural nonfarm economy almost doubled from 1970 to 1980. During the same period the percentage of rural EAP in nonfarm activities in Brazil increased from 15.2 to 23.4 percent, which suggests that this sector has become more important in respect to rural employment opportunities (see table 2.4). This trend of the rural nonfarm economy in Latin America was of major importance for the rural population due to the process modernization of commercial agriculture during the 1960s and 1970s, which tended to displace permanent workers by increasing the use of mechanization. The rural nonfarm economy has helped to decrease the instability of rural labor demand, and to reduce poverty in Latin America during the period considered (de Janvry and Sadoulet, 1989).

Table 2.3. Percentage of farmers' income derived from off-farm activities in different regions in Latin America.

Region	Year	Farm size (hectare)	Share of farm households (percentage)	Share income obtained off-farm (percentage)
Cajamarca (Peru)	1973	0 - 3.5	72	77
Puebla (Mexico)	1970	0 - 4	71	69
Garcia Rovira (Colombia)	1972	0 - 4	20	21
South Bolivia	1977	0 - 5	67	62
Region IV (Chile)	1976	0 - 5	59	53
Vertentes (Brazil)	1979	0 - 10	16	56
Northwest Altiplano (Guatemala)	1978	0 - 3.5	85	71
El Salvador	1975	0 - 2	71	36
Sierra (Ecuador)	1974	0 - 5	77	63
Coast (Ecuador)	1974	0 - 5	77	52

Source: de Janvry and Sadoulet (1989).

Table 2.4. Share of rural economically active population (EAP) in different Latin American countries working in nonagriculture.

Country	Year	Share of rural EAP working in nonagriculture (percentage)
Brazil	1970	15.2
	1980	23.4
Costa Rica	1963	29.1
	1973	41.2
Ecuador	1962	19.3
	1974	26.4
Mexico	1970	23.1
	1980	42.4
Nicaragua	1963	12.8
	1971	20.0
Peru	1961	20.1
	1972	18.8
Puerto Rico	1960	56.1
	1970	80.8

Source: de Janvry and Sadoulet (1989).

CHAPTER 3

AGRICULTURAL DEVELOPMENT AND RURAL MIGRATION IN BRAZIL: 1960-1980

Demographic and Economic Characterization

Brazil has a total land area of approximately 8.5 million square kilometers, occupying about 47 percent of the South American continent. The country is divided in 26 states,¹⁴ and 1 federal district where Brasília, the country's capital, is located. The states are officially grouped in 5 different regions: North, Northeast, Southeast, South, and West-Central, as shown in Figure 3.1.¹⁵

During the period between 1960 to 1980, Brazil's population was characterized by an uneven distribution among different regions. Tables 3.1 and 3.2 show respectively regional, and rural and urban shares of Brazil's population from 1960-1980. Table 3.1 shows that the Southeast was the most populated region, with about 44% of the total population. The Northeast region was second with 30-32% of the total population, followed by the South region with about 17% of the total population. The North and West-Central were the least populated regions, which together accounted only for 8-10% of the total population during the period studied. When a region's share of the total rural and urban total population are considered the results are different. The Northeast, for instance, showed the highest share of the country's total rural population during the

¹⁴The state of MT was divided in MT and MS in 1979, and the state of GO was divided in GO and TO in 1990 (see figure 3.1).

¹⁵The information concerning to the physical aspects of Brazilian regions were obtained from Editora Abril (1991).

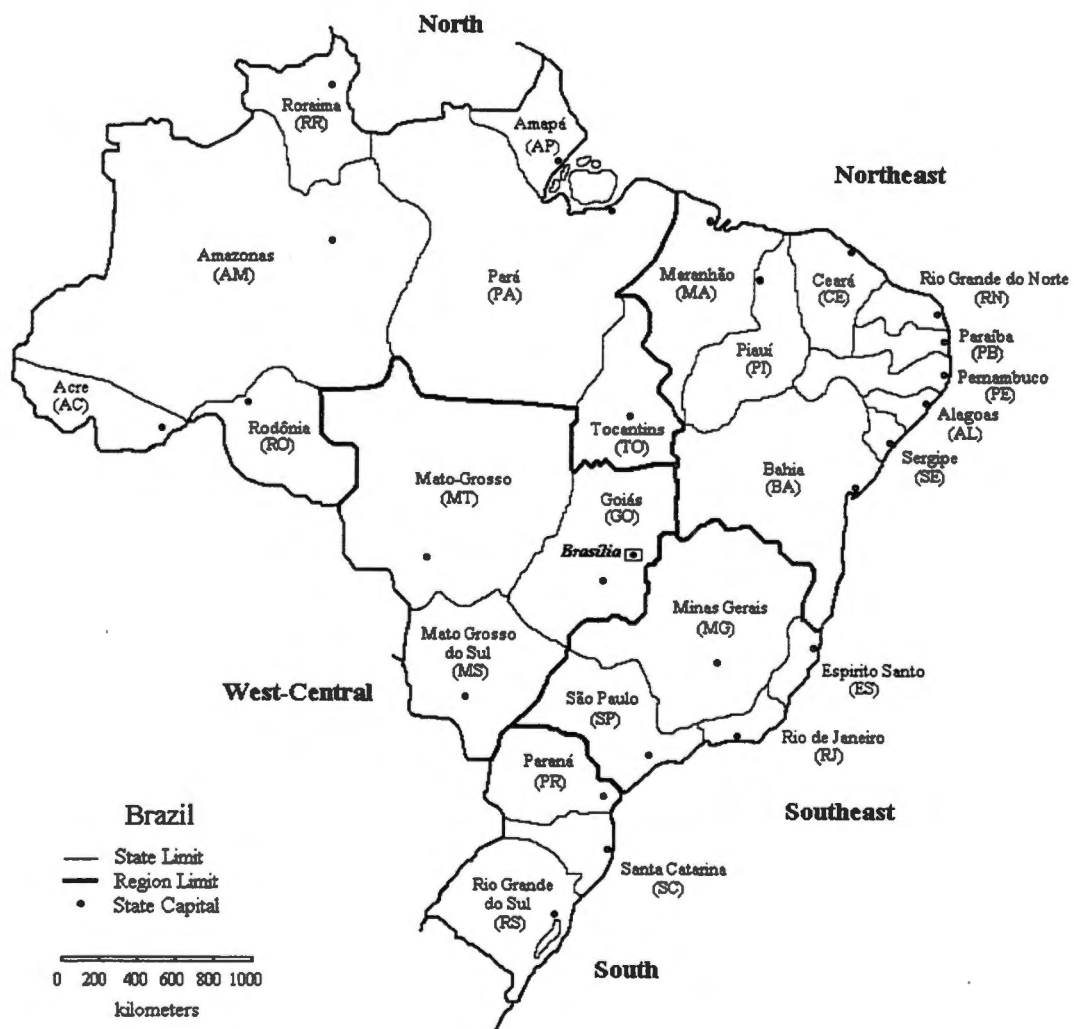


Figure 3.1 - Sketch of Brazilian state and regional division in 1994.

Table 3.1 - Regional share of total rural and urban population in Brazil.

Regions	Total			Rural			Urban		
	1960	1970	1980	1960	1970	1980	1960	1970	1980
North	4	4	5	4	5	7	3	3	4
West-Central	4	5	5	5	6	6	3	4	5
South	17	18	16	19	22	19	14	14	15
Northeast	32	30	30	38	40	45	24	23	22
Southeast	44	43	44	34	27	23	56	56	54
Brazil	100	100	100	100	100	100	99	100	100

Source: Censo Demográfico Brasil.

Note: percentages may not sum up to 100 due to rounding

Table 3.2 - Population distribution in Brazil, 1960-1980

Brazilian Regions	Rural			Urban		
	1960 %	1970 %	1980 %	1960 %	1970 %	1980 %
North	63 (60 67)	55 (53 59)	48 (40 51)	37 (33 40)	45 (41 47)	52 (49 60)
West-Central	67 (61 70)	57 (56 58)	38 (37 38)	33 (30 39)	43 (42 44)	62 (62 63)
South	63 (56 69)	56 (47 64)	38 (32 41)	37 (31 44)	44 (36 53)	62 (59 68)
Northeast	66 (55 82)	58 (46 75)	50 (38 69)	34 (18 45)	42 (25 54)	50 (31 62)
Southeast	43 (21 71)	27 (12 55)	17 (8 36)	57 (29 79)	73 (45 88)	83 (64 92)
Brazil	55	44	33	45	56	67

Source: Censo Demográfico Brasil.

Notes: 1) numbers in parenthesis are region's minimum and maximum values, respectively; 2) percentages may not sum up to 100 due to rounding;

whole period, and the Southeast was second. In respect to a region's share of total Brazilian urban population, the Southeast was first and the Northeast was second. From 1960 to 1980 the North and West-Central increased their shares of total Brazilian population, and this increase was experienced both in rural and urban areas. The Northeast increased its share of total rural, and decreased its share of total urban, and Southeast decreased its share of both total rural and total urban.

With respect to rural and urban shares of a region's population, the Southeast was the only region which had the percentage of urban population larger than that of the rural throughout the period. The Southeast also showed the highest percentage of urban population in the country. The remaining regions had the urban share surpassing the rural share of total population in 1980, with exception of Northeast which was half rural half urban in terms of population that year. In general, the data shows that Brazilian population became more urban during the period considered, especially the Southeast region, which accounted for near half of the country's population (see table 3.2).

The pattern of population density was also uneven among Brazilian regions. Table 3.3 shows that the Southeast had the highest population density from 1960 to 1980. The South was the second in population density, and the Northeast was the third. North and West-Central regions had the lowest levels of population density, and were far below other regions.

The distribution of regions' GDP among economic sectors, and total Brazilian GDP among regions, can be observed in table 3.4. According to table 3.4 the Southeast accounted in 1970 and 1980 for more than half of the total Brazilian Gross National Product (GDP). The South was second in regional share of total GDP, while the Northeast ranked third. The North and West-Central were the least important regions in terms of contribution to the total GDP. The services sector was the most important for all regions during the period studied. The Southeast had the largest industry share, and the

Table 3.3 - Population density in persons per square kilometer, 1960-1980.

Brazilian Regions	1960	1970	1980
North	1 (0.1 1)	1 (0.2 2)	2 (0.4 3)
West-Central	1 (1 3)	2 (1 5)	3 (2 6)
South	20 (19 22)	29 (24 35)	33 (28 38)
Northeast	14 (5 43)	18 (7 55)	22 (9 68)
Southeast	33 (17 151)	43 (20 206)	56 (23 259)
Brazil	8	11	14

Source: Censo Demográfico Brasil, and Editora Abril (1991).

Note: numbers in parenthesis are region's minimum and maximum values, respectively.

Table 3.4 - Sector and regional distribution of GDP, 1970-1980.

Brazilian Regions	1970				1980			
	AG %	IND %	SERV %	RS %	AG %	IND %	SERV %	RS %
North	24 (8 41)	15 (3 59)	61 (33 66)	2	16 (9 25)	37 (16 51)	47 (41 66)	3
West-Central	36 (35 37)	9 (9 9)	55 (55 56)	3	32 (28 37)	19 (16 22)	49 (47 50)	4
South	25 (23 28)	22 (17 30)	53 (44 55)	17	17 (16 20)	37 (32 47)	46 (37 49)	17
Northeast	23 (14 43)	18 (7 26)	59 (48 65)	12	16 (11 31)	30 (20 36)	53 (48 58)	12
Southeast	7 (2 21)	37 (13 44)	57 (50 70)	66	6 (1 18)	42 (32 48)	52 (47 66)	64
Brazil	13	31	56	100	10	39	51	100

Source: IBGE/Brazil (1986).

Notes: 1) numbers in parenthesis are region's minimum and maximum values, respectively; 2) AG stands for agriculture, IND for industry, SERV for services, and RS is the region's share the country's GDP.

West-Central the largest agriculture share. Between 1970 and 1980, the shares of the agriculture and services sectors decreased, while the share of industry increased for all regions. This pattern of sector growth of Brazilian economy during the period between 1970 and 1980 reflects the economic development strategy pursued by the public sector, which was largely based on industrialization. According to Baer (1989), in the years of 1968 to 1974 Brazil's GDP grew at an average rate of about 11 percent, and the leading economic sector was industry. Baer also notes that this process of economic growth was mostly concentrated in the South and Southeast regions. Comparing tables 3.1 and 3.4 we notice that from 1970 to 1980 the Southeast had about 65% of the total Brazilian GDP, but only about 43% of the total population. On the other hand, the Northeast had about 30% of the country's total population, but accounted for only 12% of the total GDP. The other regions had the shares of total GDP similar to the shares of total population.

Table 3.5 shows regions' average rural and urban incomes of the economically active population. The Southeast presented the highest urban income in the period, but was the fourth in rural income, surpassing only the Northeast. Therefore, the high economic performance of the southeast in terms of GDP (see table 3.4) had a more accentuated impact on urban income, rather than in rural income. The Northeast presented the lowest rural and urban average incomes in both years. The poor economic performance of the Northeast during the sixties and seventies, according to Baer (1977), was due to a policy bias of public incentives against the region.

Table 3.6 shows the average product in agriculture (AP) per region in Brazil, and the regional share of the country's total AP. The Southeast region had the highest share of Brazilian AP both in 1970 and 1980. The South and West-Central were second with about the same levels, and the North and Northeast showed the poorest results. From

Table 3.5 - Rural and urban average incomes of the economically active population, 1970-1980.

Brazilian Regions	1970		1980	
	Rural Cz\$	Urban Cz\$	Rural Cz\$	Urban Cz\$
North	1009 (950 1252)	1890 (1758 2322)	2056 (1932 2124)	3366 (3122 3839)
West-Central	998 (952 1085)	1868 (1813 1963)	2164 (2061 2316)	3248 (2988 3657)
South	1169 (1064 1338)	2247 (2001 2342)	2216 (2061 2316)	3862 (3331 4158)
Northeast	595 (468 693)	1496 (758 1819)	1056 (745 1321)	2517 (1799 3107)
Southeast	973 (810 1217)	2958 (1827 3051)	2037 (1673 2577)	4154 (3045 4768)
Brazil	859	2605	1648	3731

Source: Censo Demográfico Brasil, 1970 and 1980.

Notes: 1) numbers in parenthesis are region's minimum and maximum values, respectively; 2) all values are in Cz\$ (cruzados of 1986) per month; 3) In the 1970 Census of Population personal income was given per group of economic activities. The rural income was approximated by the earnings in agriculture, livestock, forestry, fishery, and hunting; and the urban income was approximated by the earnings in industry and services.

Table 3.6 - Average product in agriculture, 1970-1980.

Regions	1970		1980	
	AP Cz\$	RS %	AP Cz\$	RS %
N	483 (371 1428)	3	784 (617 1442)	4
WC	1175 (1111 1270)	7	2872 (2490 5459)	10
S	1180 (912 1676)	34	2711 (2501 2991)	33
NE	354 (212 493)	18	679 (310 914)	17
SE	1379 (888 2147)	37	3022 (1994 5055)	36
Brazil	823	100	1725	100

Source: Censo agropecuário Brasil, 1970 and 1980.

Notes: 1) AP is average product in agriculture (total value product in agriculture divided by the farm labor force, in a monthly basis), and RS is the region's share of AP; 2) all values are in Cz\$ of 1986; 3) percentages may not sum up to 100 due to rounding.

1970 to 1980 all regions experienced a sharp increase in AP. The process of agricultural modernization during the seventies displaced farm labor using machinery, and increased export and large scale crops' yield by using modern inputs such as fertilizers, high-yield seeds, etc. (Graziano da Silva, 1981). Considering that AP is total farm product divided by total farm population, the country-wide increase in AP during the seventies can be regarded as influenced by the process of agricultural modernization.

The period between 1960 and 1980, therefore, was characterized by changes in the pattern of rural and urban population distribution. Table 3.7 shows that, between 1960 and 1970, close to 13 million people left rural residences in Brazil, which was equivalent to 33% of the Brazilian rural population in 1960. In the period between 1970 and 1980 close 16 million migrated out of rural areas in Brazil, which corresponded to 38% of the country's rural population in 1970. From 1960 to 1970 the Southeast accounted for more than half of the total rural out-migration of the country. In absolute terms the Northeast was the second in rural out-migration, which accounted for a migratory out-flow of approximately 4 million people. In relative terms, however, the North was the second with a migration rate (MR) of 32%. In the seventies the Southeast experienced the largest absolute flow of rural out-migration, with approximately 5 million people leaving rural residences in the region. In relative terms, however, the South showed the highest migration rate, which was 48%. The state of Paraná, in the South, and the state of Mato Grosso, in the West-Central, presented negative rates of rural out-migration between 1960 and 1970, which means that those states had net in-migration during the period analyzed. Also, during the seventies the states of Acre, Roraima, Rondônia, Amapá — which are grouped in Table 3.3 as TR¹⁶ — and Pará, all

¹⁶In Martine's calculation of the migration rate the states of AC, RO, RR, and AP (which were federal territories in 1970), are grouped as one unit; which is referred in the present study as TR (Martine, 1987).

Table 3.7 - Rural population and migration, 1960-1980.

	Rural Population			Migration			
	1960	1970	1980	1960-1970		1970-1980	
	(Thousands)			NOM (Thousands)	MR (%)	NOM (Thousands)	MR (%)
North	1390	1977	2843	447	32	1	0.1
TR	214	283	534	47	22	-139	-49
AM	476	549	573	195	41	257	47
PA	914	1145	1736	205	22	-117	-10
West-Central	1884	2604	2392	135	7	1199	46
MT	546	902	934	-114	-21	243	27
GO	1338	1702	1458	249	19	956	56
South	7392	9193	7153	1079	15	4395	48
PR	2962	4425	3157	-166	-6	2516	57
SC	1444	1656	1474	391	27	617	37
RS	2986	3112	2523	854	29	1262	41
Northeast	14665	16359	17246	4373	30	4990	31
MA	2033	2241	2741	598	29	586	26
PI	957	1144	1241	220	23	319	28
CE	2197	2582	2478	523	24	899	35
RN	717	813	783	180	25	182	22
PB	1304	1380	1321	414	32	466	34
PE	2270	2350	2359	846	37	760	32
AL	838	956	1006	223	27	355	37
SE	462	485	522	180	39	180	37
BA	3888	4408	4794	1189	31	1243	28
Southeast	13170	10889	8894	6801	52	5038	46
MG	6065	5427	4396	2933	48	2611	48
ES	919	877	730	273	30	408	47
RJ	1396	1089	923	641	46	467	43
SP	4789	3496	2844	2954	62	1552	44
BRAZIL	38510	41054	38566	12835	33	15622	38

Source: Martine (1987).

Notes: 1) TR include the states of AC, RR, RO, and AP; MT includes the states of MT and MS; 2) NOM stands for net out-migration from rural areas, and MR for migration rate; 3) detailed description of the calculation procedure of NOM and MR are in Appendix A-1.

in the North region, had net inflows of population during the period.

According to Martine (1992), the process of rural migration in Brazil during the sixties and seventies was mainly caused by:

1. the expansion of the agricultural frontier;
2. the pattern of urbanization; and
3. the strategy of agricultural modernization.

The expansion of the agricultural frontier was specially important in the West-Central region during the sixties, and in North region during the first half of the seventies (Graziano da Silva, 1981). The negative rate of migration in Mato Grosso during the sixties, and in Acre, Roraima, Rondônia, Amapá, and Pará in the following decade, suggests that the inflow of population in those states are related to policies aimed at expanding the agricultural frontier. The pattern of urbanization after the mid-sixties, which concentrated economic activities in large urban center, in special those of the Southeast region (e.g. São Paulo, Rio de Janeiro, and Belo Horizonte), increased the rural-urban differential in economic opportunities; pulling large populations of rural migrants into urban centers. The process of agricultural modernization, according to Martine (1987), was accomplished by public incentives to adopt capital intensive technologies, which reduced the demand for labor in rural areas. The reduction in rural labor demand decreased expected rural earnings and induced out-migration. This latter factor will be discussed in greater detail in the next section.

Table 3.8 and 3.9 show two proxy variables of the rural nonfarm economy. Table 3.8 shows farmer's income obtained from nonfarm activities (RNFINC). This variable intends to measure the relative share of the rural nonfarm economy in the total farm household budget. The Southeast presented the highest absolute value for RNFINC both in 1975 and 1980, while the North and West-Central had the lowest values during the same period. In relative terms, however, the North showed the highest shares during

Table 3.8 - Farmers share of non-agricultural income (RNFINC)

Regions	RNFINC			
	1975		1980	
	(1000 Cz\$)	%	(1000 Cz\$)	%
North	3311	33 (18 41)	3529	22 (8 36)
West-Central	2054	7 (7 7)	1827	4 (3 5)
South	5207	4 (4 5)	3651	3 (3 4)
Northeast	4907	9 (4 16)	4978	7 (4 11)
Southeast	6687	6 (2 9)	5832	4 (2 7)
BRAZIL	22166	7	1987	5

Source: Censo agropecuário Brasil, 1975 and 1980.

Notes: 1) RNFINC is the share of farmers' income obtained off-farm; 2) all values are in Cz\$ (cruzados) of 1986; 4) RNFINC started to be included in the Brazilian Census of Agriculture in 1975.

Table 3.9 - Rural labor not living or taking steady job on farm (RNFPOP)

Regions	RNFPOP			
	1970		1980	
	(1000 people)	%	(1000 people)	%
North	361	34 (25 49)	399	31 (7 32)
West-Central	685	49 (47 54)	766	38 (32 41)
South	1877	36 (33 39)	1248	27 (20 32)
Northeast	3196	35 (19 44)	3675	37 (23 52)
Southeast	3246	53 (49 73)	2622	46 (44 62)
BRAZIL	9365	41	8710	37

Source: Censo agropecuário Brasil, 1975 and 1980.

Note: RNFPOP is the share of rural population of age 14 and older not living or taking steady job on farm;

the period considered. The North had a relative value of RNFINC of 33% in 1975 and 22% in 1980, which were further above the country's average on both years. Considering that the North comprises most of Brazilian rain forest, a possible explanation for the high relative shares of RNFINC in this region would be the greater importance of activities such as forestry, mining, fishing, hunting, etc., as sources of income for the northern farm households. From 1975 to 1980 the relative share of RNFINC decreased in all regions. In absolute terms RNFINC increased slightly in the North and Northeast, and decreased in all other regions.

Table 3.9 shows the absolute and relative share of the rural labor force not living or taking steady job on farm (RNFPOP). This variable aims to approximate the size of the rural labor force primarily working in non-agricultural activities. In percentage terms RNFPOP was highest in the Southeast both in 1970 and 1980, and lowest in the North and South regions during the same periods. This variable decreased in relative terms for all regions but the Northeast between 1970 and 1980. In absolute terms, RNFPOP increased between 1970 and 1980 in the North, West-Central, and Northeast; and decreased in the South and Southeast. Therefore, in the North and West-Central RNFPOP increased in absolute terms but decreased in relative terms, which indicates that in these regions the farm labor force grew faster than the nonfarm labor force between 1970 and 1980. In the Northeast RNFPOP increased its relative and absolute share, which indicates that the nonfarm labor force grew faster than the farm labor force during the same period. Therefore, in general RNFINC and RNFPOP experienced relative decline in respect to the farm sector during the periods studied. This pattern of the rural nonfarm economy may be an indication that public policies towards rural development in Brazil during the seventies targeted primarily the farm sector.

The variables RNFINC and RNFPOP are defined respectively as an approximation for *nonfarm (1)* and *nonfarm (2)* respectively, which were defined in

Chapter 2 (see Figure 2.2). That is, RNFINC is a proxy for income from nonfarm activities with a seasonal pattern of labor demand; while RNFPOP is a proxy for nonfarm activities information, which was represented by the percentage of rural population in households with which are characterized by full-time labor demand. Comparing the variable RNFPOP to the share of rural economically active population (EAP) working in nonfarm activities showed on table 2.3 in Chapter 2 (de Janvry and Sadoulet, 1989), an inconsistency is noticed. In table 2.3 the share of rural EAP on nonfarm activities increases from about 15% in 1970 to 23% in 1980 in Brazil, while RNFPOP in table 3.9 shows a decrease in the rural nonfarm population from 41% to 37% during the same period. A possible reason for the difference between the two approximations is that the numbers in table 2.3 shows the percentage EAP working in nonfarm, while the numbers in table 3.9 shows the total rural population 14 years old and more not living or taking steady job on farm. That is, RNFPOP accounts for all the rural nonfarm labor force, while de Janvry and Sadoulet's numbers account only for the nonfarm labor force actually working. The latter estimate, therefore, offers a better approximation of the rural nonfarm economy. The problem with this information is that it was not available for the state level in Brazil. The variable RNFPOP, thus, is alternatively used.

Empirical studies of migration have commonly accounted for non-economic factors — such as education, age, information flow, public infrastructure — as influencing an individual's decision to relocate (Hay, 1980; Barnum and Sabot, 1977; Cole and Sanders, 1983). Table 3.10 shows regional based data representing rural age structure, rural schooling, rural-urban flow of information, and public infrastructure in rural and urban areas. The average years of education of the rural population (EDU) was higher in the South and Southeast during the period studied. From 1970 to 1980 all regions increased the years of schooling of the rural population. The average age of the

Table 3.10 - Demographic and place characteristics likely to influence population distribution, 1970-1980

Regions	EDU (years)		AGE (%)		INFO (%)		ELET (%)	
	1970	1980	1970	1980	1970	1980	1970	1980
North	0.8 (0.7 0.9)	1.3 (0.9 1.4)	20 (19 21)	21 (21 21)	34 (34 37)	54 (48 57)	3 (2 4)	11 (5 15)
West-Central	0.9 (0.9 1.0)	1.5 (1.4 1.6)	20 (20 20)	22 (21 22)	38 (37 40)	65 (65 65)	2 (2 3)	10 (9 11)
South	1.7 (1.2 2.2)	2.5 (2.0 2.9)	21 (20 23)	24 (23 25)	64 (59 69)	87 (83 90)	12 (7 20)	34 (21 55)
Northeast	0.5 (0.4 0.6)	0.8 (0.6 1.0)	21 (21 22)	23 (22 24)	26 (14 36)	64 (43 75)	2 (0.4 6)	9 (1 18)
Southeast	1.3 (1.1 1.7)	1.9 (1.6 2.4)	22 (21 22)	24 (23 24)	51 (41 68)	81 (75 88)	16 (8 29)	38 (16 70)
Brazil	1.0	1.4	21	23	42	69	8	21

Source: Censo Demográfico Brasil, 1970 and 1980.

Notes: EDU is the average years of education of the rural population; AGE the average age of the rural population; INFO the percentage of rural population living in households with a radio; ELET the percentage of rural households using electricity.

rural population (AGE) showed a small cross-region variation. This variable increased slightly from 1970 to 1980, but still showed small cross-region variation in 1980.

The flow of information, which was represented by the percentage of rural population in households with radios (INFO), was higher in the South and Southeast in both periods. All regions increased this share from 1970 to 1980. The level of rural infrastructure is approximated by the number of rural household using electricity (ELET). This variables attempts to capture government investment in rural areas during the period of 1970 to 1980. The Southeast and South showed the highest levels, with respectively 16% and 12% in 1970, and 38% and 34% in 1980. All regions experienced an increase in ELET from 1970 to 1980.

The Agricultural Modernization Strategy

The agricultural sector in Brazil has historically been characterized by high levels of land concentration. According to Graziano da Silva *et al.* (1978) this pattern has its roots in the early stages of Brazilian economic development, when the country's economy was based on the production of export crops on *latifúndios* (large agricultural production units). In general, the development of small scale agricultural production — the *minifúndio* (small production units) — was accomplished as auxiliary to the structure of the *latifúndio*. The small producer, which had either the ownership (property rights) or was a tenant on the land cropped, usually located around large farms, and supplied an important portion of the working force on the *latifúndio*. For the *minifúndio*, the labor employed on the large farm constituted, in general, an important component of subsistence. This pattern of development of the agrarian economy in Brazil has, to a large extent, survived to contemporary times (Graziano da Silva *et al.*, 1978).

Table 3.11 shows the distribution of farm land in Brazil for the years of 1970 and 1980.¹⁷ In 1970 farms with less than 10 hectares represented 50% of the total number of farms, but had tenancy or ownership over only 3% of the total farmed land. Taking the two lowest strata together, i.e., farms with less than 100 hectares, one observes that those producers represented about 90% of the total, but had tenancy or ownership over only 24% of the land. The remaining 10% largest farms were owners or tenants over 76% of the agricultural land. The distribution of land in Brazil can be measured by the Gini coefficient, which was 0.833 in 1970 and 0.854 in 1980. Such a level of the Gini coefficient can be interpreted as a very unequal pattern of land use (Stevens and Jabara, 1988). The concentration of land in Brazil as a whole, although high, increased during the seventies. The South and Southeast had the lowest Gini coefficient among Brazilian regions, while the North and West-Central were the only regions which experienced a decrease in the concentration of land use.

The agricultural development strategy implemented by the post-1964 military governments attempted to promote the modernization of large scale farms, particularly export-oriented production. According to Mendes (1987, p.39)

...the aim of this model, backed up by the use of technology “packages” with a high content of chemical and biological inputs, improved seeds and mechanization, was to boost farm production and productivity and adapt the products to the needs of agro-industry, achieving food self-sufficiency and generating an increasing surplus of exportable farm products. The basic argument was that the adoption of this model could speed up the economy with positive effects in all sectors, and break down the technological and socio-economic barrier between Brazil and the developed countries.

¹⁷The definition of farm (*Estabelecimento agropecuário*) in the Brazilian census of agriculture consider production units owned by the producer, or with some contractual arrangement such as tenancy or sharecropper. The distribution of farm land on table 3.2, therefore, refers to both ownership and tenancy.

Table 3.11 - Farm land distribution in Brazil, 1970-1980

Farm size/Regions	N		WC		S		NE		SE		BR	
	farm %	area %	farm %	area %	farm %	area %	farm %	area %	farm %	area %	farm %	area %
1970												
<10	42	2	25	0.4	33	2	66	6	42	6	50	3
10-99	42	15	43	5	52	24	27	25	53	38	41	21
100-999	15	35	27	26	14	47	6	44	4	32	9	37
1000-9999	1	38	5	64	1	26	0.4	25	0.4	23	1	37
>10000	0.0	11	0.0	5	0.0	1	0.0	0.2	0.0	0.4	0.0	2
total	100	100	100	100	100	100	100	100	100	100	100	100
Gini coefficient.	0.834		0.851		0.716		0.840		0.752		0.833	
1980												
<10	36	1	21	0.2	39	5	65	5	33	2	49	2
10-99	47	16	39	4	55	35	29	23	52	22	40	18
100-999	16	30	33	24	6	35	6	40	15	47	9	35
1000-9999	1	43	7	66	0.5	25	0.4	30	1	29	1	42
>10000	0.0	10	0.0	6	0.0	0.0	0.0	1	0.0	0.4	0.0	3
total	100	100	100	100	100	100	100	100	100	100	100	100
Gini Coefficient	0.830		0.840		0.735		0.857		0.763		0.854	

Source: Censo agropecuário Brasil, 1970 and 1980.

Notes: 1) percentages may not sum up to 100 due to rounding; 2) The Gini coefficient is a measure of inequality based on the Lorenz curve, which ranges from 0 (perfect distribution) to 1 (perfect inequality). See Gastwirth (1972) for details on the description and standard procedure of calculation of the coefficient.

To accomplish its objective the post-1964 governments enacted a policy of selective incentives, which especially favored the Southeast and South regions, and, within those regions, commercial and export crops. According to Mendes (1987), subsidized credit for agriculture was the single most important tool for implementing the process of modernization of the agricultural sector in Brazil.

Table 3.12 shows that large farms received the major portion of the total agricultural loan value (GLV) during the period studied. In general, the larger strata also increased their shares of loans from 1970 to 1980. The percentage of producers who received government loans in each farm size stratum (FL) was higher for the larger strata. Furthermore, this percentage also increased from 1970 to 1980. Another aspect of the agricultural policy of credit distribution in Brazil was that, to have access to credit and subsidies farm producers needed the land title as collateral. As land ownership is more frequent among large size farmers, those producers generally benefited from farm credit policies (Binswanger, 1991). Table 3.13 shows that the regional distribution of government loans for agriculture were primarily for the Southeast and South regions in both years. From 1970 to 1980, however, the South and Southeast were the only regions which lost shares of GLV. The Southeast and South were also the regions which showed a higher percentage of farmers receiving government loans for agriculture (FL). According to Graham, Gauthier, and Barros (1987), the post-1964 government policies toward agricultural modernization targeted mainly the South and Southeast because those regions were traditional producers of commercial and export crops, therefore having comparative percentage of land cropped with commercial and export crops.

Table 3.14 and 3.15 show the percentage of crop land cultivated with commercial and export crops in Brazil, per region and farm size respectively. In 1970 and 1980 the larger stratum of farm sizes had, in general, higher percentages of crop land

Table 3.12 - Receipt of government loans per farm size, 1970-1980.

Farm Size (ha)	1970			1980		
	<i>TF</i>	<i>FL</i>	<i>GLV</i>	<i>TF</i>	<i>FL</i>	<i>GLV</i>
	%	%	%	%	%	%
[<10]	51	2	4	51	8	4
[10 to 99]	39	13	33	39	28	32
[100 to 999]	8	19	44	9	33	43
[1000 to 9999]	1	22	15	1	31	18
[10000 and over]	0.0	16	3	0.0	21	3
Total	100		100	100		100

Sources: Censo Agropecuário Brasil, 1970 and 1980.

Notes: 1) percentages may not sum up to 100 due to rounding 2) *TF* is the percentage of total farm, *FL* is percentage of farms which received loans from government agencies, and *GLV* is percentage of the total agricultural loan value from government agencies.

Table 3.13 - Receipt of government loans per regions, 1970-1980

Brazilian Regions	1970			1980%		
	<i>TF</i>	<i>FL</i>	<i>GLV</i>	<i>TF</i>	<i>FL</i>	<i>GLV</i>
	%	%	%	%	%	%
North	5	2	2	8	6	2
West Central	5	11	10	5	18	14
South	26	14	37	22	33	34
Northeast	45	3	13	48	12	18
Southeast	19	14	38	17	24	32
Total	100		100	100		100

Sources: Censo Agropecuário - Brasil 1970 and 1980

Table 3.14 - Percentage of total Brazilian farm land cultivated with export crops per farm size, 1970-1980.

Farm Size (hectares)	1970 %EXP	1980 %EXP
<10	21	22
10-99	24	36
100-999	26	39
1000-9999	26	33
≥ 10000	25	17

Source: Censo Agropecuário Brasil, 1970 and 1980.

Table 3.15 - Percentage of farm land cultivated with export crops per region, 1970-1980.

Brazilian regions	1970		1980	
	EXP %	RS %	EXP %	RS %
North	7 (2 8)	2	4 (0.3 9)	4
West-Central	8 (4 16)	7	16 (8 25)	13
South	29 (13 35)	32	52 (39 59)	30
Northeast	21 (7 38)	30	26 (3 50)	29
Southeast	35 (17 48)	28	38 (20 52)	25
Brasil	26	100	35	100

Source: Censo Agropecuário Brasil, 1970-1980.

Note: EXP is the share of cropped land cultivated with large scale and export crops, and RS is the region's share of the country's total cropped area.

cultivated with commercial and export crops. Also, this percentage increased during that period, with the exception of the stratum composed of farmers larger than 10000 hectares. Farms of less than 10 hectares had the lowest percentage of area cultivated with commercial and export crops in 1970, and the second lowest in 1980 (see table 3.14). Table 3.15 shows that, during the period between 1970 and 1980, the West-Central doubled, and the South nearly doubled their shares. These results suggest an association between the policy of rural credit and an increase in the share of land cultivated with export crops; and that such policies targeted mainly large producers on the South and Southeast regions.

Summary of Descriptive Statistics

The first two sections of this chapter described the pattern of population distribution among Brazilian regions, as well as regional and state rural-urban migration trends. Those sections also showed region level data representing factors likely to influence changes on population distribution. Table 3.16 summarizes country-level descriptive statistics such as the rate of rural-out migration (MIG), and the variables representing factors likely to cause changes on population distribution. The mean rate of migration was 37% which means that, on average, approximately 37% of the rural population in Brazil left rural residences to live elsewhere in the periods of 1960-1970 and 1970-1980. The mean rural and urban incomes were, respectively, Cz\$ 3305 and Cz\$ 1250 for the years of 1970 and 1980, which suggests earnings disparity between rural and urban areas during the period. The standard deviation of the urban income between states in Brazil during the period studied is higher, which indicates a higher dispersion of urban income when compared to rural income. The variable AP had a mean

Table 3.16 - Summary of descriptive Statistics

Variables	Definition	Units	Mean	Standard Deviation	Minimum	Maximum
MIG	rate of rural out-migration;	%	37	17	-49	62
U	average urban income;	Cz\$	3305	1002	758	4768
R	average rural income;	Cz\$	1250	612	468	2577
EDU	rural average years of schooling of the rural population;	years	1.4	0.7	0.4	2.9
AGE	average age of the rural population	years	22	1.4	19	26
RNF1	share of farmer's off-farm income	%	8	6	2	41
RNF2	share of the rural population age 14 and older not living or taking steady job on farm;	%	39	10	7	72
AP	average product in agriculture	Cz\$	1320	1123	212	5055
EXPO	share of state farm land cultivated with large scale and export crops;	%	31	17	1	59
GINI	Gini coefficient for land distribution;	—	0.787	0.071	0.590	0.930
INFO	percentage of farm population living in households with radios;	%	56	21	14	90
ELET	percentage of farm households using electricity;	%	15	17	0.4	70

Note: all statistics were computed for 21 cross-state observations in two time periods, making up total of 42 observations.

value of Cz\$ 1320 of 1986, therefore slightly higher than the mean values of R. AP showed a high standard deviation by state, which was close the mean value. Such level of variability for this variable indicate large differences in the output/labor ratio across states for the years of 1970 and 1980. The variable ELET was the only one which had a standard deviation higher than the mean values. This indicates high variability in the level of rural infrastructure across states for the years of 1970 and 1980. The variable AGE showed small variation, which can be seen by the low value of the standard deviation relatively to the variable mean.

CHAPTER 4

RESEARCH OBJECTIVES AND METHODOLOGY

Research Objectives

The empirical studies of migration reviewed in Chapter 2 assumed that an individual's decision to migrate was generally a function of economic factors, demographic characteristics, information flow, and public policies. In the particular case of rural-urban migration, rural income was commonly assumed to be generated in the farm economy alone. The objectives of the present study, therefore, are:

1. to develop a model of migration to estimate the influence of economic factors, demographic characteristics, information flow, and policy effects on rural out-migration in Brazil during the period of 1960-1980;
2. to expand the traditional approach of rural-urban migration models by including the rural nonfarm activities as a component of rural earnings; and
3. to examine the relationship between rural-urban migration and the rural nonfarm economy.

The hypothesis to be tested concerning the relationships between the rate of migration and the determinants of human relocation is based on the theoretical discussion, and empirical evidence of labor migration presented on Chapters 2 and 3. The rural nonfarm economy, as discussed in Chapter 2, was found in some studies of rural household budgets to be an important component of rural income. The current study, therefore, expects income opportunities in the rural nonfarm sector should increase rural households' expected earnings and, consequently, discourage rural-urban migration.

According to the theory and empirical evidence reviewed, rural-urban migration is hypothesized to respond positively to the rural-urban expected income differential (i.e. as urban expected income grows relative to rural expected income, the propensity to out-migrate rural areas increase). Therefore, the present study expects the correlation between rural earnings and migration to be negative, and the correlation between urban earnings and migration to be positive. The cost of relocation decreases the net benefits of moving (Herzog and Schlottmann, 1981; Schultz, 1971). This variable, therefore, is expected to be negatively related to the rate of migration.

With respect to demographic characteristics of individuals, this study expects the level of education and age structure of potential migrants to influence their decision to migrate. The hypothesis to be tested will be as follows:

1. the propensity to migrate increases with the average years of schooling of the rural population; and
2. the propensity to migrate increases with the average age of the rural population;

The first hypothesis assumes that the returns to human capital is higher in urban than in rural areas, influencing more educated migrants to look for employment opportunities in urban areas. The second hypothesis is based on assumption that age is associated with the individual's level of skills, influencing migration positively (Hay, 1980).

The flow of information between rural and urban areas is expected to be positively correlated to the migration rate. The reasoning of this hypothesis is that information regarding the destination provides knowledge about the labor market, and general living conditions in urban areas, which can decrease the risks associated to migration decision. The process of rural-urban migration in Brazil during the sixties and seventies was largely influenced by public intervention in development planing on the rural and urban sectors. In the rural sector, the main government policy towards agricultural modernization was

achieved through incentives to large export and commercial farms (Martine, 1992). Hence, agricultural modernization policies are expected in the present study to increase the flow of rural out-migration.

Empirical Specification

According to the migration theories reviewed in Chapter 2, an individual's decision to relocate is basically a function of expected earnings at origin, expected earnings at destination, and the cost of migration. In the particular case of rural-urban migration, the rural and urban expected present value of future earnings, and the cost of migration, are considered the main factors influencing individuals decision to migrate. Migration theory thus postulates that the potential rural migrants balance their costs and benefits associated with moving before taking decision upon relocation. The flows of expected future earnings and the cost of migration, however, are not directly observable. Empirical studies of migration have used approximations for those unobserved variables determining labor relocation. As referred in Chapter 1, empirical studies of migration commonly use economic characteristics of the labor markets at origin and destination (income, employment opportunities, etc.); the flow of information between origin and destination; demographic characteristics (population, urbanization, etc.) and individual characteristics (age, education, skills, etc.); and the effect of policies (land reform, housing policy, etc.) to approximate the unobserved determinants of migration.

The variables used to approximate unobserved factors influencing migration decision depends on the type of data available. Empirical studies using survey (primary) data permit us to estimate parameters to make inferences concerning an individual migrant's attitude towards relocation. Primary data on individuals, however, is not frequently available for migration studies. In many cases aggregate data is used to

estimate empirical models of migration which attempts to approximate individual's behavior.

The functional form of migration models usually vary according to the type of information used in the estimation procedure. It is common, however, to include explanatory variables which are endogenously determined to the system. In such cases, single-equation estimation do not yield consistent parameter estimators. When including endogenous variables as explanatory in the model, the estimation procedure frequently used in those cases is system of regression equations.

Hay (1980) estimated a rural-urban migration model using survey data, in which the probability of migration (P_i) was estimated as a function of rural expected income (R_i), the number of years of education (ED), the number of occupational training completed (SK), the migrant's age (AGE_i), the squared value of AGE , and a dummy variable which is equal to one for those who knew someone in the urban areas whom they thought would help them to find a job, and zero otherwise (INF). The R_i was assumed to be endogenous to the model. The structural form of the migration model used by Hay was set up as follows:

$$P_i = f(\underset{>0}{ED_i}, \underset{>0}{SK_i}, \underset{>0}{AGE_i}, \underset{<0}{AGE_i^2}, \underset{>0}{INF_i}, \underset{<0}{R_i}) \quad (4.1)$$

$$R_i = g(\underset{>0}{ED_i}, \underset{>0}{SK_i}, \underset{>0}{AGE_i}, \underset{<0}{AGE_i^2}, \underset{>0}{HEC_i}) \quad (4.2)$$

where the variable HEC was number of hectares of farm land per economically active man in the household, and the expected signs of the coefficients are indicated below the corresponding variable.

The study by Hay basically used three different estimation procedures. The first was the estimation of equation 4.1 using probit maximum-likelihood, and considering R_i exogenous to the model. In the second procedure equation 4.2 was estimated using Ordinary Least Squares (OLS), and the fitted value of R_i was used in the probit maximum-likelihood regression of equation 4.1, in a method similar to two stage least squares. The coefficients obtained in those two procedures were of the same magnitude and level of significance. In the third procedure P_i was regressed on all predetermined variables using probit maximum-likelihood (R_i was considered endogenous). All variables but INF had smaller and less significant coefficients compared to the previous two procedures. The author thus concluded that all predetermined variables but INF were functionally related to R_i . The use of the variables AGE and AGE^2 in the model was due to the assumption that AGE_i embodies two opposite effect in respect to P_i : the positive effect of increasing experience, schooling, skills, etc., with increasing age; and the negative effect of decreasing migrant's future planning horizon with increasing age. The relationship between AGE_i and P_i , thus, was hypothesized to be described as an inverted U-shape curve where migration propensity increases with age for younger migrant and decreases with age for older migrants. The positive significant sign of the estimate of AGE_i , and the significant negative sign of the estimate of AGE_i^2 , therefore, confirmed that hypothesis.

Kislev and Siegel (1987) estimated a rural-urban migration model using cross-country data for 22 developing and 21 developed countries, with observations for the years of 1960, 1970, and 1980. The rate of migration was calculated by indirect procedure based on the time changes of rural and urban population, and the natural rate of growth of population. The empirical model consisted of a simultaneous equations system in which the migration equation included an endogenous agricultural labor demand function. Two agricultural labor demand functions were tried: one using agricultural wage (Wa) and the

other using average agricultural product (Pa). While the function using Wa showed a R^2 (adjusted) of 0.544, and 7 out of 11 variable coefficients were non-significant at 5% level (ns), the model using Pa showed a R^2 (adjusted) of 0.943, and only two out of 11 variable coefficients were not significant at 5% level. The migration function was run in log-log form, and the labor demand functions in linear form. The system of equations, though, was described as follows:

$$M = f[(Pu/Pa), (Su/Sa), n, DC, DEC-60] \quad (4.3)$$

$\begin{matrix} >0 & >0 & ns & >0 & ns \end{matrix}$

$$Pa = g[Labor, Land, Livestock, Fertilizers, Machinery, Schooling, \quad (4.4)$$

$\begin{matrix} <0 & <0 & >0 & ns & >0 & >0 \\ Irrigation, Year(1960), Year(1980), DCs] \\ >0 & ns & >0 & >0 \end{matrix}$

where (Pu/Pa) is the ratio of non-agricultural to agricultural average product, (Su/Sa) is labor allocation (ratio of share of agricultural to share of non-agricultural labor), n is the natural rate of growth of population, DC is a dummy variable for developed countries, and $DEC-60$ is a dummy variable for the 1960s. The sign of the estimated coefficients are placed below the corresponding variable.

Cole and Sanders (1983) estimated a rural-urban migration model using aggregate data from Mexico. The migration model was set up as a simultaneous equation system as follows:

$$NIM = f(WAGE, PROB, URB, AGPOV, COST) \quad (4.5)$$

$\begin{matrix} >0 & >0 & >0 & <0 & <0 \end{matrix}$

$$WAGE = g(PROB, MODPRO) \quad (4.6)$$

$\begin{matrix} ns & >0 \end{matrix}$

$$PROB = h(WAGE, FERT, MANOUT, MIST) \quad (4.7)$$

$\begin{matrix} <0 & >0 & >0 & >0 \end{matrix}$

$$AGROV = I(\underset{>0}{OWN}, \underset{>0}{YIELD}, \underset{<0}{SPEND}) \quad (4.8)$$

where, *MIN* is the migration rate measured as the net in-migration divided by the total states population; *WAGE* represents the proxy used for modern sector wage, which is the annual *per capita* earnings for service sector establishments employing more than 5 persons; *PROB* is a proxy variable for urban employment probability, which is measured as the percentage of population 12 years or more who actively participate in the labor force during the period considered; *AGPOV* is the proportion of the agricultural labor force that earned less than 500 pesos/month; *COST* is the proxy for cost of migration, which is defined as the investment per worker in the urban informal sector and refers to firms employing five or fewer workers; *FERT* is the crude birth rate for 1969; *MANOUT* is the percentage of national manufacturing output produced in the state; *MIST* is the percentage of the state's population born in some other state; *MODPRO* is the value of annual output per worker in the urban-modern sector; *OWN* is the percentage of agricultural labor force who own the land cropped; *SPEND* is the local public expenditures per inhabitant; and *URB* is the percent of the state's population living in cities with a population of 50,000 or more in 1970. The model was estimated using two stages least squares. Three stages least squares estimators were also obtained, but those were not significantly different from those obtained from two stages least squares.

The rural-urban migration model to be used in this study aggregate cross-state data from Brazil. The migration variable is measured for the time periods of 1960 to 1970, and 1970 to 1980, while the explanatory variables are point specific data for the years of 1970 and 1980. The variables used in the proposed model to represent the determinants of rural-urban migration are defined in table 4.1, and discussed next. The rate of migration was calculated using what the United Nations, Department of Economic

and Social Affairs (1970) refers as *Indirect Measures of Internal Migration*. This process considers the population in the beginning and in the end of the migration period, and the natural rate of growth of the population during that period. Those figures yield the net out-flow of migrants in the period considered. The rate of migration, then, is obtained dividing the net flow of rural migrants by the population in the beginning of the period (See Appendix for detailed description of the procedure of calculation of the migration rate.). The rates of migration used in this study was calculated by Martine (1987).

The rural (R) and urban (U) average wage income of the working population are assumed to represent the net present values of and expected urban income, respectively.¹⁸ The problem with these measures is that they do not actually show the rural and urban average income of the potential migrants, but that of the whole rural and urban working population, respectively. Due to the lack of more detailed data on rural and urban incomes, such approximations are largely used in studies of rural-urban migration. Barnum and Sabot (1977) used rural and urban *per capita* incomes to approximate *R* and *U*, respectively. Cole and Sanders (1983) used *per capita* income in the modern sector

¹⁸In Cole and Sanders (1985) unskilled migrants are bound to the urban U-S sector, where employment is assured; while skilled migrants are bound to the U-M sector, where workers are hired according to an employment probability. To model the urban labor market according to Cole and Sanders' approach it would be necessary to define a boundary between the U-S and U-M sectors in order to approximate U-S income, U-M income, and U-M employment probability. The lack of detailed information of the urban labor markets in the proposed model makes such approximations impossible. The alternative used was to calculate *U* as the weighted average of all income groups, thus including income in both U-S and the U-M sectors. Brazil's distribution of income is shown in the Census of Population in 8 groups: workers earning less than 0.5 minimum wage (*MW*); from 0.5 to less than 1 *MW*; from 1 to less than 2 *MW*; from 2 to less than 3 *MW*; from 3 to less than 5 *MW*; from 5 to less than 10 *MW*; from 10 to less than 20 *MW*; 20 and more *MW*. Considering Y_i the average income in group i , and P_i the population of group i , *U* was calculated as follows:

$$U = \frac{\sum_{i=1}^8 Y_i P_i}{\sum_{i=1}^8 P_i}$$

Table 4.1 - Variables definition

Variables	Definition
Dependent MIG	rate of rural out-migration, calculated as the total outflow of rural migrants divided by the rural population in the beginning of the period considered;
Independent U	average urban wage income, calculated as the weighted average of income groups in urban areas for a given state and time period;
R	average rural wage income, calculated as the weighted average of income groups in rural areas for a given state and time period;
COST	initial cost of migration, which is approximated by the inverse value of the population density;
EDU	average years of education, calculated as the weighted average of groups of years of education in rural areas for a given state and time period;
AGE	average age of the rural population;
INFO	percentage of rural individuals living in households with radios;
RNFINC	percentage of the farm income earned in the rural nonfarm economy;
RNFPOP	share of the rural labor force of age 14 and older not living or taking steady job on farms;
AP	average product in agriculture, calculated as the total value product in agriculture per month, divided by the farm population
EXPO	percentage of farm land cultivated with commercial and export crops
GINI	coefficient of land use concentration;
ELET	percentage of rural households with access to electricity

Note: all money values are in cruzados (Cz\$) of 1986.

(see definition of variable *WAGE* in equation 4.5) to approximate *U*. In the rural sector Cole and Sanders did not use a measure of income, but instead a measure of rural poverty (see variable *AGPOV* in equation 4.5). The present study will use both *R* and *AP* as measures of rural earnings. The initial cost of migration (*COST*) is commonly represented in empirical studies of human relocation as the distance between origin and destination; which is used to approximate not only money cost of relocation, but also psychic costs of leaving parents and relatives (Levy and Wadycki, 1974; Barnum and Sabot, 1977; Herzog and Schlottmann, 1981). When exact places of origin and destination are not known with certainty, the use of such approximation is infeasible. This study assumes that distances between locations within states are inverse measures of the state population density. That is, states with high population density would have shorter distances between locations, while states with low population density would have longer distances between locations. The inverse of state population density, therefore, will be used in the present study as a proxy variable for the cost of migration (*COST*).

The share of farm income obtained off-farm (*RNFINC*) is used as a proxy of the size and importance of the rural nonfarm economy for the farm household. The problem with this variable is that it only considers the portion of the rural nonfarm economy linked to farm activities. That is, rural nonfarm jobs not taken by farmers are not captured by the variables. This variable, therefore, is more a measure of importance of the rural nonfarm economy for farm households rather than for the rural labor force as a whole. Another attempt to approximate the importance of the rural nonfarm economy was carried out. The rural labor force was disaggregated according to economic activities, and the share of labor not living or holding steady job on farm was isolated (*RNFPOP*). The variables *RNFINC* and *RNFPOP*, therefore, are used to approximate the rural nonfarm economy with seasonal and full-time labor demand as discussed in Chapter 2 (see figure 2.2).

The level of education is commonly regarded in migration studies as a factor likely to influence an individual's migration decision. The common approximation used for education is the number of years of schooling completed by the potential migrant (Todaro, 1976; Herzog and Schlottmann, 1981). Empirical studies have found a positive relationship between propensity to migrate and the educational level of migrants (Schultz, 1971; Barnum and Sabot, 1977). The rationale, according to Schultz (1971), is that better education provides migrants with greater competitiveness in the urban labor market, where returns to education appear to be higher than in rural areas. The positive relationship between education level and propensity to migrate, however, is not a matter of general agreement. Sahota (1968), for instance, argues that better education in rural areas will induce the entrepreneurial farmers not to migrate to cities but to stay and develop more efficient farming. This would be the case where *entrepreneurial farmers* had enough resources to make returns to education on farming at least comparable to that in the urban labor market, which is not generally the situation in less developed countries. The level of education (*EDU*) will be measured as the average number of years of schooling completed by the state rural population in each period considered.

Another demographic characteristic frequently included in migration studies is the age structure of the potential migrant population (Schultz, 1971; Herzog and Schlottmann, 1981). The reason is that potential migrants assess the expected present value of future gains from relocation based on their remaining economic lifetime after migration (Schultz, 1971). Therefore, an older person would have a shorter working horizon left after migration, and consequently a lower propensity to migrate, everything else constant.¹⁹ The present study will attempt to capture the influence of age in migration decision by the average age of the rural population (*AGE*).

¹⁹Assuming that migrants have the same working horizon (T), and consumption time preference (r).

Migration decisions are regarded by Todaro (1969) as risky, where rural migrants balance the probability of being unemployed in the city for a certain period of time. The flow of information between places of origin and destination, however, can improve potential migrants' perception of the costs and benefits from relocating and, as a result, influence their propensity to migrate. Todaro (1982) emphasizes the importance of communication factors such as improvement in transportation, and the introduction of information networks (radio, television, and the cinema) on rural areas as influential on the process of migration. The present study will approximate the level of information to which potential migrants are exposed (*INFO*) as the percentage rural individuals living in households with radios.

The process of rural-urban migration in Brazil was influenced by structural changes in the rural economy, as a result of policies conducted to promote agricultural modernization. According to Graziano da Silva (1981) the implementation of such policies, during the second half of the sixties and the seventies, was biased toward large scale agriculture, specially export crops, inducing an expansion in this sector. According to Martine (1987), this process, together with the policies of industrial concentration, produced the largest movement of rural emigration of Brazilian history. The proposed model will use the percentage of state agricultural land cropped with export products (*EXPO*) as representing the policies of agricultural modernization, and the Gini coefficient for land use distribution (*GINI*), as representing the land tenure structure in Brazil. The importance of public investments in rural infrastructure for rural income and migration will be approximated by the percentage of rural households having electricity (*ELET*).

The empirical estimation of the proposed migration model may include explanatory variables which are endogenously determined in the model. In such a case, simple least squares estimation would yield inconsistent parameters, and a system of

regression equations is recommended (Greene, 1993). The proposed migration model, then, will be estimated in a system of equations as follows:

$$MIG = f(\underset{>0}{U}, \underset{<0}{R}, \underset{>0}{EDU}, \underset{<0}{COST}, \underset{>0}{INFO}, \underset{>0}{AGE}, \underset{>0}{GINI}) \quad (4.9)$$

$$R = g(\underset{>0}{AP}, \underset{>0}{EDU}, \underset{>0}{RNFINC}, \underset{>0}{RNFPOP}, \underset{<0}{EXPO}, \underset{>0}{ELET}) \quad (4.10)$$

$$AP = h(\underset{>0}{EDU}, \underset{>0}{ELET}, \underset{>0}{EXPO}, \underset{>0}{GINI}) \quad (4.11)$$

where the expected signs of the coefficients indicated below the respective variables are in accordance with the hypotheses stated in the first section of this chapter. The rural income (R) is assumed to be endogenously determined in equation 4.10. This variable is assumed to be positively correlated to AP , and negatively correlated to $EXPO$. The reason is that an increase in AP is likely to expand economic activities in rural areas, which would induce growth in labor demand and raise the wages. Assuming that large scale and export crops are capital intensive and, consequently, labor displacing, an increase in $EXPO$ would expand the supply of labor in rural areas and induce a decrease in R . The rural nonfarm sector is expected to influence rural income positively. An increase in economic activities in the nonfarm economy expands rural labor demand, and pull wages up. The variable $RNFINC$ is likely to capture the influence of nonfarm activities on total income for the farm household, while $RNFPOP$ would examine the same influence for the rural household not directly working on farm. The econometric estimation of the model will consider the possibility of problems of collinearity between those two variables.

The variable EDU is expected to be positively related to R (equation 4.10) and AP

(equation 4.11). As R is negatively related to the rate of migration, the variable EDU would be thought to be negatively related to the rate of migration in equation 4.9. This variable, however, is expected to be positively related to MIG . The reason is that EDU is expected to increase the returns to human capital both in rural and urban sector, and equations 4.10 and 4.11 consider the influence of this variable only in the rural sector. In equation 4.9 EDU is expected to be positively related to MIG because, according the migration literature and empirical studies previously reviewed, the returns to human capital in urban areas are assumed to be greater than in rural areas.

The variable AP is also considered to be endogenously determined in the system. This variable is assumed to be positively influenced by the level of education of producers (EDU), the level of rural infrastructure ($ELET$), the level of land concentration ($GINI$), and the agricultural modernization policies ($EXPO$)(equation 4.4). Those relationships are based on the expectations that an expansion in the supply of farm land and rural infrastructure, and a decrease in the cost of capital, should induce an increase in farmer's average product, which is expected to be higher for better educated producers. The proposed model will use coefficient shifters to examine regional differences on the variables' slope.

The proposed model is represented graphically in figure 4.1, where the arrows represent the expected relation of causality between variables in the system. Migration decisions are expected to be influenced by rural and urban expected income, demographic characteristic, information flow. Rural income is hypothesized to be influenced by the average product in agriculture, rural nonfarm earnings, and education. The average product in agriculture is expected to be determined by policies of agricultural modernization, the pattern of land use, rural infrastructure, and the producer's level of education. The dotted arrows represent expected relations of causalities between variables not included in the model because of data limitations.

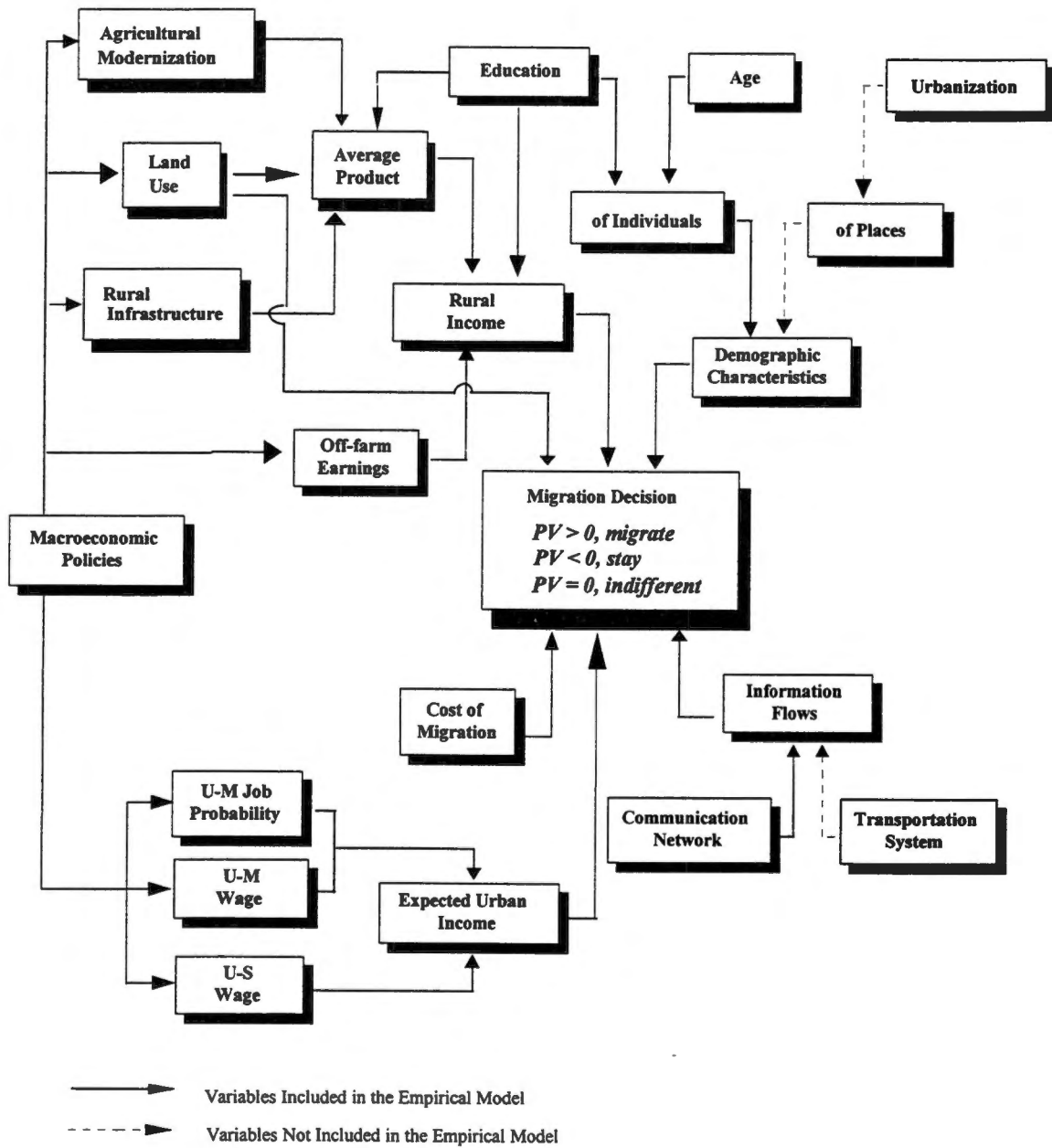


Figure 4.1 - Schematic representation of the proposed migration model

CHAPTER 5

RESULTS

The Model's Identification

The proposed rural-urban migration model defined in Chapter 4 will be estimated using a system of regression equations. This procedure, as mentioned in Chapter 4, is used to avoid simultaneous equation bias, which would result from simple OLS estimation when the regression equation has endogenously determined explanatory variables. The selection of a proper technique to estimate a system of regression equations, however, depends of prior identification of the system's structural form (Pindyck and Rubinfeld, 1981).

Consider a system of regression equations in the following structural form:

$$y_t' \Gamma + x_t' B = \varepsilon_t' \quad (5.1)$$

where,

y_t' is a vector of M endogenous variables ($1 \times M$);

x_t' is a vector of K exogenous variables ($1 \times K$);

B is the vector of the coefficients of the exogenous variables ($K \times M$);

Γ is the vector of the coefficients of the endogenous variables ($M \times M$);

ε is the vector of random error ($1 \times M$);

and t is used to index observations ($t = 1, \dots, T$)

According to Greene (1993, pp. 582-583) the solution of the system of equations determining y_t , in terms of x_t and ε_t is the reduced form of the model:

$$y'_t = -x'_t B \Gamma^{-1} + \varepsilon'_t \Gamma^{-1} = x'_t \Pi + v'_t, \quad (5.2)$$

where $\Pi = -B\Gamma^{-1}$, and Π is the vector of the reduced form coefficients ($K \times M$);

The problem of identification is to determine whether each coefficient in the structural model has one, more than one, or no one solution in terms of the coefficients of the reduced form model (Π). An equation is said to be:

1. *Underidentified* - if at least one structural parameter has no solution in terms of reduced form coefficients;

2. *Exactly identified* - if structural parameters have a unique solution in terms of reduced form coefficients;

3. *Overidentified* - if at least one structural parameter has more than one solution in terms of reduced form coefficients;

The criterion for an equation's identification is defined as follows (Greene, 1993).

Consider:

K_j^* = the number of exogenous variable excluded from equation j ;

M_j = the number of endogenous variables included in equation j ;

M = number of endogenous variables in the system

$\text{rank}[\Pi_j^*]$ = submatrix of the reduced form coefficients matrix;

The conditions for identification are:

1. Order condition, $K_j^* \geq M_j$; and
2. Rank condition, $\text{rank}[\Pi_j^*] = M - 1$

Thus, if:

1. $K_j^* \leq M_j$, or $\text{rank}[\Pi_j^*] \neq M - 1$, the equation is *underidentified*;
2. $K_j^* = M_j$, and $\text{rank}[\Pi_j^*] = M - 1$, the equation is *exactly identified*;
3. $K_j^* > M_j$, and $\text{rank}[\Pi_j^*] = M - 1$, the equation is *overidentified*.

The proposed rural-urban migration model, then, will be identified according to the criterion stated above. Consider the following system of equations:

$$MIG = a_0 + a_1U + a_2R + a_3COST + a_4EDU + a_5AGE + a_6INFO + a_7GINI \quad (5.3)$$

$$R = b_0 + b_1AP + b_2EDU + b_3RNFINC + a_4RNFPOP + b_5ELET + b_6EXPO \quad (5.4)$$

$$AP = c_0 + c_1EDU + c_2ELET + c_3EXPO + c_4GINI \quad (5.5)$$

The model's identification is done equation-by-equation as follows:

1. Equation 5.3. $K_j^* = 4$, $M_j = 2$, and $\text{rank}[\Pi_j^*] = M - 1 = 2$.

So, $K_j^* > M_j$, and $\text{rank}[\Pi_j^*] = M - 1$,. Equation 5.3 is *overidentified*;

2. Equation 5.4. $K_j^* = 5$, $M_j = 2$, and $\text{rank}[\Pi_j^*] = M - 1 = 2$.

So, $K_j^* > M_j$, and $\text{rank}[\Pi_j^*] = M - 1$,. Equation 5.4 is *overidentified*;

3. Equation 5.5. $K_j^* = 6$, $M_j = 1$, and $\text{rank}[\Pi_j^*] = M - 1 = 2$.

So, $K_j^* > M_j$, and $\text{rank}[\Pi_j^*] = M - 1$,. Equation 5.5 is *overidentified*;

Therefore the system is overidentified. The solution of the structural parameters in terms of the reduced form parameters, though, can be obtained as follows: Considering the system of equations above,

$$\Gamma = \begin{bmatrix} 1 & -a_2 & 0 \\ 0 & 1 & -b_1 \\ 0 & 0 & 1 \end{bmatrix},$$

the inverse of Γ is,

$$\Gamma^{-1} = \begin{bmatrix} 1 & a_2 & a_2b_1 \\ 0 & 1 & b_1 \\ 0 & 0 & 1 \end{bmatrix}$$

and,

$$B = (-) \begin{bmatrix} a_0 & b_0 & c_0 \\ a_1 & 0 & 0 \\ a_3 & 0 & 0 \\ a_4 & b_2 & c_1 \\ a_5 & 0 & 0 \\ a_6 & 0 & 0 \\ 0 & b_3 & 0 \\ 0 & b_4 & 0 \\ 0 & b_5 & c_2 \\ 0 & b_6 & c_3 \\ a_7 & 0 & c_4 \end{bmatrix}$$

it follows that $\Pi = -B\Gamma^{-1}$ equals

$$\begin{bmatrix} \pi_{11} & \pi_{12} & \pi_{13} \\ \pi_{21} & \pi_{22} & \pi_{23} \\ \pi_{31} & \pi_{32} & \pi_{33} \\ \pi_{41} & \pi_{42} & \pi_{43} \\ \pi_{51} & \pi_{52} & \pi_{53} \\ \pi_{61} & \pi_{62} & \pi_{63} \\ \pi_{71} & \pi_{72} & \pi_{73} \\ \pi_{81} & \pi_{82} & \pi_{83} \\ \pi_{91} & \pi_{92} & \pi_{93} \\ \pi_{101} & \pi_{102} & \pi_{103} \\ \pi_{111} & \pi_{112} & \pi_{113} \end{bmatrix} = \begin{bmatrix} a_0 & a_0a_2+b_0 & a_0a_2b_1+b_0b_1+c_0 \\ a_1 & a_1a_2 & a_1a_2b_1 \\ a_3 & a_3a_2 & a_3a_2b_1 \\ a_4 & a_4a_2+b_2 & a_4a_2b_1+b_1b_2+c_1 \\ a_5 & a_5a_2 & a_5a_2b_1 \\ a_6 & a_6a_2 & a_6a_2b_1 \\ 0 & b_3 & b_3b_1 \\ 0 & b_4 & b_4b_1 \\ 0 & b_5 & b_5b_1+c_2 \\ 0 & b_6 & b_6b_1+c_3 \\ a_7 & a_2a_7 & a_7a_2b_1+c_4 \end{bmatrix}$$

From the above matrices it can be shown that:

$$a_0 = \pi_{11} \quad a_7 = \pi_{111}$$

$$a_1 = \pi_{21} \quad b_3 = \pi_{72}$$

$$a_3 = \pi_{31} \quad b_4 = \pi_{82}$$

$$a_4 = \pi_{41} \quad b_5 = \pi_{92}$$

$$a_5 = \pi_{51} \quad b_6 = \pi_{102}$$

$$a_6 = \pi_{61}$$

and the remaining coefficients have more than one solution in terms of the reduced form parameters.

Empirical Estimation

Given that the system of regression equations is *overidentified*, *two-stage least squares (2SLS)*, and *three-stage least squares (3SLS)* techniques are recommended (Greene, 1993). According to Pindyck and Rubinfeld (1981, p. 335), however, *3SLS* estimation “yield more efficient parameter estimates than *2SLS* because it takes into account cross-equation correlation.” Considering that the computational costs of both *2SLS* and *3SLS* are similar, the present study will use *3SLS* in the system estimation of the proposed model.

The data used in the estimation consist of 21 cross-section observations in two time periods; a total of 42 observations. According to Greene (1993) models *pooling* time series and cross-section data should account for problems of cross-sectional heteroscedasticity, and time-series autocorrelation. Given that the data set in the present study includes only two time periods separated by 10 years, autocorrelation is not assumed to be a problem. The use of cross-sectional data, however, raises concern about the existence of heteroscedasticity.

The variables used in the model's estimation are based on state averages. According to Greene (1993), grouping data may lead to a loss of efficiency of the parameter estimates when the groups used have different populations. In such cases, Greene recommends multiplying both sides of the regression equation by the square root of the group population. In the present study, both sides of the regression equations are multiplied by the square root of the states' population. The parameter estimates obtained using this procedure, according to Greene, are consistent and asymptotically efficient.

The results of the 3SLS estimation of the proposed rural-urban migration model are shown in Table 5.1, and the elasticity at means of the statistically significant coefficients are shown in Table 5.2. The results are presented for two different models: Model I is the full model as presented in equations 5.3, 5.4, and 5.5 — which considers all the variables hypothesized to influence migration decision, and Model II includes Model I and regional interactive dummy variables to account for cross-region changes in the slope of variables *U*, *RNFINC*, and *GINI* as will be discussed later in this chapter²⁰. Table 5.1 also shows a summary of statistics to be used in hypothesis testing of the model significance, and the existence of heteroscedasticity.²¹ The equations' R-square, the system R-square, a Chi-square statistic, and a Breusch-Pagan statistic (B-P) are provided. The Chi-square statistic (χ^2) is used to determine the null hypothesis (H_0) that all the slope coefficients in the multiple regression model are zero (White, 1993). The critical values for this test at 10 percent significance level are 39.99 for 20 degrees of freedom (D.F.), and 46.93 for 25 D.F. Those critical values, therefore, reject H_0 for both model I and model II (see the values for χ^2 on Table 5.1). The Breusch-Pagan statistic is a

²⁰Regional coefficient shifters were also tried on the slope of the variables *COST*, *INFO*, and *EXPO*, but were not statistically significant at a 10 percent level.

²¹The model was estimated using Shazam 7.0 on the main frame of the University of Tennessee, Knoxville.

Table 5.1 - Rural-urban migration model (3SLS estimation)

	Model I Dependent Variables			Model II Dependent Variables		
	<i>MIG</i>	<i>R</i>	<i>AP</i>	<i>MIG</i>	<i>R</i>	<i>AP</i>
<i>Constant</i>	-37.94 (-0.677)	637.32 (2.148)*	-706.88 (-0.526)	-37.34 (-0.68)	777.38 (1.968)*	-1484.5 (-1.109)
<i>U</i>	0.0102 (1.558)			0.0055 (0.814)		
<i>U-SE</i>				0.0033 (1.869)*		
<i>R</i>	-0.0235 (-1.912)*			-0.0257 (-2.444)*		
<i>COST</i>	-0.0075 (-0.046)			0.045 (0.289)		
<i>EDU</i>	9.26 (1.208)	328.1 (3.308)*	493.1 (2.299)*	12.2 (1.696)	506.2 (3.791)*	98.25 (0.372)
<i>AGE</i>	4.52 (1.511)			4.09 (1.388)		
<i>INFO</i>	-0.132 (-0.502)			-0.057 (-0.217)		
<i>AP</i>		0.427 (3.218)*			0.348 (4.239)*	
<i>RNFINC</i>		10.87 (1.248)			-36.87 (-1.606)	
<i>RNFINC-N</i>					44.35 (2.204)*	
<i>RNFINC-NE</i>					41.09 (2.024)*	
<i>RNFPOP</i>		-7.14 (-2.137)*			-4.58 (-1.182)	
<i>ELET</i>		-1.35 (-0.187)	44.92 (6.262)*		-1.2 (-0.211)	49.82 (7.113)*
<i>EXPO</i>		-9.10 (-2.566)*	1.45 (0.197)		-12.95 (-3.484)*	3 (0.404)
<i>GINI</i>	-26.37 (-0.537)		1240.8 (0.804)	-15.21 (-0.317)		2848.1 (1.730)
<i>GINI-N</i>						-748.47 (-1.377)
<i>GINI-NE</i>						-874.22 (-2.231)*
R-square	0.735	0.950	0.928	0.746	0.96	0.937
System R-Square		0.985			0.989	
Chi-square		175.75 (20 D.F.)			187.71 (25 D.F.)	
Breusch-Pagan		5.758 (3 D.F.)			2.81 (3 D.F.)	

Note: numbers are estimated coefficients, and numbers in parenthesis are t-statistic;

* statistically significant at 10% level.

Table 5.2 - Elasticities at means of the statistically significant coefficients

	Model I Dependent Variables			Model II Dependent Variables		
	<i>MIG</i>	<i>R</i>	<i>AP</i>	<i>MIG</i>	<i>R</i>	<i>AP</i>
<i>U-SE</i>				0.095		
<i>R</i>	-0.93			-1.02		
<i>EDU</i>		0.32	0.44	0.47	0.50	
<i>AP</i>		0.47			0.39	
<i>RNFINC-N</i>					0.073	
<i>RNFINC-NE</i>					0.093	
<i>RNFPOP</i>		-0.22				
<i>EXPO</i>		-0.19			-0.27	
<i>ELET</i>			0.53			0.59
<i>GINI-NE</i>						-0.19

Lagrangian Multiplier test of the H_0 for diagonal covariance matrix (White, 1993). The critical values of this test for 3 D.F. are respectively 7.81 at 5 percent significance level, and 6.25 at 10 percent significance level. Therefore, the test failed to reject the homoscedasticity hypothesis at both 5 and 10 percent significance levels (see values of B-P statistic on table 5.1). The system R-square was 0.985 and 0.989 for Models I and II, respectively. For the structural equations Models I and II had R-square values of respectively 0.735 and 0.746 for the migration equation, 0.950 and 0.960 for the rural income equation, and 0.928 and 0.937 for the average farm product equation. The model using region specific coefficient shifters, therefore, showed slightly higher R-square.

In Model I the rural income (R) had negative coefficients, as expected, and was statistically significant.²² The coefficients of the remaining variables in the migration equation were statistically non-significant in model I. Even though U and AGE had statistically non-significant coefficients, the t -statistic for those coefficients were almost outside the null hypothesis region.

In the rural income equation the coefficients for average product (AP) and years EDU are both statistically significant, and had the expected signs. The coefficient for share of farmers' off-farm income ($RNFINC$) was not statistically significant at the 10 percent level. The share of rural labor force not living or taking steady job on farm ($RNFPOP$) had statistically significant coefficient, but showed a negative sign. The coefficient for $ELET$ was not statistically significant. The coefficient of the variable $EXPO$ was statistically significant, and had expected sign. In the average product (AP) equation the coefficients of the variables EDU and $ELET$ were statistically significant, and had the expected signs; while the coefficients of the variables $EXPO$ and $GINI$ were not statistically significant.

²²Coefficients will be considered statistically significant at 10 percent level.

In Model II region specific coefficient shifters were introduced account for cross-region variation in the slope of the variables. In the migration equation the variable *U-SE* introduces an interactive dummy variables in the slope of *U*, which is equal to 1 for the Southeast and zero otherwise. The objective of this variable is to examine the separate influence of the urban income on migration in the southeastern region, given that the Southeast showed the highest levels of urban population and income during the period considered (see Chapter 3). When *U-SE* is introduced, the coefficient for *U* is statistically non-significant. The coefficient of *U-SE* was statistically significant, and had expected sign. These results suggest that the influence of urban income on rural-urban migration was stronger on the Southeast region. Also, the introduction of *U-SE* increases the significance of the coefficient for *EDU*.

In the rural income equation (model II), two interactive dummy variables were introduced for the variables *RNFINC*. The dummy variable *N* is equal to one for the North region and zero otherwise, and the dummy variable *NE* is equal to 1 for the Northeast region and zero otherwise. The reason for introducing these two interactive dummy variables is that, as shown in Chapter 3, the farmers' share of nonfarm income was higher in the North and Northeast. The variable *RNFPOP* was used to approximate employment opportunities in the rural nonfarm sector, and thus was expected to be positively correlated to rural income. This variable had statistically significant negative coefficient. The coefficient sign, however, is not in accordance to the expectations.

In the *AP* equation of Model II two interactive dummy variables are introduced for the variable *GINI*, one for the North region and the other for the Northeast. The reason for introducing these two dummy variables was that public incentive for agricultural modernization in Brazil was less intense in the North and Northeast regions. Therefore, land concentration is expected to show a different response on *AP* in these two regions relatively to other regions of the country. The coefficient shifter *N* is equal to 1

for the North region and zero otherwise, and the shifter NE is equal to 1 for the northeast and zero otherwise. The introduction of these dummy variables increase the significance of the coefficient *GINI*. The coefficients *GINI-NE* was negative and statistically significant.

Discussion of the Results

The estimated rural-urban migration model confirmed the hypothesis that migration decision is a positive function of expected urban earnings, and a negative function of expected rural earnings. Similar results were found in empirical studies by Schultz (1971) in Latin America; Barnum and Sabot (1977) and Hay (1980) in Africa; and Bhattacharyya (1985) in Asia. The studies by Schultz, and Hay, only used rural income in the migration equation. In both cases the rural income coefficient was statistically significant, and negatively related to migration. Barnum and Sabot found the coefficients for urban income statistically significant and positively related to migration, but the coefficient of rural income was not statistically significant. Bhattacharyya found the coefficients for both rural and urban income statistically significant, and respectively negative and positive correlated to migration. In the present study, the elasticity for rural income was higher than the elasticity for urban income. This result suggests that increased rural income has a deterrent influence on migration greater than the city *pull effect* of increased urban income. The introduction of an interactive dummy variable for urban income in the Southeast region significant. This result may indicate that the urban *pull effect* on rural urban migration in the Southeast regions was greater than in the remaining regions.

The coefficient for the average years of schooling of the rural population was statistically non-significant in the migration equation. In model II, the *t*-statistic for this

coefficient fell just outside the fail to reject hypothesis region. Considering, for instance, a 20 percent significance level, the coefficient of *EDU* would be considered statistically significant and positively related to migration. The positive influence of *EDU* on migration was also found by Schultz (1971), Barnum and Sabot (1977), Hay (1980), and Banerjee (1991). According to Hay, increased schooling increases with migration because returns to human capital are higher in urban areas compared to rural areas. Sahota (1968), however, in a study of interstate migration in Brazil, found that the level of education of rural residents is negatively correlated to rural migration. According to Sahota (1968, p. 243) “first-rate schooling in the rural areas will induce the entrepreneurial farmers to not to migrate to cities but to stay in agriculture and develop scientific farming.” In this study, education was found to be positively related to rural income. These results concurs with education results found in studies by Hay (1980), and Kislev and Siegel (1987). Education, therefore, may have two different effects on migration: a direct effect, which is positive; and an indirect effect (through rural income), which is negative. The decision whether to migrate and look for a city job, or to invest in “entrepreneurial farming”, however, will depend on which activity renders higher returns to the potential migrant stock of human capital. The elasticity of *EDU* with respect to *R* showed that a one percent change in the average years of education for the rural population induces an increase in the average rural income of 0.32 percent in to Model I, and 0.50 percent in to Model II.

The average age of the rural population was statistically non-significant coefficient in both Models I and II. The *t*-statistic for this variable, however, fell just outside the fail to reject region. At a 20 percent significance level *AGE* would be statistically significant in both Models I and II. Banerjee (1991), in a study of rural-urban migration in India, also found a statistically significant positive relationship between *AGE* and *MIG*. This result, however, should be interpreted with caution because the

relationship between *AGE* and *MIG* may change as *AGE* increases. The migration model estimated by Hay (1980) considered *AGE* and *AGE*-square in order to capture the decreasing influence of age in migration as *AGE* increases.²³ The study found a positive statistically significant coefficient for *AGE* and a negative statistically significant coefficient for *AGE*-square. The meaning of those results according to Hay is that age influences migration positively for younger migrants, and negatively for older migrants. The variables *COST*, *INFO*, and *GINI* had non-significant coefficients.

The farmers' share of off-farm income was statistically non-significant in Model I and II. In Model II, when the region specific slope shifters were introduced, *RNFINC-N* and *RNFINC-NE* had statistically significant positive coefficients. Considering that the North and Northeast regions were the ones which had lowest average agricultural product, this result suggests that lower income farmers in Brazil rely more on nonfarm sources of income than higher income farmers. This result is consistent with the U-inverted hypothesis presented by Liedholm and Kilby (1989), according to which nonfarm incomes increases with decreasing farm income for lower income households, and increase with farm income for higher income households. Rural households in Brazil, therefore, are likely to be on the decreasing portion of the U-inverted curve. The elasticity at mean showed that one percent change in *RNFINC* correspond an increase in rural income of 0.073 percent in the North, and 0.093 in the Northeast. Therefore, the impact of *RNFINC* on *R* is greater in the Northeast; which showed the lowest average agricultural product amongst all regions.

The variable *RNFPOP* was intended to capture employment opportunity in the rural nonfarm economy, that is, the labor demand side of the market. This variable,

²³The present study estimated a model with *AGE* and *AGE*-square. *AGE*-square, however, showed a coefficient statistically non-significant.

however, does not account for people actually working in the rural nonfarm sector, but approximates the whole labor force in the sector. That is, the variable may be a better approximation of the labor supply. As such, *RNFPOP* was found to be negatively related to rural income.

The variable *EXPO* was negatively related to *R*, and was statistically significant coefficient. This result suggests that the policy of agricultural modernization in Brazil during the period studied influenced average rural income negatively. According to Martine (1987), the process of agricultural modernization in Brazil was intensive in the use of labor displacing capital, and consequently reduced labor demand on farm. The negative relationship between *EXPO* and *R*, therefore, can be understood as an indication that labor displacing technology increased the supply of rural labor, inducing a decrease on rural income.

The interactive dummy variable used with the *GINI* variable attempted to capture the impact of land concentration on average income on the North and Northeast regions. The North and Northeast regions were selected because they were less favored by public incentives for agriculture. According to Binswanger (1991) the increasing supply of agricultural credit in Brazil induced an increase in land prices, but its unequal distribution favored large producers and decrease the number of small-holders. The reason is that, as land title is generally required as collateral for the concession subsidized credit, an increase in the volume of subsidy will increase the demand for land titled and provide its owners with capital gains. Larger farmers, though, will be willing to acquire more land to increase their capital gains from public incentives to agriculture.

Land ownership concentration can be a result of an increase in the farm land area of large producers, which may use the acquired land for productive propose, or for speculating in the land market. According to Graziano da Silva (1981), both production and speculation motives induced an increase in land ownership concentration. An

increase in the agricultural area of large farmers for productive purposes is expected to have a positive effect on the average product, given that those producers are generally more intensive in the use of capital. On the other hand, an increase in the large producers' farm land area for speculation purposes is expected to decrease average product, given that this additional land is not going to be put primarily into production. The results suggest that, in regions where the process of agricultural modernization was more intense, the increase in farm land area had a positive impact on the average product, while the increase in the farm land of those regions where the agricultural modernization was less intense had a negative impact on the average product. The *GINI* coefficient in Model II showed that the coefficient for this variable was statistically significant negative for the Northeast. The negative impact of *GINI* on *AP* indicates a decrease in average product and the coefficient of land concentration increases, and suggests that, in the Northeast, the speculation motive was stronger than the production motive in the process of land acquisition by large producers. The elasticity at means showed that a one percent increase in the Gini coefficient in the Northeast induces a decrease in the average agricultural product of 0.19 percent.

The variable representing rural infrastructure (*ELET*) was positively related to average farm product, and was statistically significant. Kislev and Siegel (1987) introduced the use of irrigation in the average product function, which can be regarded as a measure of rural infrastructure. This variable was also positively related to *AP*, and had coefficient statistically significant. Cole and Sanders (1983) used the variables local public expenditures in the system of equations, which was shown to be negatively related to the percentage of low income state residents; therefore, positively related with income. The elasticity at mean of the variable *ELET* showed that one percent increase on this variable, results in an percent increase in the average product of 0.53 in Model I, and 0.59 in Model II.

The results of this study tend to support the theoretical model's expectation that increasing urban income is a positive influence on rural out-migration, and that increasing rural income is a negative influence on rural out-migration. With respect to the level of education of the rural population, the findings of this study tend to confirm the relationships hypothesized in the theoretical model, according to which the level of rural education has a positive effect on both rural income and migration. The positive effect of education on rural income, however, suggests a negative indirect effect of education on migration, given that rural income is negatively related to migration.

With respect to the rural nonfarm economy, the expected positive relationship between seasonal and part-time off-farm economic activities and rural income was confirmed for the lower average product regions (North and Northeast). The results for the full-time regular nonfarm activities, however, did not confirm the expected positive relationship of this variable in respect to rural income. The level of rural infrastructure was positively related to the agricultural average product, as expected, but had statistically non-significant coefficient in the rural income equation. Agricultural modernization had a negative influence on rural income, as expected. Finally, land concentration had a negative influence on the agricultural average product in regions where the process of agricultural modernization was less intense (North and Northeast), and had a positive influence on the agricultural average product in other regions of the country.

CHAPTER 6

CONCLUSIONS

This study attempted to define a rural-urban migration model to determine the influence of economic factors, demographic characteristics, information flow, and public policies on individuals' migration decisions in Brazil. The proposed model expanded the traditional approach of rural-urban migration models, according to which the rural economy was primarily composed of farm activities. The present study, though, assumed that the rural economy is composed of farm and nonfarm economic activities. Rural-urban migration decisions, therefore, are assumed to be influenced by income from both farm and nonfarm sources. The rural nonfarm economy was considered to be divided in two sub-sectors: one characterized by seasonal and irregular labor demand, and another characterized by full-time and regular employment. The seasonal labor nonfarm sector was assumed to have more direct linkages with the farm economy, while the regular employment nonfarm sector was considered to be composed of economic activities not directly linked to agriculture.

Public policies towards rural and urban development in Brazil, especially the process of agricultural modernization during the late sixties and early seventies, were assumed to influence population changes in the country. The study showed that, during the period considered, Brazil was characterized by large regional difference in respect to economic and demographic characteristics. The Southeast, for instance, accounted for about 65 percent of the country *GDP*, but had only about 44 percent of the country's population, while the Northeast accounted for 12 percent of the *GDP*, and had about 30 percent of the country's total population. The process of agricultural modernization, which was mainly supported by public incentives, primarily targeted the Southeast and

South regions, and medium and large size farms. On the urban sector, the development effort was mainly concentrated large Southeastern urban centers. Such policies were assumed in the present study to be the main causes of rural urban-migration in Brazil during the period studied.

The basic rural-urban migration model was defined as a system of regression equations in which migration was assumed to be a function of rural (R) and urban income (U), level of rural education (EDU), average age of the rural population (AGE), information flow ($INFO$), and the coefficient of land ownership concentration ($GINI$). The rural income variables was assumed to be endogenously determined as a function of average farm product (AP), EDU , rural nonfarm income ($RNFINC$), rural nonfarm employment ($RNFPOP$), the share of state farm land cultivated with export crops ($EXPO$), and the level of rural infrastructure ($ELET$). The variables EDU and AGE were positively correlated to rural income, and $EXPO$ was and $EXPO$ had expected coefficient signs. The average farm product was considered endogenous, and determined as a function of EDU , $ELET$, share of farm land cultivated with exportable, and land concentration. Coefficient shifters were introduced on the migration model to examine region specific changes in slope of the variables.

The results showed that the propensity to out-migrate from rural areas increases with increasing urban income, and decreases with increasing rural income. The impact of changes in rural income on migration, however, was shown to be greater than the urban income *pull effect*. That is, the elasticity at mean showed that a one percent increase in R has a deterrent influence on migration which is greater than the migration inducement caused by a percent change in U . This suggests that the development of income generating economic activities has a greater impact on migration (negative impact) on rural areas.

The variable representing the level of rural education had a statistically non-significant coefficient. The *t*-statistic for this variable's coefficient, however, fell just outside the fail to reject region. Considering 20 percent significance level, for instance, education is statistically significant and positively correlated to migration. Given that migration is a negative function of rural income, education can be regarded to having an opposite effect on migration. A direct effect represented by *EDU* on the migration function, which is positive; and an indirect effect — through rural income — which is negative. So long as the returns to education are greater in the urban sector, the direct effect of *EDU* on migration will prevail.

The share of farmer's off-farm income was shown to be positively correlated to rural income on the lowest average product regions (North and Northeast), while statistically non-significant in the remaining regions. These results lead to the conclusion that *FNFINC* is a deterrent of migration (through increasing rural income) for low average product regions. This conclusion, however, only considers the portion of the rural nonfarm economy which is linked to the farm economy characterized by seasonal and temporary labor demand.

The hypothesis of positive correlation between the full-time regular work nonfarm economy and rural income was not confirmed. The variable *RNFPOP* considered the rural labor force not primarily working on farm activities. This variable, therefore, is an approximation of the supply of labor in the rural nonfarm economy; but not necessarily of employment opportunities in this sector. A better approximation of employment opportunities in the full-time rural nonfarm sector, such as the percentage of rural labor force actually working in this sector, would have been preferred in the estimation of the proposed migration model. A possible reason for the statistically non-significant coefficient of *RNFPOP*, therefore, was that this variable was not a good approximation for economic opportunities in the full-time rural nonfarm economy.

The process of agricultural modernization in Brazil was shown to influence rural income negatively. This result suggests that agricultural modernization was labor displacing in respect to farm workers, resulting in an increase in the supply of rural labor and, consequently, a decrease in rural income. The policies of agricultural modernization in Brazil, therefore, can be regarded as inducing rural-urban migration, given that increasing *EXPO* influences *R* negatively.

Land concentration was shown to induce a decrease in average agricultural product in Northeast, and in the North when a 20 percent significance level is considered. Land concentration in Brazil was assumed in the present study as being effected by increasing returns to farm land during the process of agricultural modernization. Agricultural credit was the major instrument of public policies to promote modernization. As a result, the demand for farm land increased among large farmers, who had greater borrowing capacity than small-holders due to their greater amounts of collateral. The results, therefore, suggest that in the regions where the process of agricultural modernization was less intense (North and Northeast), the increase in land concentration was motivated by large farmers acquisition of land to speculate in the credit and land markets. In other regions of the country land concentration was more a response of land acquisition by large farmers with production purpose. The variable *ELET*, which represented the level of rural infrastructure, showed highly significant coefficient in the *AP* equation, which suggests that increasing rural infrastructure influences positively the level of average agricultural product.

Some Policy Implications

With respect to rural and urban incomes, the main policy implication is that

economic efforts aimed to increase income and employment opportunities in the rural sector has a negative influence on rural-urban migration, whereas the same policy on the urban sector tends to *pull* migrants into cities. The net effect of development policies on migration, therefore, depends on the relative influence of such policies on rural and urban income and employment opportunities. With respect to education, the positive influence of this variable on migration can be decreased by increasing the returns of human capital in the rural sector relatively to the urban sector.

With respect to the rural nonfarm economy the results of this study suggest that, in lower income areas development strategies to induce growth on seasonal nonfarm economic activities have a positive impact on rural income, and, consequently, acts as a rural-urban migration deterrent. That is, policies aimed to develop rural nonfarm activities characterized by seasonal labor demand in the North and Northeast, are expected to influence rural income positively. In respect to full-time nonfarm activities, the results did not show statistically significant relation between this variable and rural income.

The results of this study showed that the process of agricultural modernization in Brazil favored large scale and export crops, and that this policy shortened labor demand in rural areas, inducing rural out-migration. Therefore, agricultural policies aimed to promote economic growth in both export and domestic crop sectors would decrease the negative impact of agricultural modernization on rural income, and consequently decrease rural-urban migration. That is, agricultural policies should also target small-holders as a mean of keeping the level of steady employment from decreasing. Also, policies of agricultural credit which decrease the influence of large farmers on government loans would have a positive impact on the average farm product and rural income, and consequently decrease rural out-migration.

Limitations of the Present Study

Rural-urban migration was defined in the present study as an individual's decision influenced by economic factors, demographic characteristics, information flow, and policy effects. Rural-urban migration models, therefore, commonly use individual information to estimate a migrant's behavior towards relocation. The present study used cross-state aggregate data in Brazil to approximate migration determinants due to the lack of individual information, which would be preferred in the case of migration studies. Besides using aggregate information, the present study used proxy for some variables not available in the Brazilian official data (Census of Agriculture and Census of Population). Such approximations represented limitation for the present study, which are going to be discussed next.

The migration rate used in the present study was calculated based on the net out-flow of population from rural areas (see Appendix) in Brazilian state. That is, this rate accounts for net rural out-migration, but does not give any information about the destination of the migrant; which could have been rural areas outside the state, urban areas outside the state, or urban areas within the state. The proposed model assumed that, during the period studied, the flow of rural out-migration was mainly directed to urban areas within the state. This assumption was based on the information on table 3.1 (Chapter 3) according to which the regional share of Brazilian population did not experience large changes during the period between 1960-1980. This data, however, still does not give much information on the destination of rural migrants. The use of inter-state migration data would give a better approximation of the direction of the flow of rural out-migrants.

In the urban sector income was defined as the weighted average of all income groups, therefore including subsistence and modern sectors income. The use of proper

approximations of the U-S income, U-M income, and U-M employment probability would have been preferred in the present study. Nevertheless, a suitable approximation of such variables would required more detailed information on the urban labor market in order to define a boundary between U-S and U-M sectors. Also, the definition of urban subsistence and urban modern sectors is not a matter of general agreement in the urban labor market literature. The weighted average urban income, therefore, was used as an alternative.

The rural nonfarm economy was defined in the present study as divided in two main sub-sections: one characterized by seasonal labor demand, and linked to agricultural activities; and other characterized by full-time labor demand, which is not directly linked to agricultural activities. The seasonal labor demand nonfarm activities was approximated in the present study by the farmers' income obtained in activities other than crop and livestock. This data was obtained in the Brazilian Census of Agriculture. Such information, however, does not considers goods and services produced and consumed within the farm household. This approximation, therefore, underestimate of the share of farmers' income obtained in nonfarm activities. With respect to rural nonfarm activities not directly linked to agriculture, the proxy measure used was the share of rural labor force not primarily working in farm activities. This measure is an approximation of the supply of labor in the rural nonfarm sector, and does not necessarily represents the labor demand in this sector.

Suggestions for Future Research

With respect to aggregate measures of migration, a suggestion for future research is to use both rural out-migration, and interstate migration data, in order to have better information regarding the destination of rural out-migrants. The use of individual data,

however, represents a greater appeal for empirical estimation of migration models. Individual data of migrants can provide information such as the exactly places of origin and destination, and the number of friends and relatives at destination, which are commonly used as proxy measures for the initial cost of migration and the migrant's level of information concerning to destination, respectively.

With respect to the urban labor market, a suggestion for future research is to characterize the urban subsistence and modern sectors, and to examine the influence of income and employment opportunities in each of those sectors on the rural migrant's decision to relocate. Such a characterization of the urban labor market would require both survey data, and secondary data.

In this study the rural nonfarm economy was assumed to be characterized as composed of two sub-sectors: a seasonal labor demand, and a full-time employment sector. This characterization was based in studies on the rural nonfarm economy in Asia and Africa. A suggestion for future research, therefore, is to characterize rural nonfarm activities in Brazil, with respect to:

1. type of goods and services produced;
2. pattern of labor demand (seasonal and full time);
3. linkages with the farm sector; and
4. share of total rural employment.

With respect to the seasonal rural nonfarm activities, the use of survey data would provide more detailed information of farmer's production and consumption of nonfarm goods and services. In this case, non-agricultural goods and services which are produced and consumed in the household could be accounted for in the farmer's budget. Also, studies using survey data of seasonal rural nonfarm activities would be able to characterize these activities with respect to the type of goods and services produced, and the production and consumption linkages with the farm economy. With respect to rural

nonfarm activities characterized by full-time labor demand, the use of both survey data and secondary information would provide more detailed information concerning to income and employment opportunities in this sector.

This dissertation thus suggests a case study in which a survey could be conducted in a rural village (or villages) representative of rural areas in the region considered. The suggested study can survey rural households, farm and nonfarm, and get information on individuals who migrated out of the village, and on those who stayed. Such a survey can generate data on the variables considered to have influenced migration decision. Along with survey data, the study can get secondary information in local government offices and census which would be important to characterize the conditions of the labor markets at origin and destination. An example of those variables is given as below:

1. *Economic factors* - average farm income (cash and in-kind), income earned in seasonal and part-time off-farm activities, income earned in full-time off-farm activities, incomes in the U-S and U-M sectors at destination (if urban), rate of unemployment at destination (if urban), pre-arranged job at destination, distance between origin and destination, migrant's remittances, value of individual's assets (owned land, house, etc.);

2. *Demographic characteristics* - individual's age at the time of migration, individual's number of formal years of schooling, individual's years of educational training, sex, marital status;

3. *Flow of information* - number of friends and relatives living at destination, number of friends and relatives from destination living at origin, previous visit to destination, household ownership of means of communication (telephone, television, radio, etc.), transportation system connecting the village to other regions; and

4. *Public policies* - availability of public services (schools, electricity, running water, telephone, transportation infrastructure, etc.), supply of public incentives for

agricultural production and other economic activities, structure of land distribution, public investments on marketing infrastructure.

With respect to the individual's relocation decision, migration can be represented by a binary choice variable which assume value 1 for those who migrated out of the village, and 0 for those who stayed.²⁴ With respect to the rural non-farm economy, the information on seasonal and part-time off-farm activities can be captured by interviewing the farmers. In this case it would be possible to get information on nonfarm products both sold and consumed within the household. Information about the full-time employment nonfarm activities can be gathered both in interviews with rural household working on this sector, and from the local county administration. Local and regional statistics, and geographic information, are also important sources of information used to construct the variables in the migration study suggested.

Finally, the importance of future research on rural-urban migration in developing countries, according to the approach developed in this study, can furnish a better explanation of the role of nonfarm activities on rural households' budget, and potential rural migrants' decision to relocate. Such an investigation can extend the formal approach of rural development, according to which rural economic activities are assumed to be attained on farm. The suggested study, could offer a broader perspective for policies towards rural development and migration.

²⁴ In this case the model's estimation would require appropriate econometric technique for binary choice models such as the use of probit or logit models (Greene, 1993).

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APPENDIX

APPENDIX

Indirect Measures of Internal Migration

According to the United Nations, Department of Economics and Social Affairs (1970, p. 24) “where reliable statistics of birth and deaths to the residents of each component area of a country are available, it is possible to estimate the natural increase between two census dates or between any two dates for which the population is known.” The estimate of net internal migration, then, can be obtained by subtracting the natural increase of the population by the total population change in a given period. The calculation procedure for a given area and time period can be done according to the following expression:

$$Net\ M = (P_e - P_b) - (B - D) \quad (A.1)$$

where *Net M* is the net migration, P_e is the population in the end of the period, P_b is the population in the beginning of the period, B is the number of births, and D is the number of deaths. The natural population increase is given by $(B - D)$. An application of equation A.1 can be done using the net rural migration data for Brazil calculated by Martine (1987). Consider:

$$P_{80} = 38,566,000 \text{ (Brazilian rural population in 1980);}$$

$$P_{70} = 41,054,000 \text{ (Brazilian rural population in 1970);}$$

$$(B - D) = 13,134,000 \text{ (the natural growth of rural population in Brazil from 1970 to 1980).}$$

The net migration can is then calculated as:

$$Net\ M = (38,566,000 - 41,054,000) - (13,134,000)$$

$$Net\ M = -15,622,000$$

where the minus sign indicates net rural out-migration. In the present study a negative *MIG* sign stands for net in-migration, while a positive *MIG* sign stands for net out-migration. This was done for simplicity, and do not alter the results of the analysis (see table 3.7).

Martine (1987) defines a rural migration rate (*MIG*), which is equal to the total net migration (*Net M*) divided by the rural population in the beginning of the period (P_b), as follows:

$$MIG = \frac{Net\ M}{P_b} \times 100\% \quad (A. 2)$$

using the example above for Brazil, *MIG* can be calculated as:

$$MIG = \frac{-15,622,000}{41,054,000} \times 100\% = -38\%$$

which means that about 38 percent of Brazilian rural population left rural residences from 1970 to 1980.

VITA

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