The selectivity of migration and poverty traps in rural Brazil

André Braz Golgher
Cedeplar/UFMG
agolgher@cedeplar.ufmg.br

Pamila Silviero
Cedeplar/UFMG

ABSTRACT

Poverty levels in Brazil present a remarkable spatial heterogeneity and are specifically high in rural areas of the Northeast and North regions. There are different phenomena that may have an impact on regional poverty levels and migration from and to rural areas are among them, in particular due to the selectivity of migration. This selectivity was discussed with a theoretical model, which was based on the Roy and the human capital models, and also empirically, with multinomial logistic models. It was observed a general tendency of negative selection for migrants in rural/rural flows and a positive one in rural/urban and longer steps of migration. Policies that diminish the costs of migration would have a positive impact on the range of possibilities for the low-income population strata.

Key words: migration, selectivity, poverty traps, Brazil, Latin America.

INTRODUCTION

Recently in Brazil it was verified a slight advance on deprivation levels (IBRE/FGV 2005). However, poverty levels are still quite high (Barros et al 2000) and present a remarkable spatial heterogeneity (Hoffman 2000). For instance, among the macroregions of this country, the

Northeast Region had only 29% of the Brazilian population and 53% of the poor people in 1997. Ferreira et al (2000) estimated the proportion of poor people for different regions in Brazil in 1996. They verified that the Northeast Region had the greatest numbers, specially the rural parts, and was followed by the North Region. In the other macroregions of Brazil, Southeast, South and Center-West, the numbers were smaller, but still quite expressive.

Poverty levels are influenced by many factors and migration from and to rural areas is one of them. The influence of migration on regional poverty depends on the magnitude of the flows and also on their composition, because these may change population growth regimes, the age distribution of population and also the amount of human and other types of capital.

The human capital model is a commonly used framework to discuss issues related to migration. The model assumes that a rational individual migrates if the expected net return of migration is positive, and if so, he/she maximizes his/her utility among the possible destinies (Stillwell and Congdon 1991). The equation below presents this relation. Migration will occur if the net benefits of migration are positive:

(1) $G_{ij} = (V_{ij} - V_{ii}) - C_{ij} > 0$,

where **i** is present origin, **j** is potential destiny, G_{ij} is net return of migration, V_{ij} is the expected benefits in **j**, V_{ii} is the expected benefits in **i,** and C_{ij} are the costs of migration.

Factors that influence the expected benefits of individuals include personal attributes, regional characteristics and the interaction between these variables (Stillwell and Congdon 1991).

The costs of migration are normally a function of the distance between the origin and the destiny of the migrant. These costs can be monetary, psychological, of opportunity, of adaptation, etc (Stillweel and Congdon 1991). It is believed that the costs are an increasing concave function of distance (Bell et al 1990; Cadwallader 1992).

The costs of migration are also affected by many other factors besides distance. Among them is the presence of effective social networks between the potential migrants and persons in the destiny that may diminish decisively these costs by a series of reasons, enhancing the chance of migration, or even making the change of place of residence possible (Todaro 1980; Massey et al 1993).

Therefore, due to monetary and other types of costs associated to the migratory process, the individual needs a minimum amount of capital in order to have migration as an option. Poor people, especially the chronic or extremely poor ones, may not have this possibility (Kothari 2002), and may be trapped in their origin (Sandefur 1991).

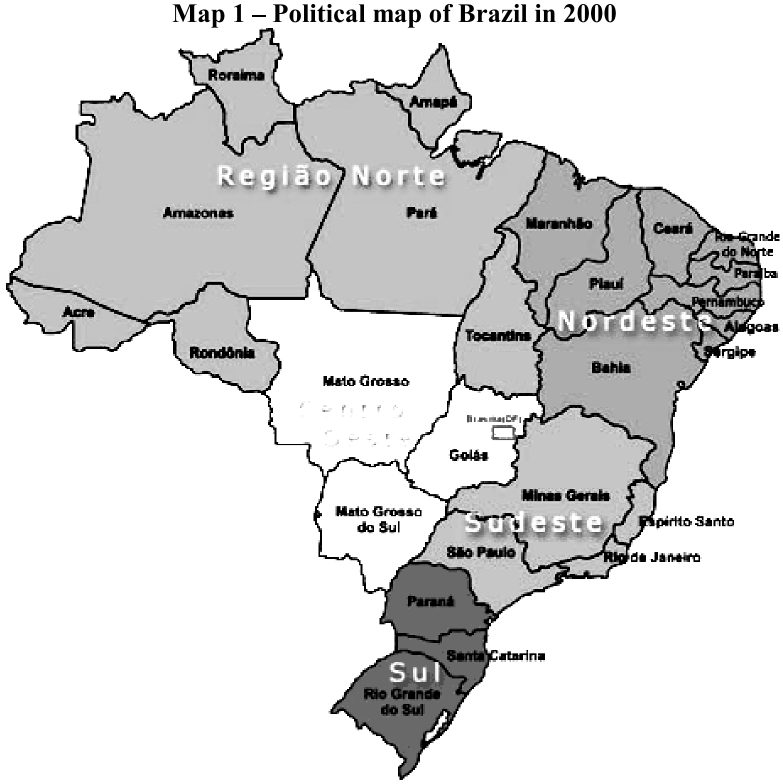
Given these characteristics, the migratory process tends to be selective. Generally, it is believed that a typical migrant is a young adult, bachelor, with a reasonable level of formal education, with more effective social networks and that is more labor market oriented (Castiglione 1989; Borjas 1996). However, what a typical migrant actually is depends on the context being analyzed and the type of migration that is being studied (Todaro 1980; Greenwood 1985; De Haan 1999).

In this paper the relationship between rural poverty and migration selectivity is examined. In order to do so, it was divided in five sections, including this introduction, as follows. The next presents some descriptive data, which shows that the migrant is not a random sample of the population in Brazil. Then, the third section shows a theoretical model, which is based on the Roy and human capitals models. The model discusses the selectivity of migration and the possibility of existence of poverty traps, due to the cost of migration, in rural Brazil. The section also presents mathematical simulations about the topic. Section four presents the empirical analyses, which were done with multinomial logistic models, and also includes some illustrative simulations. The last section concludes the paper.

DESCRIPTIVE DATA

Brazil is one of the largest countries in the World with more than 8 millions square kilometers, roughly the size of continental United States of America. It is divided in five macroregions, North (Norte), Northeast (Nordeste), Southeast (Sudeste), South (Sul) and Center-West (Centro-Oeste), and 26 states and the Federal District, as is shown in the map 1.

Map 1 – Political map of Brazil in 2000



Source: http://www.brasil-turismo.com/geografia.htm

The Brazilian Demographic Census of 2000 was used the database used in the paper. This database has the information of place of residence in the date of reference of the Census and also five years before it. Individuals that declared different municipalities were considered migrants for the 1995-2000 period (see Carvalho and Machado 1992, and Rigotti and Carvalho 1999, for a methodological discussion about migratory data in Brazilian Censuses). Migrants with rural origin and rural non-migrants were selected. Only individuals with age between 18 and 64 were included, as they represent most of the individuals that make a rational choice to migrate because of labor market characteristics.

Migrants were classified in six categories. As all of them had as origin rural areas they could be of two different types: rural/urban or rural/rural. Moreover, for each one of these types, migrants were classified as intrastate, interstate between neighbor states and interstate between non-neighbors states.

Table 1 shows the proportions of migrants in these different categories and of non-migrants for the five macroregions in Brazil and for the country as a whole. The majority of the rural dwellers in 1995 that were still alive in Brazil, around 83% of over 18 million people, were non-migrants in 2000. All macroregions in Brazil had similar values, and only one, the Center-West, a region with many rural areas of population attraction, had numbers slightly under 75%.

Given the costs of migration, short distance flows tend to be more numerous. In Brazil 12.5% of the rural dwellers in 1995 were intrastate migrants in 2000 and only around 4% of the individuals were interstate migrants. Besides that approximately half of the interstate migrants migrated between neighbor states, most in a short distance step. Besides, rural/urban flows were more numerous than rural/rural. This is the general picture for all macroregions with only one exception. The rural/urban flows between non-neighbors from the Northeast Region were quite numerous. This fact can be explained by at least two factors. First, historically, the flows from this region to São Paulo and Rio de Janeiro urban centers were numerous and social nets tend to be stronger. Secondly, the states in this region are smaller than in other regions, as can be seen in the map, and hence interstate between non-neighbors may represent a shorter distance than elsewhere.

Table 1 – Proportion of migrants of different types and rural non-migrants in Brazil in 2000

	Proportion of migrants of different types and rural non-migrants by macroregion					
Type of flow	North Region	Northeast Region	Southeast Region	South Region	Center-West Region	Brazil
Rural/urban intrastate	7.1	5.8	9.0	9.3	10.3	7.5
Rural/urban between neighbors	2.0	1.1	2.0	1.2	3.0	1.5
Rural/urban between non-neighbors	1.1	2.2	0.5	1.5	1.7	1.5
Rural/rural intrastate	5.6	4.0	5.0	6.0	8.5	5.0
Rural/rural between neighbors	1.2	0.7	0.8	0.5	1.9	0.8
Rural/rural between non-neighbors	0.3	0.4	0.3	0.8	0.9	0.5
Rural non-migrants	82.6	85.7	82.4	80.6	73.7	83.1
Total	1944790	7918930	4197819	3104775	957544	18123858

Source: FIBGE, 2000.

Next table compares migrants and non-migrants for mean schooling levels only for the group aged between 20 and 29 years, as schooling levels are highly dependent on age composition. Some points should be emphasized. Firstly, migrants and non-migrants in the North and Northeast regions had lower schooling levels than in other regions, especially this second one. Secondly, rural/rural migration presents lower schooling levels than rural/urban in all regions. Thirdly, non-migrants showed a general tendency to be between these two types of flows in the more developed regions and were more similar to rural/rural interstate migrants in these two cited regions. Lastly, it was not observed an increase in schooling levels with an enhancement of distance for all regions, but only for the poorer ones.

Table 2 - Education level of migrant flows and non-migrants, by type of flow for persons aged 20 and 29 years in Brazil in 2000

	Mean schooling (in years)				
Type of flow	North Region	Northeast Region	Southeast Region	South Region	Center-West Region
Rural/urban intrastate	4.97	4.52	6.22	6.97	5.78
Rural/urban between neighbors	5.09	4.11	5.83	6.96	5.92
Rural/urban between non-neighbors	5.95	4.96	5.96	7.22	6.08
Rural/rural intrastate	3.52	2.90	4.47	5.27	4.22
Rural/rural between neighbors	3.54	2.72	4.35	5.37	4.64
Rural/rural between non-neighbors	4.03	3.73	4.65	5.66	4.40
Rural non-migrants	3.71	3.51	5.45	6.05	5.14

Source: FIBGE, 2000.

THEORETICAL MODEL AND MATHEMATICAL SIMULATION FOR THE SELECTIVITY OF MIGRATION

As discussed previously, migrants are not a random sample of the population. Moreover, the results above showed that the levels of formal education are context dependent. In this section, a theoretical model is proposed and some mathematical simulations are done in order to discuss this selectivity of migration, which also addresses the possibility of existence of poverty traps, as described by Kothary (2002).

The model is based in two equations. The first is a long run one and includes properties of the origin and of the destiny of the migrant. The equation indicates the feasibility of migration, similar to the one presented in the introduction: migration will occur if the net benefits of migration are positive. However, this might be considered only part of the process. The second equation of the model focuses on the transition state, an unstable situation that promotes reversibility and turnover, while migrants are not well established in their origin or destiny. By including both equations, the goal is to present a formal discussion that addresses the following questions: Which type of region attracts skilled and which one attracts non-skilled migrants? And also: For which kind of flow there is a positive and for which there is a negative selection?

The development of the first of these equations is based on the Roy model, in which local income distribution and dispersion among human capital levels is a key point to answer the above questions (Borjas 1987), as non-skilled and skilled workers migrate in order to pursue greater expected earnings (Chiquiar and Hanson 2002). Following this model, assume that wages in each region depends only on the individuals' human capital level and on specific regional parameters. The following equation exemplifies this function:

(2) $\ln(W_i) = \mu_i + \upsilon_i S$,
where i represent regions, W_i are wages, $\mu_i > 0$ are the exponential of non-skilled workers wages, $\upsilon_i > 0$ represent the returns for human capital, and $S \geq 0$ is the persons´ level of the human capital, that represent years of formal education.

While discussing the human capital model applied to migration, it was presented a simple equation **(1)**. Here, this equation is modified to include also a temporal horizon of analyses and a discount rate. Making the assumption that wages can be used as a proxy for expected benefits, the following equation is obtained:

(3) $G_{ij} = \int_0^t (W_{jt} - W_{it}) e^{-pt} dt - C_{ij} > 0$,

where G_{ij} is the net return of migration between localities **i** and **j**; W_{jt} is expected wage in **j**, which is a possible destiny of the migrant, in time **t**; W_{it} is expected wage for the person in the currently origin **i** in time **t**; ρ is the discount rate; and C_{ij} are the costs of migration between **i** and **j**.

In order to pursue a final equation including aspects of both models, equation **(2)** is rewritten as: **(4)** $W_i = e^{\mu i + \upsilon i S}$. The exponential function is approximately rewritten via Taylor expansion as a polynomial function with the same characteristics of **(4)**, such as $W \geq 0$, $dW/dS \geq 0$, $d^2W/dS^2 \geq 0$ and $d^3W/dS^3 \geq 0$:

$W_i = e^{\mu i + \upsilon i S} \approx \alpha_i + \beta_i S + \delta_i S^2 + \sigma_i S^3$,
where $\alpha_i \geq 0$, $\beta_i \geq 0$, $\delta_i \geq 0$ and $\sigma_i \geq 0$ are regional parameters.

Normally schooling opportunities are smaller in rural areas and the labor market is less diversified and sophisticated, when compared to urban ones (Haddad and Di Pierrô 1999). Hence, human capital levels tend to be smaller in the former areas than in the latter. Assume that in rural areas the level of human capital is a constant for adults: **(5)** $S_r(t) = S_0$. On the other hand, in urban areas, human capital tend to increase after migration: **(6)** $S_u(t) = S_0 + at$, where S_0 is human capital level at time of migration and $a \geq 0$.

Equation (3) also includes a cost function. The cost of migration can be written as a function of the distance between the origin and the destiny, d_{ij}, $D(d_{ij})$, and of the type of migration, k_h, $K(k_h)$, if rural/rural or rural/urban. Moreover, it is a function of the effectiveness of social networks of the potential migrant between two specific localities, $R(r_{ij})$, where r_{ij} is the proportion of individuals in the migrants' potential destiny that had as origin the same place of the migrants´ present locality of residence. The cost of migration is a multiplicative function of these functions: **(7)** $C_{ij}^h = D(d_{ij})K(k_h)R_{ij}$.

A common used equation in aggregated studies for the relation between distance and costs of migration is given by: $D(d_{ij}) = Ad_{ij}^{\alpha}$, where A and α are positive constants and $\alpha \in (0,1)$ (Bell et al 1990; Cadwallader 1992).

If the human capital that was acquired by the migrant in its´ origin can be used effectively in the destiny, the costs of migration might be smaller than otherwise. Moreover, if origin and destiny resemble physically and socially, the effect might be also this one. Consequently, it can be said that migration between localities with similarities may present lower costs. Therefore, rural/rural (r/r) migrations may have lower costs than rural/urban (r/u) ones, if all other variables are held constant. Thence, the $K(k_h)$ function take on two different values for these types of migration: $K_{r/r} < K_{r/u}$.

The existence of an effective social network may diminish decisively the costs of migration. In order to represent this, the function $R(r_{ij})$ must have the following characteristics: $R(0)=1$, $R'(r_{ij})<0$, $R''(r_{ij})>0$ and $\lim_{r_{ij}\to\infty} R = 0$. A function with these characteristics is $R(r_{ij}) = 1 - e^{-wr_{ij}}$, where r_{ij}, as cited, is the proportion of the population of **j** that had **i** as origin, **w** is the effectiveness of individuals´ links between migrants and non-migrants with the same origin.

This discussion so far included all the variables of the first part of the model. They indicate whether the returns of migration are positive or not. That is, if it is feasible in the long run. However, migration will occur if the returns are positive, and also if the individual can pay the costs of migration in the short run. This means that another feature to be examined is if the potential migrant can overcome the difficulties posed by the transition state in the short run, otherwise migration is not an option, even if in the long run the net returns are positive.

Hence, the migrant can migrate only if the differences between earned income and basic everyday costs in a short period of time t´ after migration are larger than the costs of migration. Equation (8) shows this relation:

(8) $$H = \int_0^{t'} [(W_{ij}(S) - E(S)]dt - C_{ij} > 0,$$

where E(s) are the basic everyday costs that can not be used to pay migration costs

Generally, lower income individuals have a marginal propensity to consume that is superior to higher income ones (Huggett and Ventura 2000). Consequently, daily basic everyday costs increase with human capital, but at a lower rate than income. The following polynomial has these characteristics:

$$E(S) = \phi_d + \varphi_d S_d + \theta_d S_d^{\ 2},$$
where $0 \leq \phi_d \leq \alpha_d, 0 \leq \varphi_d \leq \beta_d, 0 \leq \theta_d \leq \delta_d$,

Equations (3) to (7) represent the selectively of migration in the long run, and equations (7) and (8) denote the phenomena in the short run.

Mathematical simulations

In order to illustrate the consequences of the aspects concerning the selectivity of migration described theoretically and formally above, some simulations are presented below. The empirical analyses discuss three types of migration - intrastate, interstate between neighbors and interstate between non-neighbors, as presented in table 1. Therefore in these simulations $D(d_{ij})$ has only three values respectively A, 3/2A and 4A. These values are an approximation for the mean value of the function of the distance between the origin and the destiny of the migrant for each one of these types of migration. Given that $K_{r/r} < K_{r/u}$, it is assumed the arbitrary values of 1 and 3/2 respectively for the rural/rural and rural/urban types of migration.

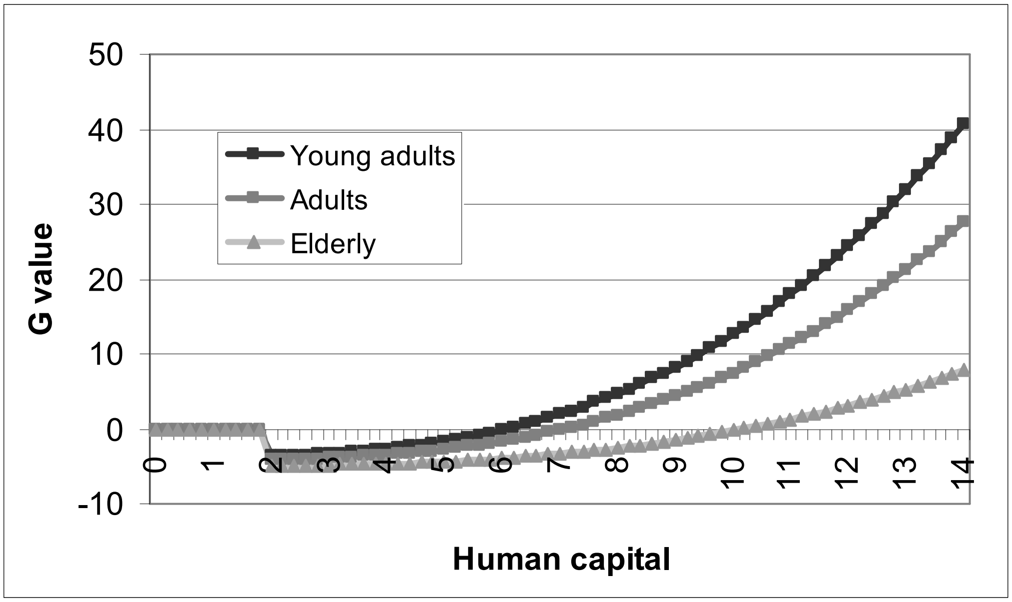
1. Rural/rural migrations

Initially, this subsection simulates the rural/rural migration with the equations presented. In particular for this type of migration, $S_d(t) = S_o(t) = S_0$, that is, the human capital does not increase after migration. The final equations for G and H are obtained by introducing these particularities in equations (3), (7) and (8) and them integrating by parts.

A benchmark simulation was set with arbitrary values. For the G equation, the chosen values were the following. The discount rate is $\rho = 0.02$. Time, t, is defined as t = 70 – age, that is approximately the time spent in the destiny after migration, assuming that the individual will be in the labor market till an age lower than 70 and will afterwards earn some income due to retirement pensions. The wage coefficients for the destiny are similar to the ones obtained for urban Brazil in 2004: $\alpha_d = 1.4$, $\beta_d = 0.1$, $\delta_d = 0.0002$ and $\sigma_d = 0.0005$. For the origin, the values are similar to rural Brazil in this same year: $\alpha_o = 1.5$, $\beta_o = 0.1$, $\delta_o = 0.0$ and $\sigma_o = 0.0$. The constants in the costs function were chosen to obtain $H > 0$ and $G > 0$ for reasonable values of human capital. These are: $A = 10$, $\omega = 1$ and $r = 1$. Regarding the short run equation, the chosen values for the constants are: $\phi_d = 1.2$, $\varphi_d = 0.05$, $\theta_d = 0$ and $t' = 12$. It must be emphasized that this constants, although based on empirical and theoretical findings, are determined only in order to give a benchmark for comparisons.

Initially, three simulations for intrastate migration are shown for different ages of potential migrants - young adults, age = 20; adults, age = 40; and elderly, age = 60 - as presented in diagram 1 with the G values. Notice that when $H < 0$, the diagram shows $G = 0$, independently of the real G value. Following the diagram, migrants can only pay the costs of migration in the short run, that is, $H \geq 0$, if their human capital, that is, the number of years of formal education, is $S \geq 2.2$. Below this value they cannot afford to migrate independently of the G value and are trapped in their origin, possibly in a state of deprivation. If $S \geq 2.2$, and consequently $H > 0$, the individual has the option to migrate or not concerning the costs of migration in the short run. Tracking the long run equation, migration will occur if G is also above 0. As can be seen in the diagram, for young adults, this happens if $S \geq 7.6$. The same is verified for adults, if $S \geq 8.0$, and for the elderly, if $S \geq 10.0$. These values can be observed in table 3 for the benchmark for the intrastate migration. This simulation is an example of positive selection. Notice that $\alpha_o > \alpha_d$, hence non-skilled earn more in the origin, and even if they could afford, they would not migrate.

Diagram 1 – Net returns of migration for rural Brazil



The results obtained in the simulation depend directly on the chosen values for the constants and should be apprehend as a point of reference. Other simulations are shown in table 3 so that the implications of the theoretical model can be better understood. The first one compares intrastate with interstate between neighbors and between non-neighbors migrations with the same constants of the benchmark. The only difference is that the K value varies, respectively K = A, K = 3A/2 and K = 4A. With the increase of distance, the costs of migration also raise and the same takes place with the needed S values. For the intrastate migration, the short-term equation will be positive for S ≥ 2.2. For the interstate between neighbors migration, the same will occur for S ≥ 4.4, and for the non-neighbors migration, for a much higher value, S = 10.2. Following these simulations, individuals with very low human capital, below S = 2.2, cannot afford to migrate at all and will be non-migrants, trapped in their origin. Persons with a relative low human capital level, between S = 2.2 and S = 10.2, can afford to migrate in the same or to a neighbor state, but cannot pay the high costs of a long distance migration. However, as is shown by the threshold of the G function, young adults with human capital level between S = 2.2 and S = 7.6 can afford to migrate, but the net returns of migration is not positive, due to the higher wage levels in the origin for the non-skilled. Only young adults with a medium level of human capital, S ≥ 7.6, roughly a complete degree of fundamental schooling in Brazil, can migrate. Only young adults that hold approximately a High School degree (S ≥ 10.4) can migrate to a distant locality. These same analyses can be done for adults and elderly. These two groups, as they have less time in the destiny to harvest the gains due to migration, might have higher levels of human capital in order to make migration a feasible process. Moreover, notice that for the elderly, the migration between non-neighbors is not a possibility, because G is negative for any value of human capital.

Table 3 – Threshold values for H and G functions – rural/rural migration in Brazil

Simulations	H > 0	H > 0 and G > 0		
		Young adults	Adults	Elderly
Benchmark				
Intrastate	≥ 2.2	≥ 7.6	≥ 8.0	≥ 10.0
Interstate between neighbors	≥ 4.4	≥ 8.2	≥ 8.8	≥ 11.2
Interstate between non-neighbors	≥ 10.2	≥ 10.4	≥ 11.4	-
Changes in *w* and *r* values				
Intrastate	≥ 0.0	≥ 6.6	≥ 6.8	≥ 7.8
Interstate between neighbors	≥ 0.0	≥ 6.8	≥ 7.2	≥ 8.6
Interstate between non-neighbors	≥ 4.4	≥ 8.2	≥ 8.8	≥ 11.2
Changes in α_d values				
Intrastate	≥ 0.0	≥ 0.0	≥ 2.6	≥ 5.8
Interstate between neighbors	≥ 0.0	≥ 3.0	≥ 4.2	≥ 7.0
Interstate between non-neighbors	≥ 2.0	≥ 6.2	≥ 7.2	≥ 10.2

Two other simulations are presented in table 3. The first one is an increase in the effectiveness of the potential migrants´ social network. If social network is more efficient in diminishing the costs of migration or if the proportion of the population in the destiny with the same origin of the individual is increased, which would be the consequences? For these simulations, the value for the product $\mathbf{wr_{ij}}$ was multiplied by four. This would represent an increase in the proportion of immigrants from the same locality, that is, the clustering of individuals with the same origin, what is empirically observed; or can correspond to a better channel of communication between origin and potential destiny, for instance, as verified for return migration. Observe that the threshold values are much lower, especially for H. If the social network is as effective as in this simulations, even persons with extremely low human capital levels can afford to migrate, at least in short distance movements, although they will not migrate due to the negative values for the G function. Notice that the elderly would migrate in this situation, even for distant steps of migration. This may partially explains what happens with return migration after retirement (Oliveira and Jannuzzi 2005), especially between regions with more effective social networks.

In the next group of simulations, the parameter that represent the wage of non-skilled workers in the destiny increased from α_d = 1.4 to α_d = 1.55, while the value for the origin continued the same, α_o = 1.5. That is, now non-skilled earn more in the potential destiny than in their origin. All other variables values did not change. Notice that this small change enables the unskilled to migrate in an intrastate migration, but not in an interstate one.

2. Rural/urban migrations

Some other features of the theoretical model are discussed for the rural/urban migration. Some modifications must be done in the simulations. The costs of migration increase because origin and destiny are no longer similar: $K_{r/u}$ = 3/2. The human capital in the destiny is now a function of time: $S_o(t) = S_0$ and $S_d(t) = S_0 + at$. The initial value for **a** is set as zero and all the constants are the same as the benchmark in order to make comparisons between rural/rural and rural/urban migrations more insightful. Comparing benchmarks in table 3 and in table 4, observe that the H and G threshold values are larger in the latter than in the former, especially for the short-term equation in the short distance migrations. This indicates that very low skilled migrants may be able to migrate between rural areas, but not to an urban center.

Table 4 – Threshold values for H and G functions – rural/urban migration in Brazil

Simulations	H > 0	H > 0 and G > 0		
		Young adults	Adults	Elderly
Benchmark				
Intrastate	≥ 4.4	≥ 8.2	≥ 8.8	≥ 11.2
Interstate between neighbors	≥ 6.8	≥ 9.0	≥ 9.8	≥ 12.6
Interstate between non-neighbors	≥ 12.6	≥ 12.6	≥ 12.8	-
Changes in **a** values				
Intrastate	≥ 3.0	≥ 3.0	≥ 6.0	≥ 10.4
Interstate between neighbors	≥ 5.2	≥ 5.2	≥ 7.2	≥ 12.2
Interstate between non-neighbors	≥ 11.2	≥ 11.2	≥ 11.2	-
Changes in saving power				
Intrastate	≥ 0.2	≥ 0.8	≥ 5.4	≥ 10.2
Interstate between neighbors	≥ 1.8	≥ 3.2	≥ 6.8	≥ 11.8
Interstate between non-neighbors	≥ 7.2	≥ 7.6	≥ 10.6	-

Table 4 shows two more groups of simulations. Firstly, what would happen if the migrant could acquire extra human capital in urban centers? In order to test this, **a** is increased to a = 0.1. That means that for each year in the urban center, the migrant increases 0.1 units of human capital. As can be seen, this enables lower skilled young adults to migrate, particularly for the short migrations, as they can increase their wage in the destiny due to their increase in human capital levels caused by formal schooling or on-the-job training. Policies that promote formal and informal training would have this impact.

In the next group of simulations, the migrants´ saving power is increased. The new values for two of the constants are from $\phi_d = 1.2$ to $\phi_d = 1.0$, and from $\varphi_d = 0.05$ to $\varphi_d = 0.0$. Besides this, there is a small increase in the rate of growth of human capital, a = 0.12, as investments in human capital become relatively cheaper. These changes would represent relaxations of budget constrains in the short run, for instance due to easier credit. They make feasible for the very low skilled to migrate in an intrastate migration for young adults.

In all the above simulations, there were positive selections. When can it be a negative one? For instance, a simulation was done with the main difference that low skilled wages are higher in the destiny than in the origin: $\alpha_d = 2.0$ and $\alpha_o = 1.5$. For the intrastate migration, due to the low costs of migration, these differences promoted only the migration of low skilled individuals in a negative selection of migrants. Notice however that this would occur only for short distance steps of migration. That is, negative selection for migration flows with higher costs associated to the process is much more unlikely.

EMPIRICAL ANALYSES

These simulations highlighted some features of the selectivity of migration. The empirical importance of regional characteristics on migration is better understood with macromodels of migration (Stillwell and Congdon 1991). Besides that, as discussed previously, poverty levels in the North and Northeast regions are much higher than in the rest of Brazil. Besides that, non-migrants and migrants had very low levels of schooling, and consequently of income, in these regions. Hence the empirical models are applied only to these two regions.

The empirical analyses are presented in three subsections. The first one presents briefly the methodology and the data. The second shows the results that were obtained with the multinomial logistic models. The third, based on these models, presents some illustrative simulations.

Methodology and data

The selectivity of the migratory process was empirically analyzed with the application of multinomial logistic micro models. The objective is to identify personal attributes that modify the individual probabilities of being a non-migrant or a migrant of different types, with particular importance given to schooling levels.

In the multinomial logistic model, the logarithm of the odds ratio can be estimated by the following equation:

(9) $$\ln(\frac{P_{ij}}{P_{ik}}) = X_i'(\beta_j - \beta_k) = X_i'\beta_j ,$$

where P_{ij} is the probability that event **j** will occur for the individual **i** (in this particular study is the probability that the person will migrate in one of the types of migration mentioned above) and P_{ik} is the probability that event **k** will happen for the same individual (here is to be a non-migrant). One basic assumption is that the probability of one possibility will not impact on the others probabilities.

As already presented, the micro data of the Brazilian Demographic Census of 2000 was used as database. The migrants with rural origin from the Northeast and North regions and rural non-migrants of these same regions were selected. Only individuals with age between 18 and 64 were included in the analyses, most of the individuals that migrate because of labor market characteristics. The multiple regressions were done separately for each region, always comparing migrants with non-migrants in the same origin.

The response variable has 7 categories. The individual can be a non-migrant or a migrant. If the person is a migrant it can be an intrastate, an interstate between neighbors or an interstate between non-neighbors migrant of two types – rural/rural or rural/urban. The non-migrant category was always the standard for comparisons. The independent variables were: age (in years), age squared, sex (1 for male and 0 for female), ethnic group (1 for White/Asian and 0 for Black/Pardo/Indigenous), civil status (1 for married and 0 otherwise) and schooling level (years of formal education). These variables were chosen because all of them impact on the probability of migration, and most of them do not change due to migration. Schooling levels may change due to migration, as proposed in the theoretical model. However, notice that the differences are small because individuals were 18 years and older and the mean time of residence after migration is only two years.

Empirical results

The results are presented separately for the Northeast and North regions in table 5. Notice that the great majority of the coefficients are significant, a few of them, that are presented bold faced, are not. The age coefficient showed negative signs for all models. This indicates that the probability of being a migrant decreases with age for young adults, as expected by the theoretical model. Additionally, given that the coefficients for age squared were positive for all models, the propensity to migrate might increase after a specific age. This is so due to life cycle aspects, such as retirement and return migration, with highly effective social nets decreasing the cost of migration.

For the North Region, the sex dummy coefficient showed a negative sign for short distance rural/urban migration, indicating that being a man decreased the probability of being a migrant of this type. Women are normally relatively more attracted to urban destinies, also owing to labor market characteristics, what partly explains this result. For longer distance rural/urban migration the coefficient was non-significant, indicating that distance presents a higher deterrence effect on women than on men. For rural/rural migration, the sex dummy was positive for the two extreme distances, indicating the predominance of males in the rural/rural migration, as men are relatively better absorbed by rural labor market, contrary to the observed for rural/urban short distance migrations.

The coefficient for the ethnic group was not significant for intrastate rural/urban migration, but was positive and increasing for longer steps of migration of this same type. This same trend was observed for rural/rural migration, indicating that Whites/Asians tend to show greater mobility in longer steps of migration when compared to Black/Pardo/Indigenous. This suggests that the α term in $D(d_{ij}) = Ad_{ij}^{\alpha}$ is not the same for different ethnic groups: larger for this last ethnic group. This might happen because they face greater uncertainties in the labor market, and information tend to be more costly for further destinies, they also have smaller wages in Brazil, even after controlling for human capital levels, and are relatively less wealthy.

For civil status, the coefficient was negative for rural/urban intrastate migration, indicating that to be married decreased the probability of being a migrant of this sort. However, notice that the coefficient increased with distance, and was positive for the other types of rural/urban migration. A partial explanation is the same as above concerning the α term. Married individuals may regard long distance migration as relatively less costly that single persons, given that social uncertainties are smaller. Note that this trend was not observed for rural/rural migration. For this type of migration all coefficients were positive and significant. This suggests that short step migration to urban areas is also promoted in order to participate in the marriage market.

In the mathematical simulations, especially due to the short run costs of migration, it was proposed that higher income groups might be relatively more capable of migrating in a long distance step. This fact was empirically analyzed by the schooling variable. Notice that all the coefficients were positive for rural/urban migration, corroborating the previous formal discussion. Moreover, for the rural/rural migration, the coefficient was negative for short distance migration, suggesting that the threshold for migration are not very large for rural/rural short migrations, also as discussed in the theoretical model.

Table 5 – Multinomial logistic model for different types of migrant in some macroregions in Brazil in 2000

North Region[c]						
	Rural/urban migration			Rural/rural migration		
Variables	Intrastate	Interstate between neighbors	Interstate between non-neighbors	Intrastate	Interstate between neighbors	Interstate between non-neighbors
Intercept	3.439	2.138	0.826	2.994	1.278	-0.310
Age	-0.363	-0.363	-0.367	-0.326	-0.318	-0.342
Age squared	0.004	0.004	0.004	0.004	0.004	0.004
Sex	-0.190	-0.106	0.033	0.089	**0.018**[a]	0.089
Ethic group	**-0.006**[a]	0.190	0.910	0.103	0.285	1.013
Civil status	-0.038	**-0.021**[a]	0.357	0.415	0.378	0.580
Schooling	0.070	0.067	0.148	-0.086	-0.073	0.012
Northeast Region[d]						
	Rural/urban migration			Rural/rural migration		
Variables	Intrastate	Interstate between neighbors	Interstate between non-neighbors	Intrastate	Interstate between neighbors	Interstate between non-neighbors
Intercept	3.416	1.776	1.539	3.250	1.504	0.371
Age	-0.357	-0.352	-0.328	-0.341	-0.337	-0.333
Age squared	0.004	0.004	0.004	0.004	0.004	0.004
Sex	-0.264	-0.165	0.022	-0.128	-0.066	0.113
Ethic group	-0.071	**0.012**[a]	0.726	-0.126	-0.151	0.403
Civil status	-0.031	0.104	0.304	0.215	0.303	0.492
Schooling	0.029	0.008	0.088	-0.134	-0.160	-0.029

a: The results bold faced are not significant at 5%. b: Non-migrant category was the base for comparison. c:: -2log(likelihood): with intercept only 828520 and final model 468886; Number of observations = 115808. d: -2log(likelihood): with intercept only 2383356 and final model 1063728; Number of observations = 857876 .

Source: FIBGE, 2000.

The table also shows the results for the Northeast Region. The coefficients for age, civil status and ethnic group were similar and with the same trends as the ones observed for the North Region, if it is noticed that the states in the Northeast Region are much smaller than in the North Region. For the sex dummy the results for both regions were the same for the rural/urban migration. However, for the rural/rural type, they were negative for short distance flows in the Northeast Region, contrary to the observed in the North Region. Namely, woman show greater mobility in this first region. The second region present positive net migration in many rural areas, many are frontier ones, which are first occupied by men, what is not observed in the first one, and this might explain the observed differences. Finally, and most importantly, the coefficients for schooling were positive for all rural/urban migration and negative for the short distance rural/rural, as observed for the North Region. Nevertheless, the coefficient for long distance rural/rural migration was also negative. Migration from the Northeast Region to the Southeast Region in Brazil was numerous in most of the twentieth century and social nets between these areas are more effective than elsewhere, what explains partially this result.

Illustrative simulations

In order to illustrate the implications of the results discussed in these multinomial models, some simulations are presented below with the coefficients of the Northeast Region, the one with the lowest levels of formal education.

Equation (9) was used to estimate the probabilities of occurrence of the 7 possibilities that were analyzed in the above equations. The βs are the ones presented in table 5. The vector X_i was arbitrary chosen for 4 specific types of individuals, as in details below table 6. Notice that the question being answered here is: if the migrant has the following characteristics, which are the probabilities for the seven possibilities discussed.

The first simulation was done for a typical migrant in the Northeast Region: a non-White/Asian bachelor woman with 24 years old and with two years of formal education. Notice that most individuals with these characteristics would be non-migrants (85.8%). Among the migrants, 14.2%, less than half would be of the rural/rural type (5.99%), as the majority would have an urban destiny (8.20%). A large majority would be intrastate rural/urban or rural/rural, around 10%.

The second simulation was done for a Non-White/Asian married woman with 30 years old with two years of formal education. That is, the difference from the first one is that the woman is older and got married. The differences were quite large from the above simulation, indicating the lower mobility mostly due to the increase in age. The probability of migration decreased to 8.2%, approximately half of the migrants would have a rural destiny, 3.9%, and also as above, most would be an intrastate migrant, 5.3%.

A third simulation was done with just one modification that was the sex. The probability of being a migrant decreased slightly, from 8.2 to 7.3%, demonstrating the greater mobility of married women when compared to married men in Northeast Brazil, especially for the short distance rural/urban migration. In the fourth simulation, the age was increased from 30 to 50 and schooling was decreased from 2 to 1. This modification in educational level is expected in the real world as older generations have lower levels of schooling. As can be seen, the probability of being a migrant is very low, around 5%, most of them rural/rural and short distance ones, suggesting, as discussed in the mathematical simulations, that most individuals from older generation do not afford to migrate in longer steps to urban areas, at least before retirement.

Table 6 – Fictitious simulations for Northeast Region in Brazil in 2000

	Simulations and probabilities (%)			
Possibility	a	b	c	d
Rural/rural intrastate migrant	4.73	2.96	2.63	2.31
Rural/rural interstate between neighbors migrant	0.86	0.60	0.57	0.57
Rural/rural interstate between non-neighbors migrant	0.40	0.34	0.39	0.33
Rural destiny	**5.99**	**3.9**	**3.59**	**3.21**
Rural/urban intrastate migrant	5.27	2.35	1.82	0.84
Rural/urban interstate between neighbors migrant	1.11	0.58	0.50	0.26
Rural/urban interstate between non-neighbors migrant	1.82	1.35	1.39	1.02
Urban destiny	**8.2**	**4.28**	**3.71**	**2.12**
Migrant	**14.2**	**8.19**	**7.30**	**5.32**
Non-migrant	**85.8**	**91.8**	**92.7**	**94.7**

a – Non-White/Asian bachelor woman, 24 years old, with two years of formal education
b – Non-White/Asian married woman, 30 years old, with two years of formal education
c – Non-White/Asian married man, 30 years old, with two years of formal education
d – Non-White/Asian married man, 50 years old, with one year of formal education
Source: FIBGE, 2000.

CONCLUSIONS

The main objective of this paper was to discuss the selectivity of migration in Brazil and to make associations between this phenomenon and rural poverty and the possibility of existence of poverty traps. In order to do so, it was proposed a theoretical model, which was based on the Roy and the human capital models, with a long-term and also a short-term equation. The features discussed were the influence of human capital levels, distance of migration, migration type, regional wage heterogeneity for low-skilled and high skilled workers, social networks, age and saving power. Mathematical simulations indicated that migration might show a positive selection, mainly due to the short-term costs, especially long distance and rural/urban flows

It was verified empirically some of the aspects of the selectivity of migration in multinomial logistic models, most of them corroborated the theoretical findings. It was observed a general tendency of negative selection in rural/rural flows and a positive one in rural/urban and longer steps of migration. This suggests that rural/rural migration costs are much lower that a similar rural/urban step for similar distances. This might happen by different aspects discussed theoretically in the model, such as greater similarities between origins´ and destiny's. In addition, everyday costs in rural area tend to be smaller and the short term deterrence for migration might be less decisive, especially for non-skilled individuals. Likewise, there may be some interactions between type of migration and distance, as perceived distance may differ from real distance and be relatively smaller for rural/rural migration (Bell et al 1990; Cadwallader 1992). Another aspects that may explain empirical findings is that individuals in rural areas may also have stronger social bonds with persons in their origin than migrants in urban areas.

Two among the five Brazilian macroregions concentrate most of the very low-income migrant flows in Brazil, the North and Northeast ones, particularly the short distance migration with destiny in rural areas (Marques and Golgher 2007). As discussed theoretically and empirically, most low-income individuals are able to migrate, but only in short steps or low cost migration between rural areas.

In the North Region there are many rural areas with positive net migration. As showed here, the short distance rural/rural migrants present very low mean levels of schooling. They migrate from one locality to a similar close one, maybe with real chances of improving their economical situation, but with remarkable impact on deforestation of native vegetation (Laurence et al 2001).

For the Northeast, at least till 2000, most areas had negative net migration. As was observed in the theoretical and empirical models and simulations, low-income individuals show a lower propensity to migrate in long distance steps or rural/urban migration. Hence, the positive selection that may occur in areas with negative net migration might promote a vicious circle of negative feedback for economic and population regional aspects. Regional inequality may increase with this process, if positive aspects of emigration, such as remittances or knowledge transference, are not significant (De Haan 1999).

As proposed by De Haan (1999), most studies that analyzed rural and agricultural regional development did not give an appropriate importance to migration. Human mobility is much more common than normally assumed by the notion that population is essentially sedentary and would migrate only because of economical or environmental shocks. However, as was shown by Ghobadi et al (2005), migration is generally not an ex-post response to risks and shocks, but an ex-ante strategy of income and risks diversification, essential for the rural household. Therefore, given the importance of migration for rural population, policies that promote mobility or, that increase the positive effects of migration, should be encouraged. Policies that diminish the costs of migration would have a positive impact on the range of possibilities for the low-income population strata. For instance, policies that: improve channels for information exchange;

facilitate the absorption of the migrant in the destiny; minimize environmental damages; increase the effectiveness of the use of remittances for local development, etc (De Haan 1999), are some of them.

REFERENCES

Barros, Ricardo; Henriques, Ricardo and Mendonça, Rosana (2000), "A estabilidade inaceitável: desigualdade e pobreza no Brasil" in R. Henriques (ed). *Desigualdade e Pobreza no Brasil*. Rio de Janeiro: IPEA, pp. 21-47.

Bell, Paul; Fisher, Jeffery Baum, Andrew and Greene, Thomas (1990) *Environmental psychology,* Forth worth: Harcourt Brace Jovanovich College Publisher.

Borjas, George (1987) Self-selection and the earnings of immigrants, America Economic Review Vol. 77, No. 4, pp. 531-553.

________ (1996) *Labor Economics,* New York: The McGraw-Hill Companies, Inc.

Cadwaller, Martin (1992) *Migration and residential mobility: macro and micro approaches,* Madison: The University of Wisconsin Press.

Carvalho, José and Machado, Cláudio (1992), Quesitos sobre migrações no Censo Demográfico de 1991, Rev. Bras. Estudos Pop.. Vol. 9, No. 1, pp. 22-34.

Castiglioni, Aurélia (1989) *Migration, urbanisation et développement: le cas de l,Espírito Santo – Brésil,* Pouvan: Ciaco Editeur.

Chiquiar, Daniel and Hanson, Gordon (2002), International migration self-selection, and the distribution of wages: evidence from México and the United States, http://www.nber.org/papers/w9242.

De Haan, Arjan (1999), Livelihoods and poverty: the role of migration – a critical review of the migration literature, The Journal of Development Studies, Vol. 36, No. 2, pp. 1-47.

Ferreira, Francisco; Lanjouw, Peter and Neri. Marcelo (2000), A new poverty profile for Brazil using PPV, PNAD and Census Data, < http://www.anpec.org.br/encontro2001/artigos/200106356.pdf>.

FIBGE (2000) *Censo Demográfico do Brasil de 2000,* Rio de Janeiro: FIBGE.

Ghobadi, Negar, Koettl, Johannes and Vakis, Renos (2005), Moving out of poverty: migration insights from rural Afghanistan., <http://www.mrrd.gov.af/vau/N-tree/NRVA%202003%20-%20Moving%20out%20of%20poverty-migration%20insights%20from%20Afghanistan%20Jan%2005.pdf>

Greenwood, Michael (1985), Human Migration: Theory, Models, and Empirical Studies, Journal of Regional Science, Vol. 25, No. 4, pp. 521-544.

Haurin, Donald and Haurin, Jean, (1991), Youth migration in the United States: analysis of a deindustrializing region. in Stillwell and Congdon (ed) *Migration models: macro and micro approaches*. London and New York, Belhaven Press, pp. 168-186.

Haddad, Sergio and Di Pierrô, Maria (1999), Satisfação das necessidades básicas de aprendizagem de jovens e adultos no Brasil: contribuições para uma avaliação da década da Educação para Todos, <_www.cefetrn.br/unedzn/images/stories/ensino/satisf~1.doc>

Hoffmann, Rodolfo (2000), Mensuração da desigualdade e da pobreza no Brasil. in R. Henriques (ed). *Desigualdade e Pobreza no Brasil*. Rio de Janeiro: IPEA, pp. 81-107.

Huggett, Mark and Ventura, Gustavo (2000), Understanding why high income households save more than low income households, Journal of Monetary Economics, Vol. 45, No. 2, pp. 361-397.

IBRE/FGV (2005), *Miséria em queda: mensuração, monitoramento e metas,* Rio de Janeiro: Centro de Políticas Públicas do IBRE/FGV.

Kothari, Uma (2002), Migration and Chronic Poverty, < www.chronicpoverty.org/pdfs/16Kothari.pdf>.

Laurance, Willian; Cochrane, Mark; Bergen, Scott; Fearnside, Philip; Delamônica, Patricia; Barber, Christopher, D'Angelo, Sammya and Fernandes, Tito (2001), The Future of the Brazilian Amazon, Science, Vol. 291, No. 5503, pp. 438-439.

Marques, Denise and Golgher, André (2007), Migration diversity in Brazil: where are the poor people?, <http://www.abep.org.br/usuario/GerenciaNavegacao.php?caderno_id=562&nivel=4> .

Massey, Douglas; Arango, Joaquim; Hugo, Graeme; Koraoua, Ali; Pellegrino, Adela and Taylor, Edward (1998) *Worlds in motion: understanding international migration at the end of the millennium,* Oxford: Clarendon Press.

Oliveira, Kleber and Jannuzzi. Paulo (2005), Motivos de migração no Brasil e retorno ao Nordeste: padrões etários, por sexo e origem/destino, <http://www.seade.gov.br/produtos/spp/v19n04/v19n04_09.pdf> .

Rigotti, Irineu. and Carvalho, José (1998), As migrações na grande região centro-leste. in Encontro Nacional sobre Migração. Curitiba: Anais..IPARDS/FNUAP, pp. 67-90.

Todaro, Michael (1980), Internal migration in developing countries: a survey, in R. Easterlin (ed) Population and economic change in developing countries. Chicago: University of Chicago Press for National Bureau of Economic Research, pp 361-390.

Sandefur, Gary; Tuma, Nancy and Kephart, George (1991), Race, local labor markets, and migration, 1975-1983, in Stillwell and Congdon (ed) Migration models: macro and micro approaches. London and New York, Belhaven Press.

Stillwell, John and Congdon, Peter (1991), Migration modeling: concepts and contents, in Stillwell and Congdon (ed) Migration models: macro and micro approaches. London and New York, Belhaven Press, pp. 34-56.

Waddington, Hugh and Sabates-Wheeler, Racuel (2003), How does poverty affect migration choice? A review of literature, www.migrationdrc.org/publications/working_papers/WP-T3.pdf.