Migration, Urbanization and Deforestation in the Ecuadorian Amazon: The Second Generation

(THIS IS A DRAFT, FOR COMMENTS; A MORE SUCCINCT EDITED VERSION WILL BE PROVIDED IF IT IS ACCEPTED FOR PRESENTATION AT THE 2005 PAA CONFERENCE)

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Abstract. Since the 1970s, migration to the Amazon has led to rapid population growth and land clearing. Over time, a second phenomenon has emerged–urbanization. This paper uses longitudinal household survey data on migrant settler colonists in the Northern Ecuadorian Amazon, from 1990 and 1999, to analyze what happens to the second generation. A multinomial discrete-time hazard model is used to estimate the determinants of out-migration to urban vs. rural areas, and addresses key questions: Do the children of the migrant settlers stay on the farm or move out as they reach adulthood? Do they extend the frontier by moving to rural destinations, feed the growth of local towns/cities, or move back to origin areas? The results show important differentials between migrants and non-migrants and among types of migrants in personal characteristics, human capital, landholdings, lifecycle, access to community infrastructure, and networks. The paper concludes with policy implications.

Keywords. Ecuadorian Amazon; rural-urban migration; rural-rural migration; agricultural colonization; development policies in frontier areas

Introduction

The Ecuadorian Amazon, a region also known as "Oriente", is one of the richest reserves of biodiversity in the world (Myers 2000), and has faced one of the highest rates of deforestation of any Amazonian nation, with huge losses of biodiversity and natural resources (FAO 2001). Most of this forest elimination has been caused by agricultural colonization that followed the discovery of oil fields in 1967. In addition to deforestation on original farms, population surpluses in traditional frontier areas have fostered out-migration to unoccupied areas within

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the Ecuadorian Amazon", leading to further deforestation and losses of biodiversity. Thus, a "vicious cycle" is created: pressure over available land leads to deforestation within and adjacent to farms, thereby reducing the possibilities for further agricultural extensification (deforestation); out-migration follows, particularly to other rural, forested areas in the Amazon where continuing population growth and pressures in new settled lands, spurs further out-migration to rural destinations and unabated deforestation (Barbieri and Carr 2003).

Increasing Amazonian urbanization during the 1990s also led to new patterns of population mobility within the Amazon, as well as to changes in the traditional ways by which rural settlers make their living. Rural-urban mobility fostered growth first among long-settled river towns, but also led to the emergence of "pioneer" urban areas, the transformation of rural communities (which acquired urban characteristics), and an increasing economic and social articulation between rural communities and local towns. These processes constitute the emerging complex network of urban places in the Amazon. Rural-urban migration has increased pressures on public facilities and services in local towns and, given the selective nature of migration with the more educated and younger individuals among the most mobile, rural production systems have suffered a loss of educated labor (Bilsborrow, Oberai and Standing 1984).

This paper analyzes key factors determining recent out-migration from rural areas in the Ecuadorian Amazon, and how they affect decisions to move intra-regionally to rural or urban areas within the "Oriente". Population mobility is regarded as one of the most important catalysts of regional change (White 1980; Bilsborrow 1998). It implies important demographic and economic consequences for movers and their farm households, as well as changes in communities of origin and destination. However, while very significant in its

effects on deforestation, urbanization and regional development, population mobility within the Amazon has scarcely been studied. In particular, prevailing theories and empirical applications have focused on factors at a specific scale of analysis, especially the macro-level involving large administrative units such as provinces, regions or states (Axinn and Barber 2003), with many fewer including cogently effects of multiple scales of analysis. Empirical studies on migration have privileged cross-sectional data instead of studies based on longitudinal data (Massey 1990; Marquette and Bilsborrow 1999), and have also neglected that farm households in frontier areas are the ultimate agents of out-migration decisions (Bilsborrow *et al.* 1987; Findley 1987; Marquette and Bilsborrow 1999; Wood 2002). Furthermore, few studies have focused on second generation settler demographic dynamics (Walker *et al.* 2002); out-migration is a key demographic factor in this case, for example, when sons, daughters, grandsons or granddaughters of pioneer settlers reach the early adult stage in the life cycle (when they marry and face increasingly scarce farmland or on-farm employment restrictions), and migration becomes a likely outcome. One of the few exceptions in empirical studies is Laurian *et al* (1998), but these authors rely on cross-sectional evidences and statistical approaches which do not deal with the multi-scalar nature of factors influencing out-migration of second generation frontier colonists.

This paper addresses these issues, providing a longitudinal and multi-scalar approach to understand determinants of out-migration of second generation frontier colonists from the Ecuadorian Amazon. The paper is organized as follows. The background to the study includes the next section, which discusses the major factors determining rural out-migration in developing countries, as suggested by the empirical literature on migration, and the third section which briefly describes the study area in the Northern Ecuadorian Amazon. The fourth section discusses the data and the statistical procedure to assess the effects of major determinants of out-migration of second generation frontier colonists to rural and urban areas

in the Ecuadorian Amazon, followed, in the fifth section, by the presentation of descriptive and analytical results. The paper concludes with a synthesis of major findings and a discussion of implications for future research and for policy interventions.

Background and Hypotheses

Three interrelated sets of factors affecting rural livelihoods have influenced recent population redistribution in the Ecuadorian Amazon frontier, and, therefore, people's perspectives on whether they should remain at home or migrate from farm households. Each set of factors builds upon predominant theories on rural out-migration and, especially, how do they relate to frontier areas in Latin America, but not necessarily on the understudied mobility of second generation colonists.

First, demographic changes related to personal attributes and household life cycle factors are likely to increase pressures for out-migration among second generation colonists. "Household Life Cycle" approaches, which are based on early formulations of Chayanov's peasant cycle (Thorner, Kerblay and Smith 1986; Ellis 1988), and which are adapted by many authors to the Amazonian context (e.g., Walker and Homma 1996; Marquette 1998; McCraken *et al* 2002; Perz 2001, Walker *et al* 2002; Moran, Siqueira and Brondizio 2003), focus on the effects of changes over time in household size and composition, and patterns of land use. Demographic changes are measured by the relationship between the "consumer-producer ratio", or the relation between the number of consumers (children and the elder) and producers (adults and working children or adolescents) living in the farm household. Number of adults and working-age adolescents and children can reflect labor productivity on the farm. The more young children (non-productive members), the smaller the returns to labor, resulting in greater pressures for out-migration; and consequently, the effect of number of adults can be positive or negative, depending of the amount of farm land available. A small

amount of land can generate decreasing returns to labor, given population growth and constant productivity, thus favoring out-migration. On the other hand, a large availability of land per capita can accommodate pressures for out-migration from the farm household, and allows returns to labor to increase until an optimal point.

The basic argument in the Household Life Cycle approach is that changes in household size and composition ultimately determine the form of land use. Consequently, households experience demographic and land use processes that affect mobility decisions and therefore the supply of household labor. During periods of low labor availability (for example when couples have young children or when adult sons or daughters marry and move), households usually adopt agricultural practices more suitable to the availability of labor, such as annual crops to keep a regular cash flow (Moran *et al* 2003). After the accumulation of some capital, and in periods of higher availability of labor (e.g., presence of teenage children or young adults), households can shift from annual crops to pasture and cash crops. At this stage, household members can also out-migrate due to labor opportunities elsewhere and, through remittances, to invest in the original farmland, often in cattle or perennials. Alternatively, they may out-migrate in order to constitute a new household in the event of a marriage, or following farmland degradation. In latter lifecycle stages, with a new generation assuming most farm activities, the process is repeated but with initial farming conditions established by former generations, characterized by land and forest scarcity, farm fragmentation, and a higher percentage of land in pasture or permanent crops (McCraken *et al* 2002; Moran *et al*. 2003).

Some key personal attributes reinforce the effects of household life cycle on rural out-migration, such as the human capital endowments of the farm household (e.g., education level, employment background). "Human Capital" approaches have focused on individual (microeconomic) decision-making as a rational process of income maximization based on the

comparison of the utility or personal satisfaction of staying or moving to another place (Milne 1991). Differences in individual processes in comparing relative place utility are ultimately explained as well by factors such as age, sex, education and occupational background (Sjaastad 1962; Vanderkamp 1971; DeJong and Fawcett 1981; Da Vanzo 1981; Milne 1991). Bilsborrow (1998), for example, discusses education as an indicator of human capital and on potential earnings, and as a way to influence attitudes, aspirations and access to information, which ultimately have a positive effect on decisions to migrate to urban or rural areas. Some factors are likely to play an important role in selecting migrants from the household; for example, farm households adopting out-migration as a strategy of risk diversification are likely to allocate individuals with previous employment experience or better education, since their expected returns (and thus expected remittances) are higher.

Previous work on the study area in the Northern Ecuadorian Amazon also suggests the importance of other personal characteristics on out-migration, especially age and the gender differences between migrants, with young women being more likely to leave their parent's households and to choose urban destinations more than young men (Laurian, Bilsborrow and Murphy 1998). Barbieri and Carr (2003) show that out-migration to other rural areas in the Amazon, especially pristine areas, is considerably greater than out-migration to the growing, but still incipient, Amazonian urban areas. Furthermore, men are more likely to out-migrate to rural areas than women, while the reverse occurs for urban areas.

A second set of factors refers to socio-economic and structural elements which affects individual and farm household perceptions about “costs and benefits” of out-migrating. The decreased sustainability of farming and pressure over resources due to high population growth, and increasing limitations to land extensification and intensification, generate a demand for land that exceeds the limited supply in the occupied lands of frontier regions

(Brondizio *et al* 2002; Barbieri *et al*, 2003). Rural households use temporary or permanent out-migration of one or more family members as a way of earning cash income and diversifying risk, a strategy which helps alleviate dependence on dwindling forest resources (Laurian *et al*. 1998). Supporting this argument, the "New Economics of Labor Migration" (NELM) (Stark and Bloom 1985; Katz and Stark 1986; Stark and Lucas 1988; Stark and Taylor 1989, 1991) suggests that mobility decisions should be taken into account in the context of imperfect market functioning, as a way to accumulate resources for farm investments and overcome imperfect credit markets, or minimize risks to the household subsistence. The NELM also represents a change from an individual approach (of neoclassical economics inspiration) on the modeling of migration, to the household as the main *locus* of migration decisions. Migration in this case constitutes one of a number of options of a household unit that allows it to control risks for the welfare of the whole household unit (Keely 2000).

The key factor "triggering" the adoption of household strategies to diversify risk is the perception, by household members, of changes in their living standards. Bilsborrow (1987) argues that perceived changes in living standards make farm household members choose a response from a "portfolio" of options which can include a mix of land intensification, land extensification and out-migration of one or more household members, and, in more extreme circumstances, fertility regulation. The adoption of mobility as a response is most likely to occur when labor mobility in developing countries is facilitated by transformations in the agrarian society due to the introduction of capitalist forms of production and commercialization which expand the demand for seasonal farm labor (e.g., larger farms employing agricultural labor during seasonal coffee harvests), or for labor in urban areas (such as construction services or domestic work) and in extractive activities (such as the oil

industry in the Ecuadorian Amazon). These processes are facilitated by the large supply of labor in rural areas present in many developing countries.

Perception about changes in living standards and "costs and benefits" of out-migration should involve not only factors associated with farm households, but also with the broader context of the community where the farm household is located. Community infrastructure is a key factor in this regard; for example, education and health resources are likely to provide better living conditions and influence the sense of relative deprivation, thus reducing pressures for population mobility. On the other hand, better educational resources can have the opposite effect of stimulating out-migration, if it is associated with an improved capacity to assimilate information about opportunities elsewhere as well as to shape individual aspirations in terms of welfare and income.

"Migrant networks" are also an important socio-structural element influencing migration decisions, and are defined by Massey (1990:7) as "sets of interpersonal ties that link migrants, former migrants, and non-migrants in origin and destination areas by ties of kinship, friendship, and shared community origin; having friends, relatives, or other members of one's personal community at a destination dramatically increases the probability of migrating there". Migrant networks act as a social structure to facilitate and reduce the costs of migration, incurred in transportation, labor searches, and psychological stresses from leaving family and community (Bilsborrow *et al.* 1984). The number of previous migrants in the community is likely to have a significant effect on further out-migration, due to their effect on individual and household aspirations relative to welfare and income.

Third, policies fostering the opening of roads and improved transportation accessibility in frontier areas have historically reduced physical and socioeconomic barriers to migration into or within rural and urban areas in the Amazon (Burt *et al* 1960; Moran 1983; Rudel 1983; Schmink and Wood 1984; Southgate, Sierra and Brown 1991; Pichón

1996; Nelson and Hellerstein 1997; Rudel and Roper 1997). Understanding how spatial factors, especially physical barriers and distance, affect motivations to migrate has been a widely debated issue among migration theoreticians. Ravenstein (1889) and Lee (1966), for example, conceptualized migration as a process driven by income differentials, and conditioned by factors such as costs of movement (a function of distance), and physical barriers to moving. Road accessibility in frontier areas allows the expansion of consumer markets for agricultural and other types of products, and facilitates the mobility of labor within and outside the region, as well as the communication and travel of migrants and their relatives.

In particular, improvements in transportation networks in the Ecuadorian Amazon reflect strategies among oil companies to expand their production in the region rather than policies directly related to agricultural regional planning. There is also a connection between transportation accessibility and urbanization in long-settled areas, which in turn shapes the rural-urban migration behavior of second-generation settler colonists. For instance, Von Thunen (Hall 1996; see also Walker and Homma 1996) suggests that the expansion of the agricultural frontier and out-migration to new agricultural areas will depend both on the growth of an urban nucleus where agricultural products are consumed, and the extension of the road network.

A limitation in most of the approaches mentioned above is how to address the fact that migration decisions are usually constrained by the degree of accessibility to information and perceptions about opportunities in places of origin and destination. This limitation is particularly relevant for approaches of neoclassical economics orientation. Lee (1966), in a classical treatment of population mobility, and building upon Ravenstein's theory, discussed "pull" and "push" factors as influencing migration decisions based on personal evaluations of economic, social or environmental factors present in the place of origin that encourage people

to move (push), or at the destination, which attract people (pull). A key issue here is the assumption of migration flows in a context of perfect information, and as a response to wage differentials and unequal distribution of production factors (labor and capital) between distinct regions. However, factors such as low levels of education and poor access to communication and transportation resources hamper interaction with the outside world, and create inefficiencies in migrant networks or other mechanisms through which potential gains in migration are communicated. Thus, following Stillwell and Congdon (1991), mobility decisions can be treated as a two-stage process in which decisions are based primarily on push factors (factors at origin) and secondly, at a later stage, on the choice for a destination. Given the relative isolation of frontier areas such as the Northern Ecuadorian Amazon - and therefore the high degree of inefficiencies in migrant communication networks - and the fact that most out-migration is internal (i.e., within the study area), push factors should play a particularly important role in migrant decisions.

Study Area

The Ecuadorian Amazon is located in the western Amazon Rain Forest, and together with the Coastal region and the Highlands ("Sierra") represents three distinct landscapes in the country. The study area is located in the Northern Ecuadorian Amazon (Figure 1).

FIGURE 1 HERE

The occupation of the study area was initiated by agricultural settler families after the discovery of oil in 1967, which was followed by the laying of pipelines and an adjacent road network, and by the establishment of the town of Lago Agrio. Virtually all colonization in the Ecuadorian Amazon has been spontaneous, facilitated by the initial opening of roads by petro-dollars. From the mid-1970's to the present, oil exploited in the Ecuadorian Amazon has been responsible for half or more of both foreign exchange earnings and government

revenues in Ecuador. Despite being extensively occupied by agricultural settlers, the region still attracts migrants from other parts of Ecuador, especially the Sierra. For ultimate drivers, however, one has to examine what it is that leads the large numbers of spontaneous migrants to leave their places of origin. Though this has not been quantitatively demonstrated, it seems likely that the lack of land and rural poverty, linked directly to the extreme concentration of landholdings in the Sierra, must be major factors in impelling out-migration.

As a consequence of colonization and oil extraction activities, the Northern Amazon has experienced high rates of deforestation, with forest cover on sample farms falling from virtually 100% in the early 1960s, to 59% by 1990 and further to 45% in 1999. There are now four main towns in the study area: Lago Agrio (the largest, with 34,000 people, according to the 2001 Ecuadorian census), Coca, Joya, and Sushufindi. The total population in the Ecuadorian Amazon in 1990 was 384,582 - 4% of the Ecuadorian population (INEC 1992). The population in 2001 was about 550,000 - 5% of the Ecuadorian population, following 30% growth over 1990-1999 vs. 22% nationally (INEC 2001). These numbers are explained by a) the effects of different fertility rates in the Amazon compared to the rest of the county - while mortality rates have decreased in recent years in the country, the Total Fertility Rate (TFR) in the Amazon was 5.5 in 2000, relative to 3.4 for the entire country (CEPAR 2000); and b) continuing out-migration from the Sierra and Coast (and, in the late 1990s, refugee migration from Colombia).

Data and Methods

A representative probability sample of farms was selected in 1990 to implement a household survey on population and land use of colonist families – a 5.9% sample of the rural population of the Northern Ecuadorian Amazon[1]. This study area, comprising the

municipalities of Lago Agrio, Coca, Joya and Shushufindi, was the locus of dramatic colonization by spontaneous migrants settling along roads initially built by oil companies to extract oil for export. In 1999, a follow-up survey was conducted and the same plots of land were visited, with the identification of 249 farm households in which the household's head or his spouse was the same in both years. A total 1,782 individuals were living in the farm households in 1990, and 308 were born after the 1990 survey and before the 1999 survey. Thus, there are 2,090 individuals living at any point during the 1990s, a number including those who were born, died, or out-migrated during the decade.

A survey taken in 2000 (with retrospective information for the 1990s) provides information at the community-level for 42 rural communities in the sample region. A farm household is inserted in a specific community if the Euclidean distance between the farm household and a central point in the community (e.g., a communitarian center or school) is the shortest one, compared to other communities in the sample region. The community survey provides key information on physical accessibility to nearby towns (road distance and road improvements) and longitudinal information on community infrastructure (e.g., year in which a school or health facility was present in the region).

Two types of longitudinal models are used. First, a discrete-time binomial hazard model measures determinant of out-migration for person-years, that is, individuals living in a farm household between 1990 and 1999. Each individual living in the household in 1990 being at risk of out-migration until he or she moves or dies:

$$\log\left(\pi_{\mathrm{it}}\right) = \alpha_t + \beta_A \mathrm{X}_{\mathrm{i}} + \beta_B \mathrm{X}_{\mathrm{it}} \qquad (1)$$

where $\pi_{it} = \frac{p_{it}}{1 - p_{it}}$ represents the probability that an individual i will out-migrate at time t (t=1990,…,1999). The baseline hazard, α_t, estimates the effect of time on the odds of out-

The 1990 survey was conducted by Francisco Pichón and Richard Bilsborrow (who also conducted a follow-up survey in 1999), from The University of North Carolina at Chapel Hill.

migrating. X_i is a matrix of time-invariant covariates, and X_{it} is a matrix of time-varying covariates. β_A and β_B represent, respectively, a matrix of vectors of the average effect of X_i and X_{it} on the log-odds of out-migration between 1990 and 1999.

"Out-migrants" are those individuals between 12 and 59 years old who left permanently the usual place of residence in a farm household to live elsewhere at a given year between 1990 and the interview date in 1999. The definition privileges, thus, permanent change of residence. For example, if an individual was 11 years old in 1993, he will be not included as an observation from 1990 to 1993, but will be included for the remaining years (1994-1999, considering he will survive for this entire period), when he or she was 12 and older. This assures out-migration analysis to focus on those individuals of sufficient age to out-migrate due to labor opportunities elsewhere or to pursue educational opportunities (and not *only* to follow parent's mobility), and below an age in which migration ceases due to factors declining health, and less access to employment opportunities.

A modification in Equation 1 allows the estimation of a discrete-time multinomial hazard model of out-migration, which measures alternative out-migration destinations (that is, if an out-migrant chooses a rural or urban destination, or chooses not to move):

$$\log\left(\frac{\pi_{\text{rit}}}{\pi_{\text{sit}}}\right) = \alpha_{rt} + \beta_{rA}\text{X}_{\text{ri}} + \beta_{rB}\text{X}_{\text{rit}} \qquad (2)$$

where $\log\left(\frac{\pi_{\text{rit}}}{\pi_{\text{sit}}}\right)$ represents the log-odds of having an event of type r (r = 1 representing out-migration to a rural area, and r = 2 representing out-migration to an urban area), rather than an event of type s, the reference category (s = r = 0, the decision of not moving). The effects of the percent change in one unit of covariates X_i or X_{it} on the odds of out-migration can be estimated using the odds ratio, e^{β}, in the equation

$$\% \text{ change} = 100 \times \left(e^{\beta} - 1\right) \qquad (3)$$

Given the clustered nature of the multi-scale data, with individuals within the same farm household and community being more homogeneous regarding the covariates, the assumption of independence of observations is likely to be violated, which could lead to underestimated standard deviations and thus inefficient parameter estimates. In order to avoid this problem and correct for the clustered nature of the data, the binomial and multinomial models are estimated using Huber-White robust standard deviations, also known as "sandwich estimators" (Hox 2002):

$$V_R(\hat{\beta}) = H^{-1} C H^{-1} \qquad (4)$$

with $\mathbf{V}_R$ representing the robust covariance matrix of the regression coefficients; **C,** the correction matrix, is "sandwiched" between the inverse of the Hessian matrix, $\mathbf{H}^{-1}$ (Hox 2002). The Hessian matrix, **H,** provides second-order partial derivatives of the log-likelihood function described in Equations 1 and 2.

Results

Motivations to Out-migrate

Table 1 show the number and percentage of permanent out-migrants between 1990 and 1999, according to place of destination. Two population subgroups are considered: all individuals in the sample, and individuals between ages of 12 and 59 (the group used in the modeling strategy). In the first group, most of the 481 out-migrants choose rural destinations (66%), while 34% choose urban destinations. These proportions are similar for the 351 out-migrants between ages 12 and 59 (68% choose rural areas, and 32% choose urban areas)[2].

[2] 21% of the 351 out-migrants between 12 and 59 years old move to areas outside the Amazon (mostly to the Sierra and Coastal areas of Ecuador, including a handful of international migrants), and 79% move within the Amazon.

TABLE 1 HERE

Table 2 presents the main reasons to out-migrate from the rural areas in the Ecuadorian Amazon and choose a rural or urban destination. It also shows how these reasons are related to particular age groups, and men and women. While "accompany spouse or relative" is, overall, the main reason to move to other rural areas compared to "looking for employment" (41% versus 35% of out-migrants), the difference is practically null for those choosing urban destinations (37% versus 38%). Rural areas in the Ecuadorian Amazon usually offer fewer employment opportunities, and out-migration is usually related to new settlements involving mobility of more than one family member (e.g., a married son with small children living in his parent's household acquire a plot of land and moves with his family). In fact, previous literature on gendered migration (see, e.g. , Radcliffe 1991; Chant 1992; Chant and Radcliffe 1992; Laurian *et al*, 1998; Barbieri and Carr, 2003) have discussed traditional gender roles in which women, especially at younger ages, are more easily released from farm work compared to men. Female out-migrants below 19 years of age, who leave the rural household to accompany the spouse or relative, predominate for both rural and urban destinations (about 19%, compared to about 6% men), and to a smaller extent, for rural-rural female out-migrants between 20-34 years of age (about 9%, compared to 5% men).

Most out-migration for employment reasons occurs among men below 20 years of age, followed by 20 and 34 years of age. While most of the women below 20 years of age migrate to accompany a relative or spouse, most of the women between 20 and 34 or below 20 years of age move to an urban area for employment reasons. Overall, 13% of women choose an urban destination for employment reasons, against 9% for rural destinations. Women are more likely than me to move to pursue educational opportunities, combining both destinations: 10% (7% for women below 20 years of age) versus 3% for men.

TABLE 2 HERE

Determinants of Out-migration: Descriptive Results

Table 3 presents descriptive statistics of independent variables used in the models of out-migration by status (rural, urban or no out-migrants). It considers only individuals between 12 and 59 years of age, but aggregate demographic measures for the farm household and community (number of children and adults, number of previous out-migrants) considers all individuals who live or lived in the farm household or community in a given year, irrespective of age. Means and standard deviations for aggregate variables (farm households and communities), in the left column for each out-migration status, and means for 1990 and 1999, are weighted by person-years. That is, the means of aggregate variables are a function of the number of people between 12 and 59 years old at given year, t, living in a farm household and community. For example, if four individuals in household X are exposed to the risk of out-migration at time t, but only three are exposed at t+1 (because one individual died, out-migrated, or reached age 60), farm household X will have a weight 4 at t, and 3 at t+1.

TABLE 3 HERE

Personal attributes

Table 3 shows that women tend to out-migrate proportionally more to urban areas compared to men, who are comparatively more likely to engage in rural-rural migration. Regardless of destination, out-migration is concentrated at the two younger age groups, with those over 35 being more likely to remain on the farm. The higher mean for rural-urban out-migration for those between ages 12-19 probably reflects a female bias in this type of migration stream. Nonetheless, between 1990 and 1998 out-migration becomes increasingly concentrated at

older ages, as shown by the decrease in the mean number of out-migrants below 19 years of age, and the increase for those between 20 and 34 years. Since the analysis considers the same farm households and their inhabitants between 1990 and 1999, evidently these results reflect life-cycle factors related to aging of household members. Most of the household heads and spouses are earlier migrants to the region, arriving in the 1970s and the early 1980s, and thus the typical female spouse falls within the latter stages of reproductive life, having surpassed reproductive age in the 1990s. Therefore, the second generation was usually at higher risk of migration in the late 1980s and earlier 1990s, when most of this cohort remained younger than 34 years of age. The result is a reduced population in the below-20 age group and a decreasing number of out-migrants over time given a dwindling population of younger household members.

Human Capital

Two measures of "Human Capital" characteristics are used: household head's education and on-farm experience. The first is a measure of the general household human capital, and indicates the influence of the (usually male) household head's education to assimilate and transmit information about employment opportunities elsewhere, and on shaping other household members' decision to out-migrate (see examples in Vanwey, 2003; Barbieri and Carr, 2003). It represents the head's capacity to assimilate information about employment opportunities elsewhere and transmit them to household members. Rural-urban migrants come from farm households with lower household head's education (on average having achieved less than secondary school), while higher education among household heads is associated with rural-rural migrants. Since women are relatively more associated with urban destinations and men with rural migration, a potential link emerges between lower head's education and females' decision to move to urban areas. This is a reasonable hypothesis. If

farm households with low average educational level are disadvantaged in urban labor markets, households with such a handicap may decide that women may fare better. Similarly, household members with on-farm experience only are more associated with (mostly male) rural-rural migration or no migration, compared to (mostly female) decisions to move to urban areas being associated with a higher proportion of individuals without on-farm experience.

Farm Household Life Cycle

Household life cycle variables reflect demographic variations that can affect household land use and mobility strategies. Table 3 shows important differences in farm area between farm households with out-migrants and farm households without out-migrants. In the first case, farm area decreased 24% on average between 1990 and 1999, and in the second case farm households without out-migrants show a substantially smaller reduction in the average farm area - 11%. Land size variation over the decade reflect pressures on the second generation given reduced access to natural resources, especially land, as well as variations in farm household wealth. This is a key understudied issue in studies of demographic dynamics in frontier areas. While land subdivisions among sons and daughters imply short-distance out-migration (within the community), land subdivisions to new in-migrants reflects the importance of the study area in continuing to attract colonists from other parts of the Amazon or other parts of the country. Decreasing number of children over time is consonant with the evolution of the farm household, with the household head's spouse reaching the twilight of her reproductive window or surpassing it, while the decreasing number of adults reflects out-migration and, to a smaller extent, deaths over the decade. These two processes influence a decreasing pace of out-migration form the region in the late 1990s, as pressures on available farm resources were relieved from earlier out-migration, and children entering working age.

Each stage in the household life cycle is associated with distinct land uses. The latter stages of the life cycle are associated with capital accumulation and investments in less labor-consuming land uses, such as pasture for cattle, thus encouraging mobility. Conversely, a high proportion of farmland dedicated to crops or perennials means a higher demand for family or hired labor (including female labor), with a negative effect on migration. Table 3 shows that at later life cycle stages (in the late 1990s), farm households with out-migrants are likely to have a higher proportion of land in pasture and a smaller proportion in crops. The highest proportion is found among households with rural-urban migrants, which are also the only ones with a decrease in the proportion of land in forest. There is, in this case, an apparent association between forest conversion to pasture, which is not evident among rural out-migrant households or among those remaining at the farm households.

Community attributes and migration network

Number of previous out-migrants refers to the total number of out-migrants from the community since a farm household was established in the study area until a given year in the 1990s. The number of previous out-migrants increases for all out-migration status, but the increase is greater for urban out-migrants, showing the increasing importance of this type of migration network in engendering further out-migration from the community in the late 1990s. Distance from the community to the nearest town reflects the physical accessibility to local labor markets, agricultural markets and other services and infrastructure. Reduced distance also lowers migration costs and facilitates the establishment of migration networks. Rural-urban migrants come, on average, from communities located relatively far from the nearest town compared to rural out-migrants or those not moving. The variation of person-years weights explains the difference, in 1990 and 1999, in the means of time-invariant covariates. Table 3 also shows that rural communities acquire better infrastructure over time,

especially heath and education, with the consequent improvement of living standards in rural areas, and an incentive for household members to remain.

Determinants of Out-migration: Analytical Results

Figure 2 compares the percent changes of the odds ratio (Equation 3) of out-migration to a rural or urban area, or both combined, for a given year between 1990 and 1998 compared to 1999. Figure 2 was constructed using trend lines representing the estimated coefficients for α_t (Equations 1 and 2), which are constituted of dichotomous variables representing each year between 1990 and 1998 (1999 as the reference category). Out-migrant data for 1999 do not refer to the full year, since fieldwork ended in September of that year. Nevertheless there is a clear trend of consistently decreasing mobility odds across the decade. This reflects the fact that as the same cohort of farm households are followed over time, the number of out-migrants tends to be smaller since the number of those exposed to the risk of moving (especially younger household members) is reduced compared to a previous year. Furthermore, as farm households adjust their risk-diversifying strategies, such as allocating one member to commuting or out-migration, or investing in land intensification, further out-migration from the farm household becomes less likely to occur.

Nonetheless, Figure 2 shows that the variation in the odds of rural-urban out-migration between 1990 and 1998 (71%-24%) is considerably higher compared to rural-rural out-migration (38%-10%). Rural-urban out-migrants have substantially higher odds of moving in the earlier years of the decade than do rural-rural out-migrants. This is probably due to the effects of the migration of younger women, or even younger men moving to diversify household income sources and investment in the farm, or to marry and constitute a new household. In later years, as the "stock" of younger women (due to the aging of the

second generation) shrinks, gender differentials tend to have a smaller effect on the odds of out-migration. The aging of the second generation, in this case, therefore tends to be an equalizer of the two migration fluxes.

FIGURE 2 HERE

Table 4 presents the results of the discrete-time binomial and multinomial models of out-migration from the Ecuadorian Amazon. (The discrete variables representing years, which were used to estimate the percent change in the odds of out-migration in Figure 2, are not included in the Table 4). Model 1 does not distinguish between out-migrants' places of destination, while Models 2a, 2b, and 2c distinguish, respectively, between rural-rural migrants compared to no migrants, rural-urban migrants compared to no migrants, and rural-rural migrants compared to rural-urban migrants. Figure 3 compares the percent changes in the odds ratio of out-migration for the significant variables in Models 2a, 2b and 2c. The following variables potentially useful for policy purposes are not identified as significant in Model 1, but are significant when considering out-migrants' destination (Models 2a, 2b and 2c): gender, household head's education, and availability of secondary school in the community.

TABLE 4 HERE

FIGURE 3 HERE

Personal attributes

As expected, younger household members are more likely to out-migrate. The out-migration odds of an individual between 12 and 34 years living in a farm household to rural destinations between 1990 and 1999 is approximately one-quarter greater compared to out-migrants above 34 years of age. The odds are substantially higher for rural-urban migrants – over 65%, for the two age groups below 35 years, suggesting that this migration flow is more likely to be

associated with youth compared to rural-rural migration. This result seems to be associated with a higher volume of female out-migration, as shown in Table 3. Indeed, the odds of a male out-migrant choosing an urban area is one-third smaller compared to women. Younger women are more likely to out-migrate to urban areas due to their being considered "marginal labor" for farm work, to their role in providing domestic work and family assistance to other household members living in urban areas (especially men and children at school ages), and to the lower wages that they usually receive in urban employment.

Human capital

Engagement in farm work is positively related to out-migration, but the results are significant only for rural-rural migrants. Engagement in on-farm experience increases the odds of out-migration 100% when compared to those not having such experience. Previous rural employment is thus a strong predictor of rural-rural migration, and when rural workers reach stages in the life cycle where the demand for land is higher, rural-rural migration is a likely consequence. Further, among movers, the odds of out-migrating to a rural area instead of out-migrating to an urban area are 75% higher for those with just on-farm experience. That less on-farm experience does not seem to affect rural-urban migration is likely explained by the relatively larger volume of young females in this subgroup.

Household head's education is significant only for out-migrants choosing urban destinations. Contrary to the orthodox in the migration literature, a household head with at least secondary education decreases by 29% the odds that an individual will out-migrate to urban areas. As explained previously, we posit that this finding is due the relative advantage that women will have in finding urban employment relative to their under-educated male spouses or household's head.

Farm Household Life Cycle

Four variables representing the farm household life cycle - number of adults, number of children, and change in the proportion of land in pasture and in forests - are significant in at least one of the Models 2a, 2b and 2c. Number of adults living in the farm household is inversely associated with rural-urban out-migration: one additional adult living with the farm household decreases the odds of out-migration to an urban area by 2%. Despite the small effect, this result can reflect the fact that women (who are predominantly rural-urban migrants), are accommodated by the farm household more easily than men. Furthermore, the nature of urban employment opportunities (e.g., seasonal work in the oil industry, transportation and domestic services, etc.), and the availability of services such as school and health care, creates a dichotomy between places of residence and work, that is, it generates a pattern of temporary mobility or commuting in which farm households can still serve as their place of residence with members engaged in temporary labor in urban-type activities.

An additional adult in the household has a positive effect on rural-rural migration when compared to rural-urban migration. However, the effect is minimal, with the percent change in the odds ratio approaching zero. On the other hand, an additional child living in the farm household increases by 1.4% the odds of rural-rural migration, and by 2% the odds of rural-urban migration. Despite the small effect, this suggests that non-productive members in the household are likely to exert pressure over available resources, which ultimately promotes out-migration as a response to a (likely) decrease in resources per capita on the farm.

Results indicate a positive association between a higher proportion of land in pasture between 1990 and 1999 and rural-urban migration, with the odds of out-migration being 136% higher compared to the case of farms without a higher proportion of land in pasture. Furthermore, the odds of out-migrating to a rural area instead of out-migrating to an urban area are 50% smaller for those individuals living on a farm with an increasing proportion of

land in pasture. These results suggest an important articulation between strategies of capital accumulation, via rural-urban migration of a farm household member coupled with investment in cattle, as noted in the Brazilian Amazon (Browder and Godfrey 1997). Furthermore, as pasture is a less labor demanding activity, female work is probably more easily released from the farm toward urban destinations. On the other hand, having proportionally more land in forests (at least partially due to secondary forest growth) decreases by 40% the odds that an individual will out-migrate to other rural areas. This can reflect the fact that the growth of secondary forests *per se* indicates a scarcity of farm labor (probably due to previous out-migration from the farm household), with a mitigated pressure to convert forests to pasture, crops or perennials, and, therefore, reduced incentive to out-migrate.

Prima facie, farm area in hectares is not easily interpreted in Table 4 given the square and cubic transformations used to adjust these variables. However, their effects can be interpreted from an analysis of the predicted probabilities that an individual will out-migrate[3]. Figure 4 shows that probabilities decrease as the amount of farmland increases. Nevertheless, for fewer hectares of farmland until 25 ha, individuals are more likely to out-migrate to urban areas compared to rural areas; and for farm areas above 25 ha, rural-rural migration is more probable. Rural-urban migration probabilities decrease more rapidly compared to rural-rural migration probabilities among farm households with relatively large amounts of land.

Community attributes and network

As for farm area in hectares, Figure 5 compares predicted probabilities of out-migration to a particular destination according to the distance, in km, from the community where the individual lives to the nearest town. Probabilities of out-migration increases as distances

[3] From Equation 2, the predicted probabilities are estimated as: $P_{rit} = 1 / (1 + e^{- \alpha rt - \beta rAXri - \beta rBXrit})$.

increases, and at shorter distances from towns, rural-urban migration is more probable. However, the probability of rural-rural migration increases more rapidly as distance increases, until the point – at 18 km – where rural-rural migration becomes more probable than rural-urban migration.

Number of previous out-migrants in the community has a positive impact on out-migration in the models 1, 2a and 2b. Having an additional out-migrant in the community in past years increases the odds of rural-rural migration by 0.30%, and 0.70% for rural-urban migration. (Remembering, from Table 3, that the average of rural-rural and rural-urban migrants during the 1990s was 9.3 and 10.8 respectively). These results reveal a potential influence of migration networks on rural out-migration.

Presence of a secondary (higher) school is significant for rural-urban migrants. Contrary to our previous finding of education's relation to urban migration among household heads, the existence of a high school in the community increases the odds of rural-urban migration by 7%. As discussed in depth in the migration literature, formal education improves the capacity of younger individuals to assimilate information, shape aspirations and balance better the costs and opportunities to move to an urban area. Conversely, higher education provides relatively fewer skills useful to a rural-rural migrant. Furthermore, this result can be also related to the predominant female out-migration to urban areas, since more educated women in this study area in the Northern Ecuadorian Amazon have been noticed to be more likely to out-migrate compared to men (Laurian *et al* 1998).

Discussion and Conclusions

The empirical literature on determinants of migration has missed intergenerational characteristics associated with family succession in frontier areas. This is particularly relevant considering that, as the second or third generation of settlers demand more land, and with the

increasing lack of capacity of farms to sustain their members due to population growth (with incipient fertility control) and decreasing possibilities to improve agricultural outputs through intensification and extensification, farm households will become increasingly less likely to support their members over the years, and out-migration will continue to be a popular alternative for younger household members. This process will continuously pressure natural resources, leading to further deforestation in the Amazon, as well as pressure the (already precarious) urban infrastructure.

This paper is a novel contribution to the empirical literature, both theoretically and methodologically, providing an analysis of second-generation migration of settler colonists in the Amazon frontier, and a longitudinal and multi-scale data and method including a myriad of individual, farm household and community characteristics affecting decisions to out-migrate. "Push factors", or the conditions in places of origin of migrants, play the key role in determining out-migration from the study area. Transformations in the frontier engendering out-migration, and changes due to in-migration in places of destination such as deforestation or urbanization, are regarded not only as guided strictly by economic motivations, but also by the maturation of demographic processes related to individual and household life cycle factors, human capital and community characteristics.

The results show that men are more likely to out-migrate to rural areas than women, while the reverse occurs for urban areas. The decreasing pace of migration probabilities over the decade reflects cohort processes of aging among second or higher generation settler colonists, and higher differentials at younger ages (earlier in the 1990s) between rural-rural and rural-urban migrants. Nevertheless, gender differentials in out-migration are likely to explain, at least in part, other findings, especially those reflecting women's marginal position in the farm household. For example, considering the average reduction in farm size over the decade and a greater scarcity of resources, younger females can be more easily released from

farm labor than men and move permanently to a town, or commute between a local urban job and the farm household, especially if they are separated by shorter distances. A higher probability of rural-urban migration at shorter distances from a community to the nearby town can also reflect these gender differentials, since a shorter-distance out-migration allows young women to maintain their network of social relationships with the farm household (parents and sons or sisters) and the original rural community.

Rural-urban articulations are more associated with land use strategies privileging pasture for cattle, smaller household head's education, fewer adults living in the farm household, and the presence of a secondary school in the community. Regarding the first of these factors, rural-urban migration, as a farm household strategy to earn cash income and diversify risk, seems more likely to be associated with strategies of capital accumulation, especially the expansion of farm activities focusing on investments in cattle and the conversion of forests to pastureland (a pattern already noted in the Brazilian Amazon by Browder and Godfrey 1997). Life cycle factors also play a key role here since the aging of the first and subsequent generation of settler colonists is associated with land use strategies, such as cattle ranching instead of crops and perennials, which require a lower demand for labor and consequently fewer adults living on the farm. Rural-urban migrants are usually younger compared to rural-rural migrants, and thus more likely to contribute to the original farm (the first generation farm colonists) through remittances compared to rural-rural migrants, which occurs at older ages and is likely to be more associated to the formation of a new family and household. Indeed, rural-rural migration is associated with on-farm employment experience only, showing the lack of articulation between rural employment background and urban employment. This possibly reflects an "early mobility transition stage" (Zelinsky 1971) in which urbanization is incipient and unable to rupture rural traditions and employment strategies (via rural-rural migration). Rural-rural migration is also associated

with a dearth of farm land in forest, which is indicative of limitations for land extensification in the farm.

Educational factors are associated only with rural-urban migration, but in a distinct direction when considering the scale of analysis. The average educational level of the farm household is inversely associated with out-migration, while availability of a high school in the community is positively associated with out-migration. In this sense, expected positive relations between education and rural-urban migration are validated by more aggregated data involving communities rather than involving farm households. The latter can reflect a "passive gender effect" between out-migration and education, which is better captured by micro-level analyses focusing on farm households and individuals: younger women, even due to their smaller insertion in farm labor, are more likely to frequent high school than men, irrespective of the smaller educational level of their parents.

Migration networks, number of children in the farm household, youth, farm area, and distance to the nearest town, are significant factors explaining both rural-rural and rural-urban out-migration. Distance from the community to the nearby town, and migration networks play a significant role as a source of information and in reducing migration costs for individuals and farm households seeking mobility as a strategy to cope with adversities. That an additional child in the farm household is positively associated to out-migration can reflect both a higher pressure on available farm resources which stimulates out-migration as a risk-diversification strategy, and also the maturation of life-cycle processes in which married sons or daughters living in their parents' farm household are more likely to move in order to constitute an independent household.

The results inform policymakers about the effects of specific factors on population mobility and redistribution in the Amazon, and consequently on urbanization, deforestation and regional development. This is a key issue regarding future development in the Amazon,

due to the importance of population mobility on socioeconomic development and environmental sustainability. In this regard, an important policy implication is the necessity of a long term planning perspective incorporating issues such as family planning and the anticipation of second generation effects on patterns of land use, demographic dynamics and overall living standards. As suggested by Walker *et al*. (2002:195) "endogenous forces emanating from families are unleashed once a region is settled, and it may be impossible to turn the conservation clock as far back as one would like through top-down interventions, such as reduced expenditures on highway construction or improvement". There is, however, a contradictory effect in some policies aimed at regulating migration fluxes in frontier areas. While some policies, for example those fostering urban employment and the expansion of oil industries, can have the direct effect of inducing rural-urban migration, they can also encourage rural-rural migration to other areas in the Amazon.

In this regard, it is reasonable to assume, following the history of the spontaneous colonization in the Northern Ecuadorian Amazon in the 1970s, that macroeconomic policies tied to oil revenues are likely to promote further expansion of road networks in the Amazon and increase spontaneous migration into new frontier areas. (In fact, the results show a significant association between larger distances from rural communities to local towns, and rural-rural migration). Furthermore, policy strategies to improve living conditions in rural areas, for example through the construction of schools, should anticipate future increases in rural-urban migration, since education can reinforce out-migration given its selective nature: individuals with better education are likely to be allocated to out-migration by farm households since their expected returns are higher. Rhoda (1983), for example, reviews "rural development strategies" aiming to improve infrastructure and off-farm employment opportunities in Latin America, and suggests that such policies are likely to have a null or even positive effect in terms of encouraging out-migration.

Despite the paper's potential contribution to the empirical literature, yet key issues remain for future research. Further studies are necessary to examine remaining questions as to who will migrate, to where, and what will be the socio-economic, demographic and environmental outcomes of these movements. One fertile avenue of research suggested by the results of this paper is to further probe gender differentials out-migration, particularly why female migration is more associated with urban destinations, and male migration with rural destinations. Understanding gender differentials according to out-migrant destination helps identify important factors for policy purposes, such as the effect of urban employment opportunities, education and health assistance (including family planning) in gendered out-migration from rural communities.

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Table 1 – Permanent out-migrants from the study area in the Ecuadorian Amazon between 1990 and 1999, according to place of destination

	Total	Rural		Urban	
	Out-migrants N	Out-migrants N	Out-migrants % of Total	Out-migrants N	Out-migrants % of Total
All persons	481	319	66.3	162	33.7
12-59 years	351	240	68.4	111	31.6

Table 2 – Reasons to out-migrate to rural or urban areas, according to gender and age group - study area in the Northern Ecuadorian Amazon, 1990-1999

	Rural Destinations (N=223)						
Reason to	Male			Female			
Out-migrate (%)	age 12-19	age 20-34	age 35-59	age 12-19	age 20-34	age 35-59	Total
accompany spouse or relative	6.0	5.2	2.1	18.9	8.6	0.4	41.2
looking for employment	12.9	11.2	2.1	1.7	6.0	1.3	35.2
education	0.9	0.4	0.0	2.6	0.0	0.0	3.9
other reasons*	8.6	4.7	1.3	2.1	2.1	0.9	19.7
	Urban Destinations (N=110)						
Reason to	Male			Female			
Out-migrate (%)	age 12-19	age 20-34	age 35-59	age 12-19	age 20-34	age 35-59	Total
accompany spouse or relative	6.4	5.5	0.0	19.1	5.5	0.9	37.3
looking for employment	15.5	9.1	0.9	4.5	7.3	0.9	38.2
education	0.0	1.8	0.0	5.5	1.8	0.0	9.1
other reasons*	8.2	0.9	0.0	2.7	2.7	0.9	15.5

* Include, for example, answers like "health reasons", "military service", "didn't like the place".

Table 3 – Means and standard deviations of independent variables, according to out-migration status - study area in the Northern Ecuadorian Amazon, 1990-1999

Variable	rural out-migrants		urban out-migrants		no out-migrants	
	Means (st.dev.)	1990 means / 1998 means	Means (st.dev.)	1990 means / 1998 means	Means (st.dev.)	1990 means / 1998 means
Personal attributes						
gender (0=female, 1=male)+	0.63 (0.48)	0.62 0.62	0.48 (0.50)	0.50 0.56	0.57 (0.50)	0.56 0.57
age group 12-19 years old	0.45 (0.50)	0.54 0.32	0.57 (0.50)	0.61 0.32	0.33 (0.47)	0.25 0.36
age group 20-34 years old	0.46 (0.50)	0.38 0.55	0.40 (0.49)	0.35 0.65	0.29 (0.45)	0.32 0.29
age group above 35 years old	0.09 (0.28)	0.08 0.13	0.03 (0.18)	0.04 0.03	0.38 (0.49)	0.43 0.35
Human capital						
engagement in farm work (1=engaged, 0=not engaged)	0.79 (0.41)	0.79 0.79	0.66 (0.47)	0.62 0.65	0.71 (0.46)	0.79 0.63
household's head education+ (1=at least some secondary)	0.65 (0.48)	0.36 0.45	0.34 (0.47)	0.36 0.41	0.41 (0.49)	0.40 0.41
Farm household life cycle						
farm area (ha)	41.61 (16.24)	44.91 34.08	41.70 (23.52)	46.61 35.76	43.05 (27.60)	46.61 41.15
number of adults in the farm household	7.66 (4.62)	7.32 5.60	6.11 (2.52)	5.99 5.58	6.60 (3.99)	6.79 6.19
number of children in the farm household	1.66 (0.92)	1.63 1.45	1.52 (0.79)	1.21 1.16	1.28 (0.82)	1.53 1.15
increase in proportion of land in crops, 1990-1999 (1=increased)+	0.45 (0.50)	0.46 0.42	0.41 (0.49)	0.44 0.35	0.42 (0.49)	0.44 0.41
increase in proportion of land in pasture, 1990-1999 (1=increased)+	0.63 (0.48)	0.62 0.66	0.79 (0.40)	0.78 0.85	0.59 (0.49)	0.59 0.59
increase in proportion of land in forest, 1990-1999 (1=increased)+	0.37 (0.48)	0.36 0.49	0.28 (0.45)	0.32 0.24	0.45 (0.50)	0.44 0.46
Community attributes/network						
Number of previous out-migrants in the community	9.25 (6.48)	4.86 15.74	10.75 (7.25)	4.68 21.03	11.58 (8.03)	4.52 16.68
distance from community to nearest town (km)+	22.88 (16.63)	22.34 27.09	26.73 (19.32)	25.71 26.57	23.10 (17.91)	23.52 22.93
health facility in the community (0=no, 1=yes)	0.30 (0.46)	0.25 0.42	0.39 (0.49)	0.34 0.50	0.36 (0.48)	0.28 0.43
secondary school in the community (0=no, 1=yes)	0.24 (0.43)	0.16 0.28	0.39 (0.49)	0.32 0.47	0.33 (0.47)	0.22 0.36

+ time-invariant independent variables

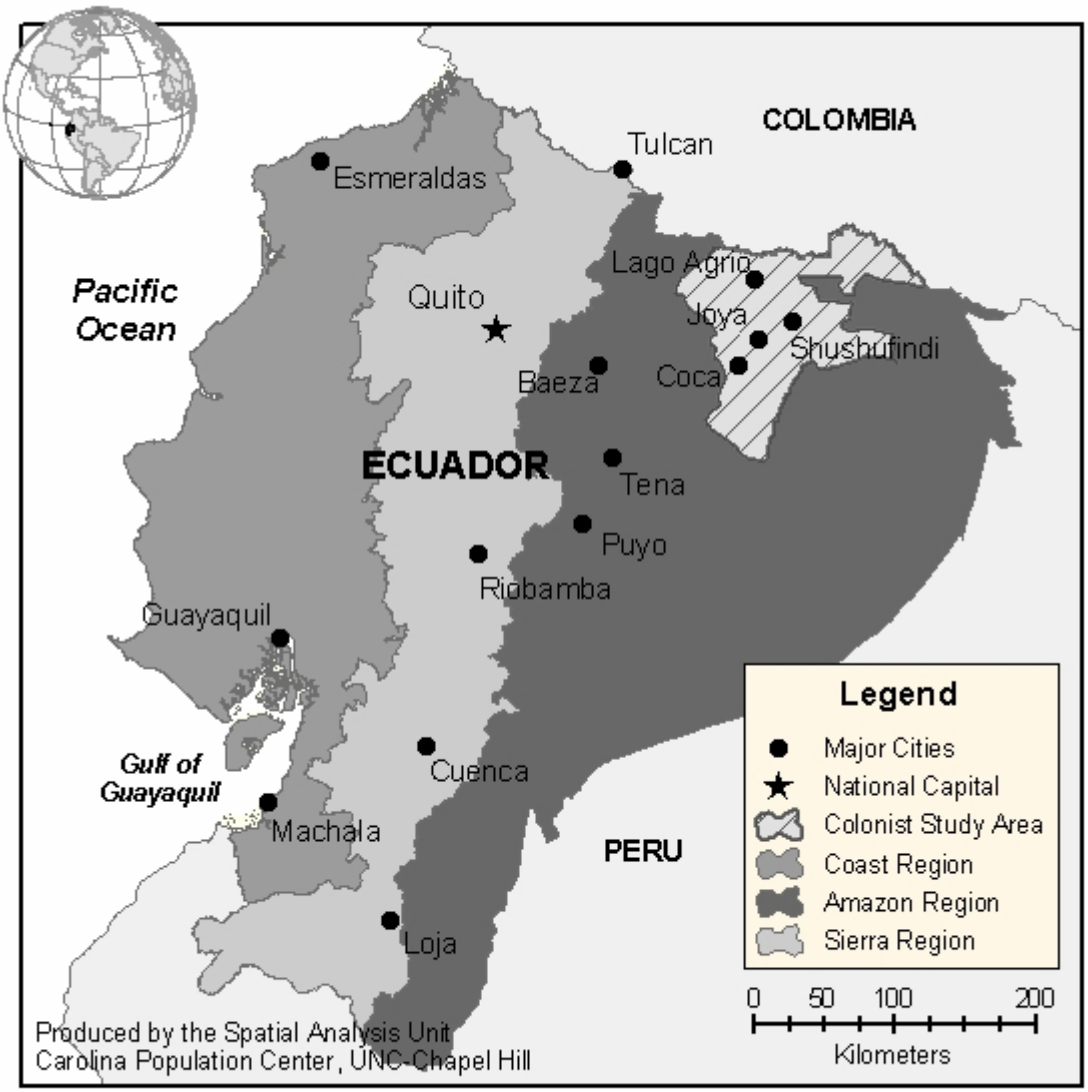
Table 4 – Unstandardized beta coefficients, standard deviations (in parenthesis) and significance level in the regression models of out-migration from rural areas of the Northern Ecuadorian Amazon, according to place of destination

Variable	Model 1 out-migration vs. no out-migration	Model 2a rural out-migration vs. no out-migration	Model 2b urban out-migration vs. no out-migration	Model 2c rural out-migration vs. urban out-migration
Personal attributes				
gender (0=woman, 1=men)	-0.0503	-0.0306	-0.4074**	0.3317
	(0.1160)	(0.1374)	(0.1903)	(0.2432)
age group 12-19 years old	0.2435***	0.2073***	0.5019***	-0.0003
(reference group: over 35 yrs. old)	(0.0425)	(0.0292)	(0.0566)	(0.0002)
age group 20-34 years old	0.2556***	0.2156***	0.5045***	-0.0003*
(reference group: over 35 yrs. old)	(0.0414)	(0.0254)	(0.0506)	(0.0002)
Human capital				
engagement in farm work	0.3918***	0.6939***	0.0238	0.5589**
(1=engaged, 0=not engaged)	(0.1250)	(0.1561)	(0.1998)	(0.2637)
household's head education+	-0.0032	-0.0834	-0.3394*	0.0024
(1=at least some secondary)	(0.1033)	(0.1287)	(0.1835)	(0.0060)
Farm household life cycle				
farm area (ha)	-0.0030***	-0.0022***	-0.02255***	-0.0004**
	(0.0009)	(0.0008)	(0.0071)	(0.0002)
squared farm area (ha)	-	-	0.0004***	-0.000005**
	-	-	(0.0001)	(0.0000)
cubic farm area (ha)	-	-	-0.000001***	-
	-	-	(0.0000)	-
number of adults in the farm household	0.0085*	0.0030	-0.0215***	0.000048***
	(0.0046)	(0.0031)	(0.0049)	(0.0000)
number of children in the farm household	0.0404***	0.0136***	0.0163**	-0.000001
	(0.0156)	(0.0038)	(0.0085)	(0.0000)
increase in proportion of land in crops, 1990-1999 (1=increased)+	-0.1707	0.0088	-0.1655	0.1853
	(0.1259)	(0.1499)	(0.2152)	(0.2475)
increase in proportion of land in pasture, 1990-1999 (1=increased)+	0.2700**	-0.0928	0.8613***	-0.6916***
	(0.1370)	(0.1705)	(0.2226)	(0.2631)
increase in proportion of land in forest, 1990-1999 (1=increased)+	-0.3250**	-0.5016***	-0.3191	0.0099
	(0.1481)	(0.1861)	(0.2328)	(0.2861)
Community attributes/network				
number of previous out-migrants in the community	0.0027**	0.0029***	0.0070***	-0.000002
	(0.0012)	(0.0007)	(0.0018)	(0.0000)
distance from community to nearest town/market (km)+	0.0825***	0.0924***	0.0114***	-0.0121**
	(0.0249)	(0.0321)	(0.0049)	(0.0060)
squared distance from community to nearest town/market (km)+	-0.0028***	-0.0032***	-	-
	(0.0009)	(0.0012)	-	-
cubic distance from community to nearest town/market (km)+	0.000025***	0.000028**	-	-
	(0.0000)	(0.0000)	-	-
health facility in the community (0=no, 1=yes)	0.0051	-0.0008	0.0039	-0.0003
	(0.0132)	(0.0145)	(0.0370)	(0.0002)
secondary school in the community (0=no, 1=yes)	-0.0044	-0.0204	0.0671*	-0.0002
	(0.0141)	(0.0157)	(0.0401)	(0.0002)
intercept	-2.1484***	-2.5330***	-2.9041***	0.8323**
	(0.2505)	(0.2980)	(0.3600)	(0.3740)
log-likelihood	-4491.40	-3471.58	-1992.23	-1236.20

+ time-invariant independent variables

Significance levels: *p<0.10, **p<0.05, ***p<0.01 (two-tailed test)

Illustrations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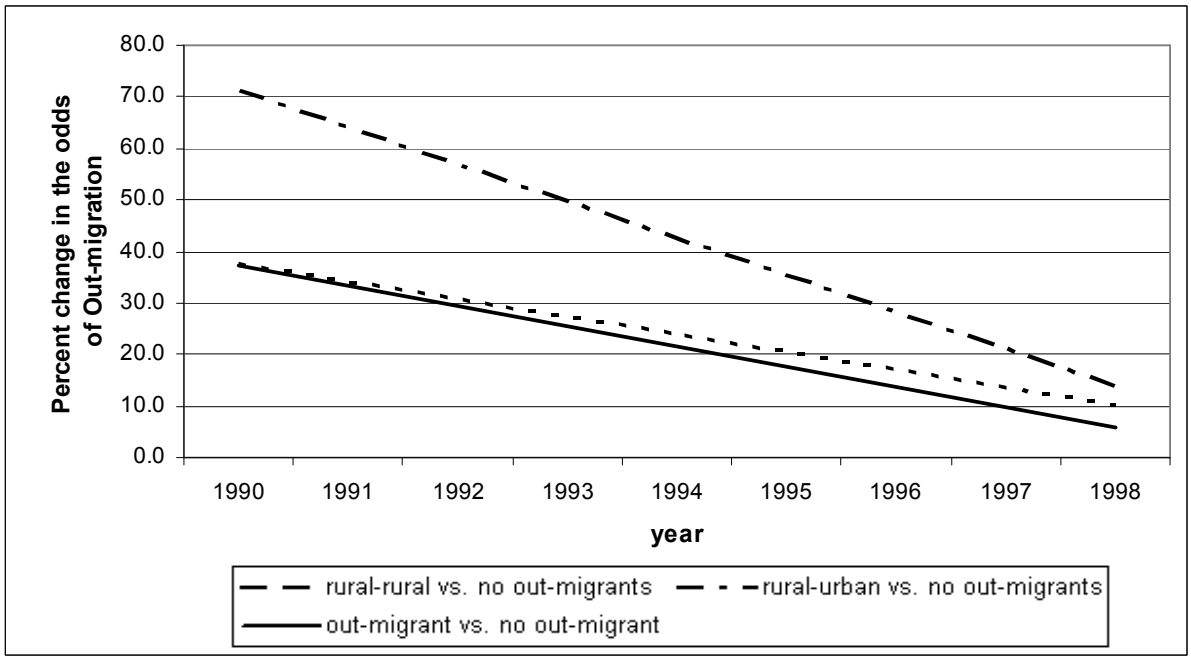
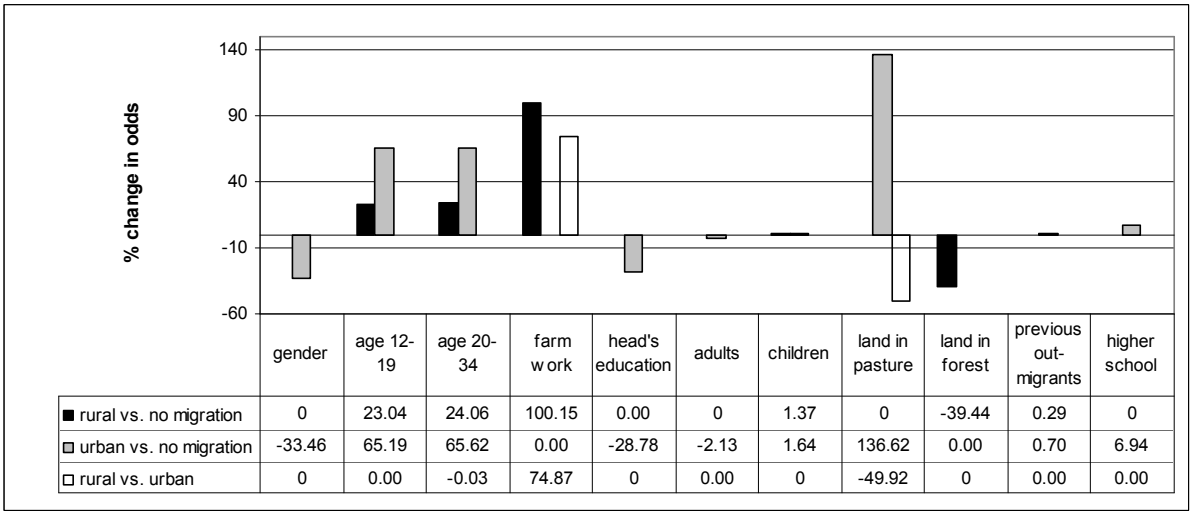
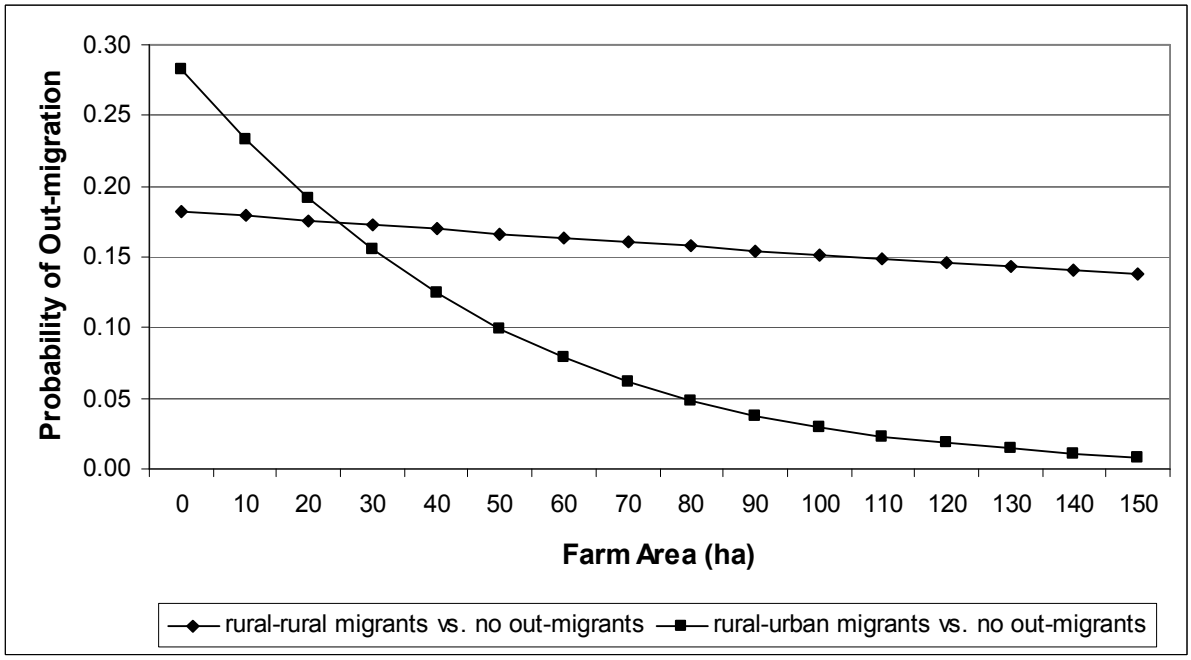
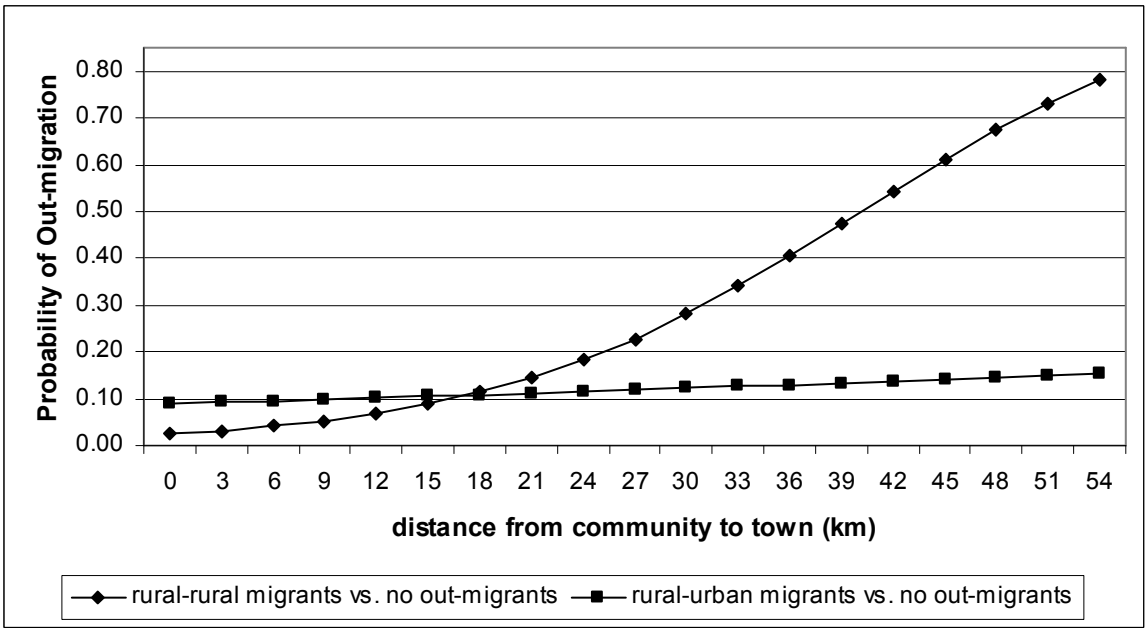
Esmeraldas
Lago Agrio
Pacific
Ocean
Quito
Joya
Shushufindi
Baeza
Coca
ECUADOR
Tena
Puyo
Riobamba
Guayaquil
Legend
Major Cities
National Capital
Colonist Study Area
Coast Region
Amazon Region
Sierra Region
Gulf of
Guayaquil
Cuenca
Machala
PERU
Loja
0 50 100 200
Kilometers
Produced by the Spatial Analysis Unit
Carolina Population Center, UNC-Chapel Hill


Percent change in the odds of Out-migration
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1990
1991
1992
1993
1994
1995
1996
1997
1998
year
rural-rural vs. no out-migrants
rural-urban vs. no out-migrants
out-migrant vs. no out-migrant



	gender	age 12-19	age 20-34	farm work	head's education	adults	children	land in pasture	land in forest	previous out-migrants	higher school
■ rural vs. no migration	0	23.04	24.06	100.15	0.00	0	1.37	0	-39.44	0.29	0
▫ urban vs. no migration	-33.46	65.19	65.62	0.00	-28.78	-2.13	1.64	136.62	0.00	0.70	6.94
□ rural vs. urban	0	0.00	-0.03	74.87	0	0.00	0	-49.92	0	0.00	0.00


Probability of Out-migration
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Farm Area (ha)
rural-rural migrants vs. no out-migrants
rural-urban migrants vs. no out-migrants


Probability of Out-migration
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54
distance from community to town (km)
rural-rural migrants vs. no out-migrants
rural-urban migrants vs. no out-migrants