Environmental Motivations for Migration: Population Pressure, Poverty, and Deforestation in the Philippines

Gregory S. Amacher, Wilfrido Cruz, Donald Grebner, and William F. Hyde

ABSTRACT. *This paper uses a multinomial discrete choice model and data from the Philippines to examine migrant choice between alternative destinations. Travel costs and perceived opportunities at the upland frontier are more important than general (upland plus lowland) destination attributes that indicate more developed social infrastructure or greater expected welfare. For example, migration streams are larger to destinations where the public share of forestland and the road system are larger. These features also characterize regions of more rapid deforestation. Therefore, emigration policies must recognize their effects on deforestation at the frontier—and their anticipated indirect effects on downstream environments.* (JEL Q23)

I. INTRODUCTION

Population pressure is generally accepted as a prime cause of ozone depletion, deforestation, greenhouse gas accumulation, pollution, and general large scale reductions in environmental quality. Migration can be a temporary outlet for population pressure, but often it only creates new population pressures and new environmental degradation in the region of in-migration.

The typical migration pattern worldwide has been from rural to urban areas. Rural communities have been the source of urban immigration and a source for degradation of the urban environment. This pattern reversed itself in the 1980s, particularly in Southeast Asia, as migrants began leaving impoverished cities to settle in sparsely inhabited upland and forest frontiers. The rural poor have added to the upland migrant stream as they too search for uninhabited land and better agricultural opportunities. Government resettlement policies and policies favoring capital over labor, particularly in the industrial sector, induced disemployment and migration to the frontier where the open–access nature of existing land tenure regimes provided opportunity but enhanced the likelihood of environmental degradation.

The object of this paper is to examine Philippine migration in the 1980s and the forested upland as an attractant for this migration. There are other examples—Indonesia's experience with transmigration, migration to Thailand's northeast after the army built roads for military movement and national security, or Nepal's experience with migration to the tarai after malaria was eradicated from that region—but the Philippines may be the best example. Manufacturing, employment, and per capita income actually decreased in the Philippines in the 1980s, and many poor urban and landless rural families migrated to the uplands where agricultural land conversion has destroyed 200,000 hectares of native forest annually for the last twenty years. Often this land is poorly suited for agriculture. Cultivation on slopes greater than 18 percent, for example, increased by more than 225,000 hectares each year in the 1980s (NRAP 1991).

We will use a multinomial discrete choice model, together with census data on migration flows, and socioeconomic and environmental data from the late 1980s to assess the factors explaining the migrating population's simultaneous choices among alternative upland destinations. This approach allows us to estimate the relative importance of population factors, environmental resources, government policy, and economic opportunity at the destination as elements in the final migration decision. We will find that migrants are responsive to local income opportunity but less responsive to population factors. The

Amacher, Grebner, and Hyde are with the Forestry Department at Virginia Polytechnic Institute and State University. Cruz is with the Economic Development Institute of the World Bank. Author order is unassigned. An anonymous reviewer helped improve our analysis and presentation.

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availability of upland natural resources and insecure land tenure are strong and statistically significant attractants. This means that migration is greatest to those regions where deforestation could accumulate on the largest scale. These results argue that it is difficult to predict the long-run effects of policies targeting employment, income, or property rights. Similarly, predictions of the effects of trade and industrial policies that reduce the welfare of the urban poor would be incomplete without including the degrading impacts of these policies on the upland environment.

II. MIGRATION AND DEFORESTATION IN THE PHILIPPINES

Poverty in the Philippines grew steadily through the 1970s and 1980s until it reached 50 and 60 percent in rural and urban areas, respectively, in 1988 (World Bank 1988). The Philippine recession of the 1980s, coupled with government incentives for capital- and energy-intensive industries, and disincentives for commercial agriculture, reinforced this disappointing trend. Displaced urban workers and landless agricultural workers migrated to the upland frontier in search of better opportunity, and they converted upland forests to subsistence agricultural production. Government forest policy—and the government's inability to enforce it effectively—reinforced the migrant impact on the uplands. The government officially classifies lands with slopes greater than 18 percent as forests and retains public ownership of these lands, but the government has difficulty enforcing use rights. As a result, these lands are effectively open to deforestation by improper logging and illegal homesteading.

The results have been an upland population growing at 3 percent annually since 1950 and settlement mostly on previously uninhabited open access forest (Cruz, Zosa-Feranil, and Goce 1988). Total forest cover has decreased by 24 percent since 1970 until 72 percent of the total upland area is now cultivated. This is more than double the area of upland cultivation in 1950 (NRAP 1991; FAO 1983).

Without secure private claims for the land, the new upland farmers tend to favor extensive cultivation practices and short-term production maximization. The environmental results have been unsustainable agriculture on land that is poorly suited for agriculture in any event, erosion and degradation of the upland forest, and downstream losses due to heavy sediment deposition on commercial agricultural land, in water catchments intended for hydroelectric power production, and in the coastal fisheries.

III. THE MIGRATION DECISION

The debate on world forest policy recognizes the importance of migration to deforestation, yet the empirical economic assessment of the issue is largely restricted to one related study. Cropper and Griffiths (1995) assessed the relationships between population growth, economic development, and deforestation for a cross-section of Latin American countries. They found a positive relationship between deforestation and population growth, and a mixed relationship between deforestation and income, but they did not examine migration explicitly. Other economic assessments of migration have tended to feature urban immigration, disregarding the upland environment. Numerous geographic and demographic inquiries do examine rural immigration, but this literature provides little basis for conjecture about economic policy.[1]

We will combine economic characteristics with the geographic and demographic characteristics common to previous migration assessments, but alter our focus to the migrant's choice among upland destinations, and especially to the attraction of accessible upland natural resources. An individual's decision to migrate involves a complex comparison of the known utility received at the

[1] Cruz et al. (1988) compute changes in upland forest populations in the Philippines and informally tie population growth to the decrease in forest area. Todaro (1976) reviews earlier economic migration models. Cruz and Francisco (1993) review migration and the environment.

site of current occupation with the utilities expected at various potential destinations. Once an individual chooses to emigrate, then the potential destinations form a discrete set of alternatives. Each emigrant from one origin faces the same set and the aggregate of similar choices made by individuals from one origin defines a migration stream.

Empirical Specification

Let the indirect utility for any individual with a potential destination m be given by

$$V(X_m; \Omega, \beta) + \varepsilon_m, \quad \text{for all } m \qquad [1]$$

where X_m is a vector of variables affecting prices and income at the destination, β is a vector of estimable parameters, and ϵ_m is an error term.[2]

The probability that an individual migrates from origin province i to destination province j is

$$P_{ij} = \text{pr}\{V(X_j; \Omega, \beta) + \varepsilon_j > V(X_m; \Omega, \beta) + \varepsilon_m\} \quad \forall\, m \neq j. \qquad [2]$$

We can estimate this probability with individual data (where choices are binary variables) or with sample proportions (Ben-Akiva and Lerman 1988). Sample proportions are especially well-suited for large population studies like ours where data on individuals are unavailable and where individual migration decisions can be aggregated as migration streams.

We can define migration streams if the individuals who make similar migration choices are themselves similar. A migration stream M_{ij} is the total number of individuals in origin province i making the identical choice to migrate to destination province j. If all observations of migration are contained within one time period, then the economic, environmental, and demographic attributes vary only across provinces.[3]

Sample proportions define the frequency distributions of migration patterns. The sample proportion for each origin i and destination j is

$$p_{ij} = \frac{M_{ij}}{\sum_j M_{ij}}. \qquad [3]$$

The p_{ij} substitute for the P_{ij} in [2], and the choices in [2] become frequencies in [3]. These frequencies sum to one when they are aggregated over all migration streams from each origin province.

The error term in [2] has an extreme value distribution (Fomby, Hill, and Johnson 1984). Therefore, we can use a maximum likelihood procedure to determine how the probability that a migration stream occurs depends on the vector of explanatory variables in the utility function. Following Ben-Akiva and Lerman (1988), a maximum likelihood procedure follows from defining the probability of migration between origin i and destination j as:

$$p_{ij} = \frac{\exp(x_{ij}^T \beta)}{\sum_m \exp(x_{ij}^T \beta)} \quad \text{for all } i,j \qquad [4]$$

where x_{ij} is the vector of explanatory variables from destination province j that are known to migrants from origin province i. The denominator is the vector sum over all potential destination alternatives. The probability p_{ij} is computed for all provinces, $m = 1, 2, \ldots, i, j, \ldots, N$, where N is the total number of provinces.

This multinomial discrete choice specification will provide consistent estimates of the effects of destination attributes on our

[2] Moving costs incurred by the migrant are implicitly present in the indirect utility function because moving costs affect income.

[3] This focus on groups of migrating individuals, rather than the total population, and on the attributes of destination locations, is appropriate for examining choices among potential migration destinations—but not for assessing the question of whether or not to emigrate. It is especially appropriate for our interest in the different environmental characteristics associated with upland destinations.

An assessment of the migrant's prior decision of whether to migrate would require a prior examination of the attributes of migrating individuals in comparison with the attributes of non-migrating individuals in the origin population. This would require data on non-migrant populations which are unavailable to us. If these data were available, the destination choice could be nested in the decision to migrate.

migration streams. If we assume a Cobb-Douglas form for the representative individual's utility function, [1], then our specification of [4] will be logarithmic. We will follow Pudney's (1988) recommendation of linear attachments for nonprice and nonincome variables (environmental and demographic variables, in our case).

Finally, we are also interested in identifying the broad categories of explanatory variables with greatest relevance for migration. For example, we would like to know which are greater attractants for migration: expected personal welfare, population and social infrastructure, and natural resource availability; or upland, lowland, or province-wide characteristics as a group. This suggests that we should group our explanatory variables and complete our analysis with hypothesis tests that examine the importance of these groups of variables.

Data

Our fundamental source is Philippine migration data processed from 1990 national census observations of individuals who moved within the 1985–90 period. These observations were based on a stratified random sampling scheme designed to capture variation in lowland and upland socioeconomic factors. The original sample included 5,476 migration streams involving 74 provinces.[4] A 1990 survey of the Philippine Bureau of Census provided general income, employment, and demographic data. Data distinguishing upland areas within a province were taken from a University of the Philippines, Los Banos survey of 8,935 households. Annual Philippine Statistical Yearbooks provided our data on agricultural and forest lands.

We made two modifications to the data and two modifications to the analysis. First, three provinces contain no upland forests. These provinces failed to attract any immigrants and we dropped them as potential destinations. (They remain as origins for migrations streams). Second, some attribute data (income, employment, or demographic data) are missing from three provinces from which there also were no upland emigrants. Dropping the provinces with missing attribute data leaves 74 origin and 52 destination provinces, for a total of 3,848 observations on migration streams. This means that the model represents fewer choices, but our sample is large. Dropping a few observations should not have a serious effect on the analysis because multinomial discrete choice models implicitly assume the independence of irrelevant alternatives (IIA) (Amemiya 1986).[5]

The full sample of migration streams separates into three approximately equal groups of origin-destination pairs: the first, for which there are no observations; the second, which includes less than half the migrants from an origin province; and the third, which shows that more than half of all migrants from one particular origin province emigrated to one particular destination province. The largest migration sources were the provinces of central Luzon, the most populous and industrial region of the country and the northern-most main island. Many movements were local, within the province of origin. The destinations of the largest longer distance migration streams were the 22 provinces on the less-settled and southern-most large island of Mindanao.

Table 1 summarizes the descriptive statistics for the destination attributes. Approximately one of every 400 individuals nationwide migrated (line 1) to a large variety of destinations, but it is difficult to distinguish among destination attributes from the raw data. Various measures of destination attributes might be used. The measures in Table 1 were selected to include measures of income and employment opportunity, population pressure, and resource availability. Larger total populations and larger total land area available suggest more information available to migrants and more migrant con-

[4] These migration data are the key to our analysis, and obtaining them was the most difficult part of this research project. M.C. Cruz is the source for our basic research idea, and she directed the migration survey of more than 815,000 individuals commissioned by the Philippine Department of Agrarian Reform and conducted by the Institute of Agrarian Studies at the University of the Philippines, Los Banos (Cruz et al. 1988).

[5] We tested for IIA by removing three of the largest provinces and computing the appropriate test statistic (Hausman and McFadden 1984). We could not reject the hypothesis of independent destination choices.

TABLE 1
DESCRIPTIVE STATISTICS FOR MIGRATION ATTRIBUTES

Attribute	Mean	Standard Deviation	Minimum Value	Maximum Value
Migration (% of 1980 origin population	0.23	0.17	0.04	0.79
Average household income (pesos/yr in 1990)	31,591	8,808	16,000	55,390
Average upland household income (pesos/yr in 1990)	11,676	20,296	9,999	61,950
Unemployment rate (% in 1990)	6.16	2.75	2.0	11.9
Households in bottom 30% of income profile (1990)	12,728	3,517	7,165	23,150
Population (1980)	222,710	144,190	9,009	707,000
Upland population density (1980)	38.41	6.74	6.60	73.96
Arable land (km^2)	1,148.44	467.25	247	2,363
Road density in arable uplands (mi/km^2)	1.46	1.54	0.39	11.66
Forest land area (ha)	263,360	214,630	28,200	1,042,000
Forest land area classified as public (ha)	328.1	216.1	40.4	1,041.8
Share of forest land area with >18% slope (%)	50.32	16.46	18.64	82.40

fidence about the perceived opportunity, but average income and population density also indicate levels of opportunity at the destination. Therefore, it is important to use each of these attributes—and not to normalize all attributes for either population or area. We will discuss our expectations for the effects of each attribute in our discussion of empirical results.

Many of our data distinguish upland from province-wide attributes because province-wide information may be the summary information most available to long distance migrants, but the uplands tend to be their final destinations. Several of our agriculture and forest data sets were selected for their implicit indications about secure land tenure, a critical issue for natural resource and environmental policy and management in the Philippines. Price data for selectively upland agriculture and forest resources were unavailable.

Political Unrest and Distance as Deterrents to Migration

Our analytical additions to these data are a political unrest variable and a travel cost variable. Fourteen provinces in the central Visayas and the ethnically different areas of Mindanao suffered from extreme political unrest, including guerilla activity and military responses to it. This unrest may have made these areas less attractive. The Philippine Embassy in Washington identified these provinces, and we marked them with a dummy variable.[6] A negative and significant coefficient on this dummy will imply that political unrest restrained immigration and, thereby, deterred deforestation.

The general literature on migration anticipates that travel costs are important deterrents to migration, with larger travel costs acting as a deterrent to migrations of greater distances. Distance alone, however, does not satisfactorily incorporate the mix of time costs for overland travel and financial costs for ferry passage characteristic of migration in the Philippines. The time costs may be especially important for many poor Filopino migrants who cannot afford commercial travel. For them, the financial cost of ferry passage may be overwhelming. Moreover, the strongest felt cost of migration in the Philippines is probably its deterrent on fam-

[6] L.Q. Del Rosario, personal communication, October 11, 1995.

ily communication during holidays. Therefore, the threshold which makes periodic return visits unlikely is critical. This threshold may be approximated by overland travel beyond the boundary of the province of origin or by ferry travel of any distance.

We developed two alternative systems for incorporating these market and non-market features of migration costs. The first is a system of weights that assigns two points to migration streams contained within the original province, another point to migration out of a province but within one of the twelve broad administrative/geographic regions of the Philippines, a fourth point to migration to a new administrative region, a fifth to any movement across water to a new island (or to ferry travel), and a final point to additional overland movement inland and upland once the ferry travel component of migration is complete. Some, but not all, migration out of the province includes ferry travel. Some ferry travel is followed by additional overland migration. Our second system for incorporating travel costs uses migration within a province as the standard and assigns a new dummy variable for each of the four subsequent weights in the previous system. We examined both systems in our empirical analysis.

Results

Table 2 displays our empirical results corrected for generalized heteroskedasticity. The first column reports the results associated with our scaled index of travel costs. The second column reports the results associ-

TABLE 2
MULTINOMIAL DISCRETE CHOICE ESTIMATES FOR DESTINATION ATTRIBUTES

Attributes	Regression Coefficients[a]	
Average household income (pesos/yr) (+)	3.310***	4.005***
	(3.708)	(4.486)
Average upland household income (pesos/yr) (+)	−0.011	−0.0453
	(−0.282)	(−1.169)
Share of households in bottom 30% of income profile (−)	−2.867***	−2.448***
	(−3.280)	(−2.810)
Unemployment rate (%) (−)	5.551***	8.003***
	(2.342)	(3.384)
Population (1980) (+)	1.741***	1.340**
	(2.932)	(1.991)
Upland population density (1980) (+/−)	−0.343	0.505
	(−0.508)	(0.855)
Arable land (km^2) (+/−)	0.753***	0.384
	(1.964)	(1.002)
Forest land area (ha) (+)	0.577*	0.154
	(1.786)	(0.477)
Road density in arable uplands (mi/km^2) (−)	−0.690***	−0.915***
	(−2.806)	(−3.726)
Share of forest land area classified as public (%) (+)	0.796***	0.925***
	(3.719)	(4.320)
Share of forest land area with >18% slope (%) (+)	1.307***	1.414***
	(2.860)	(3.093)
Political unrest dummy (1 for provinces showing political unrest during 1985–90, 0 otherwise) (−)	−0.0310	
	(−0.101)	
Travel cost dummy (0 for moves within province of origin, 1 otherwise) (−)		−54.588***
		(−54.057)
Travel cost index (−)	−3.246***	
	(−21.913)	
Log likelihood	−292.39	−292.39

[a] Expected signs and t-statistics in parentheses. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

ated with one application of the distance dummies. Except for this travel cost variable, all destination attributes are the same in both regressions, and all destination attributes are in log form. The table describes the anticipated signs and the statistical significance for each attribute, as well as the estimated coefficients. Twelve of thirteen attributes display expected signs—in both models. Ten are statistically significant in the first regression and eight are significant in the second. A Chow test rejected the hypothesis that the two regressions are significantly different.

The first group of destination attributes refers to income and employment. Average household income is a predictor of expected migrant income at the destination and, as such, is a powerful migration attractant. The uplands are the destination of most migrants, but average upland income is an insignificant predictor, probably because it represents a much smaller population and because most migrants have less well-formed perceptions of this measure than of the province-wide average household income. The income status of poorer households is also important. Since migrants themselves are not generally well-off, it is reasonable they would be concerned with the income opportunity of the province's poorer inhabitants. The proportion of households earning less than 30 percent of average provincial household income is a measure of the opportunity of poorer households. A larger proportion earning less than 30 percent reflects poorly on migrant expectations, and deters immigration. Finally, the positive sign on unemployment is surprising, but measures of unemployment are particularly unreliable in many developing countries. Perhaps higher unemployment rates reflect only the influx of migrants who become engaged in subsistence agricultural activities but who prefer some market employment.

The second group of destination attributes refer to population. A larger provincial population probably translates into better information about the destination province held by migrants as they prepare to depart the province of their origin. (For example, Americans on the East Coast tend to know more about more populated California than they know about less populated Nevada or Arizona.) For the upland areas which tend to be the migrants' final destinations within any province, however, population density may be a more important attribute. Higher population density may indicate greater social support, an attractant, or it may indicate less available land, a detractant to immigration. The expected sign on upland population density is uncertain, and our empirical results do not improve on our uncertainty.

The agricultural and forest attributes are indicators of resource availability. A larger arable land area may suggest greater availability and may attract migrants, or it may indicate that more land has already been settled and may detract. Our regressions indicate that the former argument must dominate. Our expectations for a larger forest land area are unambiguously positive. Larger forest area implies more land available for settlement and greater opportunity for deforestation and conversion to new small-scale upland agriculture. The regression coefficients support these expectations.

The remaining agricultural and forest attributes all reflect on the security of existing claims to the land. Less secure existing claims are migration attractants because they indicate greater opportunity for immigrants to extract some claim for themselves. Of course, the resulting new claim cannot be very secure, and short-term management and environmental destruction will probably accompany settlement. Lower road densities in arable uplands suggest either that the existing farms are larger and less-populated with tenants, or that the uplands contain a larger road-free and undeveloped interior. In either case, areas with fewer roads would be more susceptible to settlement by new immigrants. The government is largely unsuccessful at restricting settlement on public forestland. Therefore, the public share of the forest land base is also a migration attractant. The share of forestlands with steeper slopes is officially all public. Its availability is an attractant and an indicator of likely off-site environmental damage made certain by the insecurity of a settler's tenure on forestlands that are nominally public. This insecurity encourages migrants to make temporary and unofficial claims, but it discourages long-term investments and conservation management practices by the new upland settlers.

The distance and political unrest dummy variables performed as anticipated. Distance and political unrest both detract from migration streams, although the detraction due to political unrest is statistically insignificant and small in magnitude. Perhaps political unrest sends a mixed signal, indicating distress which is a migration deterrent, but also indicating less security of existing land tenure and, in a few cases, attracting potential settlers who will compete for the tenurial rights. On the other hand, political unrest and local concerns for land tenure are mutually reinforcing, and the insignificance of our political unrest dummy variable may be due to the interdependence of these two issues.

The first column of results in Table 2 reports the coefficient for our index of travel costs. It is negative and highly significant—as expected. The regression with four distance dummies did not perform well, but it did indicate a critical threshold at the borders of the province of origin. Perhaps this is because the migration streams identified by the second through fourth dummies (migration out of the province to various more distant destinations) were too small for reliable statistical analysis. When we reestimated (effectively lumping these dummies) such that our only distinction is between migration within or beyond the province of origin, then this second regression performs well. The second column of Table 2 reports the results with this dummy variable. (The larger coefficient on this distance dummy is due to the dummy's smaller value: 1 or 0 for the dummy in column two versus weights between 2 and 7 for the distance variable in the first column of results.) This result shows the importance of the border of the origin province as a migration threshold and, thereby, lends support to the argument that the strongest felt cost of migration is its deterrent to family communication during holidays.

Hypothesis Tests

A series of hypothesis tests can broadly identify which sets of attributes are most important to large-scale migration patterns. Travel cost is clearly a key variable, but our greater interest is in the relative importance of the various destination attributes. We can examine the relative contributions of sets of attributes by dropping a set, reestimating the model, and conducting a likelihood ratio test on the difference in parameters between the initial and reestimated model. Likelihood ratio tests reject the null hypothesis that attributes in the set are unimportant if the value of the likelihood ratio test statistic is large.

Table 3 reports the chi-square test statistics when each of several attribute sets is removed from the first regression in Table 2. We cannot reject the null hypothesis for the sets of income, population, and general resource availability attributes. The chi-square test statistic supports the importance of the two poverty attributes (households in the bottom 30 percent of income and unemployment rate) and of the attributes that reflect upland characteristics alone (upland income, upland population density, roaded arable uplands, government forestland). The chi-square test

TABLE 3
HYPOTHESIS TESTS (VALUES OF THE CHI-SQUARE TEST STATISTIC)

Attribute Set	Destination Attributes Dropped from Model	Test Statistic
Income	(avg. income, avg. upland income)	0.036
Population	(population, upland pop. density)	0.036
Poverty	(bottom 30% of income profile, unemployment)	20.05*
General resource availability	(arable land, total forest land)	1.88
Upland resource availability	(upland pop. density, roads in arable uplands, public share of forestland)	67.84*

* Indicates significance at the 0.05 level or better.

statistic for the poverty attributes supports our expectation that the status of poorer households reflects closely on migrants' expectations for their own opportunities. The test statistic on upland attributes (not shown in Table 3) argues that, while general province-wide income, population, and general resource availability attributes are unimportant, more selective upland attributes are important for the choice of a migration destination.

Indeed, the insignificant coefficient on upland income in Table 2, together with the first (income) and fifth (upland) hypothesis tests, encourage a variant on the latter with upland income removed. (The last row of Table 3 reports this chi-square test statistic.) Altogether, these observations seem to argue that upland resource availability is a more important migration attractant than expected income. This would be a most reasonable finding for immigrants whose subsistence agricultural opportunities are more important than their participation in the cash economy. This last hypothesis test is critical. It confirms our initial expectations that it is the uplands attracting migrants in the Philippines, and that regions which display lower population density and larger areas of insecurely tenured lands are especially attractive. Settlement of these areas implies deforestation, and the difficulty the settlers have in establishing their own long-term rights to these lands implies a preference for short-term management practices that would create potentially important erosion and off-site environmental destruction.

IV. CONCLUSIONS

We have examined the attributes of alternative destinations in order to learn how they affect choices for migrating populations. A data set on Philippine migrants provided the basis for our analysis, but we expect the Philippine case is representative of many developing countries where an undeveloped frontier attracts an active migration flow.

Our empirical results confirm the expectations that attributes associated with the migrants' expected opportunities determine their choices among alternative destinations, and they highlight the importance of accessible natural resources. Upland income and employment opportunities may be attractive, but the availability of undeveloped land like forests and (developed or undeveloped) land with insecure rights to the existing tenure is particularly important.

This identification of upland natural resources as an attractant for streams of migrants is a crucial insight for policy analysis. Land at the frontier tends to be more fragile and more susceptible to environmental destruction. This is certainly the case for the steep upland frontiers of the Philippines. The combination of fragile lands and insecure tenure should raise grave concern for excessive deforestation and for downstream damage to reservoir catchments, prime agricultural land, and the in-shore fisheries. Policies to correct the tenure problem at the frontier will have important positive environmental impacts, especially where the immigration flow is substantial. Policies designed to encourage capital, subsidize energy, or support commercial agriculture or international trade often have unintended negative impacts on employment. Therefore, they unintentionally encourage migration and expand environmental damage at the frontier. The proponents of these policies seldom consider their indirect impacts at the frontier, but our results suggest that those impacts can be great where the migration streams are large.

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