Job Search and Migration in Peru[1]

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Abstract. Most of the empirical literature on migration in the context of developing countries focuses on migration from rural to urban areas. This paper aims to extend the analysis by incorporating rural-rural migration in Peru for the year of 1997. Based on a theoretical result, three empirical factors are explored in the paper using data from the Peruvian Living Standard Measurement Survey. First, wage differentials from different jobs shape the probabilities of rural-urban and rural-rural migration in distinct ways. Second, as compared with individuals that migrate to rural areas, urban migrants accumulate private wealth – in the form of durable goods - and acquire more public services. Finally, migrants are equally likely to move to a rural or an urban district as long as these are located in richer provinces.

1. Introduction

For some decades, several theoretical perspectives and empirical findings have aimed to explain the massive population movements that occur within and between regions. Due to the intrinsic dichotomies in the dimensions of migration, these studies have focused on specific issues of the migration process, making migration a fragmented field in the social sciences. For example, while some researchers explain the process of migration others explain the product of migration; there are studies of legal and illegal migration, internal and international migration, and investigations on voluntary versus forced migration, temporal

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versus permanent migration. Some studies have attempted to overlap some fragments of migration aiming to account for a more complete description of the process and its dynamic overtime. For instance, causes of international illegal immigration, consequences of returned migrants for rural development, among many others.

The migration literature has not only been shaped by its intrinsic dichotomies but also by its importance inside the political discourse of each country. In this sense, international migration, as a topic, has dominated the academic circles of Western universities, especially from those countries that are considered net receivers of immigrants, i.e. United States, United Kingdom, France, Italy, Spain, and Canada. Research on international migration has comprised many areas that range from understanding where migrants come from, issues related to assimilation, multiculturalism, immigration policy, social capital and socioeconomic performance, etc. A similar situation occurs for the case of internal migration. Due to its massive size, its impact on rapid city growth and city primacy, the costs for governmental authorities to provide services, and its consequences for the development of sending areas, rural-urban migration has been widely analyzed for the case of developing countries.

In the context of internal migration, urban-urban movements have been analyzed mainly in industrialized countries like the United States (Cadwallader 1992 and 1996), Western Europe (Fielding 1982), and the United Kingdom (Coombes 1987 and Fielding 1993); however, little has been done for the case of less developed nations. Similarly, urban-rural migration has been investigated mainly as a return migration phenomenon in developing nations (Nelson 1976) or as urban migrants from rich nations looking for amenities in rural areas (OECD 1996). Finally, rural-rural migration has been quantified as population movements at a national level using census data but limited analysis has been undertaken to understand the phenomenon. Moreover, comparisons between different migrant groups are rarely performed either due to lack of data available from specialized migration surveys (Bilsborrow et al. 1984), time constraints or budget limitations. In this paper, I attempt to partially tackle this issue by analyzing rural-urban and rural-rural migration for the case of Peru.[2]

In the theory of migration, some models have followed the neoclassical economics school which associates migration to an individual choice, that is a person will migrate if the present discounted value of his income is greater in the destination location than in the actual place of residence (Harris and Todaro 1970, and Krichel and Levine 1999). Other models from the new economics of migration state that migration

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[2] Due to data constraints, I could not identify urban-urban and urban-rural migration movements.

choices are made by households or communities, and these group of individuals act as to minimize risks involved with income earning activities and to overtake market imperfections (Stark 1991). Extensions to the theoretical models of migration have included social capital topics, that is the set of networks and interpersonal ties that connect migrants from origin and destination communities (Portes 1995), and cumulative causation, which means that migration has a self-reinforcing mechanism that makes it self-sustainable over time (Massey 1999).

The theoretical model developed in this paper assumes that the migration choice is made by individuals, who decide between staying in their origin community or migrating to a different area – either rural or urban- within the boundaries of the country, i.e. no international migration is allowed.[3] Individuals are forward looking agents who face a positive probability of losing their job and hence becoming unemployed in their origin communities. Then, individuals must decide between staying unemployed in their communities or moving to a different area, paying the cost of migration, and becoming unemployed in the destination area. This theoretical model extends previous analyses of dual economies by allowing individuals to distinguish between two places within the same area, that is two rural areas are not the same for migrants.

The theoretical model is tested empirically, with econometric methods, using data from the Living Standard Measurement Survey, LSMS, of Peru, 1997. This empirical model aims to quantify some dimensions of the migration process. First, the role of the informal labor market for migrants is approximated by wages earned by Peruvians in secondary jobs. Tienda and Raijman (2000) state that informal employment could work as a hedge against poverty for immigrant families in the United States. Second, differences in rural-rural migration versus rural-urban migration can become apparent by differentiating between wages earned in main jobs and wages earned in secondary jobs. Third, forces that pull people into destination areas and forces that push them out of origin areas are introduced in the analysis. According to Krugman (1996) urbanization involves a tension between the "centripetal" forces that tend to pull population and production into agglomerations and the "centrifugal" forces that tend to break such agglomerations up. Finally, accumulation of public goods and private durable goods in urban areas as compared to rural areas give intuition for Lipton's urban bias thesis, which states that government in less developed countries are pressured from power groups – mainly located in urban areas - therefore their public policies are biased towards the development of urban areas (Lipton 1977).

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[3] Given that only individual's choice is been modeled, it will be shown in the theoretical section that an extension to allow for international migration is straightforward.

The reminder of the paper is as follows. In section 2 socioeconomic conditions of Peru in 1997 are analyzed to determine the macro level conditions in which migrants and non-migrants live. Section 3 presents the theoretical model of migration choice and the specific cases that can be derived from the theory. Section 4 presents econometric models and Section 5 reports on the estimation of parameters and hypotheses testing. The paper concludes with a summary and presents policy implications of the results.

2. The Peruvian Case

Voluntary population movement in Peru is primarily a social phenomenon of the last 50 years. Starting in the mid-1940s, population movements towards cities fueled urban growth in the main urban centers of Peru, especially Lima. According to Malmberg (1988) migration reached its highest point at the end of the 1960s and population movements were usually from rural areas to smaller towns and from smaller towns to Lima. As a consequence, migration resulted in rapid population growth in large cities, smaller towns growing at the rate of the natural population growth, and a decrease in population in rural areas. From a micro perspective and, using data from the LSMS 1986, Pessino (1991) reports that migrants from less developed areas of Peru tend to be more educated and have better family background than natives. She also demonstrates that migrants out of Lima tend to be less educated than non-migrants.

Hentschel (1999) performs another micro analysis to measure how different groups in the Peruvian society can cope with poverty. His main question aims to measure how poverty risk changes over time. That is, by belonging to a specific group in society, (e.g. migrants), how high was the risk of being poor in 1994? And how did this risk change over time, did it increase or decrease for 1997? Hentschel found that migrant families appeared to be integrating well into their new environment. Such families were at 16 percent lower risk of being poor in 1994 than non-migrant families and at 18 percent in 1997. While most of the rural-to-urban migrants state that they migrate for income and employment reasons, their educational level tends to be higher than the non-migrants families.[4]

In formulating their migration decisions, Peruvian households respond to the context in which decisions are made. Factors such as labor market conditions, availability of public goods and services, housing, transportation and health facilities all influence the willingness of households to stay or move towards different locations. Therefore, it is

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[4] This result confirms one of Pessino's conclusions mentioned above.

important to stress some macro level changes to understand the environment in which individuals are making their choices. In Peru, social progress from 1994 to 1997 contained several aspects worth mentioning. As one of the positive developments of Peru, social welfare improved over the period of 1994 and 1997. The poverty rate in Peru declined for three consecutive years and in 1997 stood at 49 percent. Severe consumption poverty declined from about 19 percent in 1994 to 15 percent in 1997. Moreover, per capita real income growth rates from 1994 to 1997 was about 3.5 percent (INEI, 1998). On the other side of the coin, this economic growth was accompanied by deterioration in the distribution of income. Regional disparities have grown, with some regions showing enormous progress, especially Lima. Other regions have fallen relatively behind, especially the rural areas of the highlands. According to Hentschel (1999) this increase in inequality can create an increase in poverty, since the more educated Peruvians profited more from the upswing of the economy than the less educated. Moreover, increase in regional inequality can promote migration from the highlands into Lima by altering push and pull regional factors.

The following analysis of the Peruvian labor market is based on Hentschel (1999). From 1994, 1.3 million new jobs were created in Peru. People finding jobs included a small percentage of the unemployed but many more were newcomers to the labor market. The labor market participation rate in Peru, already on the rise since the beginning of the decade, has strongly increased. Table 1 shows participation rates for men increased by 5.6 percent in rural areas but decrease by –0.1 percent in urban areas. The participation rate for women increased in urban and rural areas, 17.47 and 12.32 percent respectively between 1994 and 1997. New jobs were created mainly in the informal urban sector of the economy. The increase in the formal sector employment was slightly less than half a million while informal employment grew by more than 800,000 (see Table 2). [5]

Table 1. Labor Force Participation Rates, 1994 and 1997

	Male			Female	
	1994	1997		1994	1997
Rural	75.6	79.9		45.2	53.1
Urban	91.4	91.3		64.9	72.9
Total	**80.7**	**83.0**		**51.2**	**59.0**

Source: World Bank Staff Estimates based on LSMS (1994, 1997)

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[5] The formal labor market comprises all wage earners or the self-employed who pay taxes, are insured with the social security institute, have a signed contract, have rights to vacation, or belong to a union.

Table 2. Remunerated Job Creation, By Formal and Informal Sector.
1994-1997 (in 1000 of jobs)

	Formal	Informal	Total
Urban	430	585	1015
Rural	45	235	280
Total	**475**	**820**	**1295**

Source: World Bank Staff Estimates based on LSMS (1994, 1997)

Peru: LSMS Data Specification

The data are drawn from the Living Standard Measurement Survey, LSMS, 1997. The sample survey provides general socioeconomic information on 3,843 households and approximately 19,500 individuals. There is a semi-detailed section on internal migration where 12,244 individuals were interviewed. The analysis is confined to persons in the age group 18 years and older. In this paper the research is performed at the household level, therefore individual level data is collapsed for each household and only those families that reported positive remuneration are considered. The employed sample frame of the LSMS achieves representability in the urban and rural areas of the three agro-climatic zones in the country (Costa, Sierra, Selva) and Lima.

Data obtained from LSMS, as compared to specialized migration surveys, have limitations in the potentials of the analysis that can be performed (Bilsborrow 1996). First, the Peruvian LSMS 1997 lacks information on an individual's earnings at the moment of migration. For this reason, the wage rate that is used in this analysis measures the post migration earnings of migrants. Second, data on the previous area of residence is provided at the Province level instead of at the District level[6], which is the minimum cluster unit of the LSMS. As it is expected, some provinces contain both rural and urban districts. Given the rural predominance of Peru, I assume that all previous provinces of residence were rural, therefore I was only able to obtain two directions of migration flows, which are rural-urban and rural-rural. Third, even though the LSMS contains detailed information on provision of public services in people's own shelters at the time of the interview, it does not contain data on the types of public services provided at the time that the family migrated. Once again, information on the provision of public services is a measurement of a post migration choice and it only accounts for estimates of stocks of public services, but not the scope of the change over-time.

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[6] To make an analogy to the US political geography, Department ≈ State; Province ≈ County; and District ≈ City/Town.

Table 3. Rural-Urban, Rural-Rural Migration, and Number of Observations.

	Rural-Urban Absolute	%	Rural-Rural Absolute	%	Total Migration Absolute
Settled Migrants	1,634	73	600	27	2,234
15 years Migrants	520	66	273	34	793
10 years Migrants	342	63	201	37	543
Total	**1,634**		**1,002**		

The next approach in the analysis was to define the period of time in which the migration event took place. Given that we have information on the year that families last moved, we were able to limit the scope of the migration to any specific time period. Given the limitations on the LSMS migration data mentioned above, there was no loss on the accuracy of the information on wages, services, durable goods, etc. due to extended migration time periods. Therefore, this paper considers lifetime migrants as the sample population that will be used for analysis. Table 3 presents directions of population movements for different time intervals of migration.[7] From the total sample of households, 2,234 (58%) reported having moved at least once in their lifetime. This percentage dropped nearly 37.5 points when 15 years were taken as the time frame of migration. From the percentage of families that are settled migrants (moved at least once in their lifetime) 73 percent migrated from rural to urban areas and 27 percent from rural to rural areas. Notice that as the time length of migration decreased, the percentage of families that move into rural areas increased.

3. Theoretical Model

Assume that the economy comprises multiple regions that follow into either of these categories, urban or rural. Individuals living in these areas are able to differentiate between them, e.g. rural area A is different than rural area B. Each citizen is also a worker who must choose a location. Although population is initially divided between the regions, a worker can move from one region to another by paying a migration cost *t*. This model assumed that the rate of unemployment in the formal economy was higher in urban areas than in rural areas, therefore in an urban region it was more likely that a worker:

1. will be fired and replaced by an unemployed worker or a worker employed in the informal sector;
2. loses her job due to an economic crisis.

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[7] The percentages from Table 3 do not change drastically if we consider individuals instead of families.

Workers are uncertain about the probability of losing their job at any point in time. In urban areas, the rate at which a worker can be unemployed is governed by a Poisson process with parameter $a+r$. In the urban region, r represents the fact that the probability of being unemployed is higher than in rural areas. For rural areas the rate of losing the job is governed by a Poisson process with parameter a. Let $p_i(0,h)$ stand for the probability that no regulation that shuts down the firm will arrive in a unit of time h in region $i=\{u,r\}$. Let $p_i(1,h)$ be the probability that a regulation will make the firm shut down in region $i=\{u,r\}$.

Let the time be represented by a sequence of discrete periods of variable length h. Let z denote the value of the time that could be spent in other activities per unit of time. In developed countries z is viewed as unemployment benefits. However, for a developing economy z could measure the rate of absorption of or income benefits derived from the informal economy. Let $b(h)$ represent the discount factor applied to future costs and benefits incurred per period of length h. If an individual searches for a job she pays a cost c per unit of time and finds a new job with a probability given by a Poisson process l.[8]

Workers maximize the expected present discount value of income. Let $W^i(w_u, w_r)$ represent the given present value of stopping, accepting the best offer received in the urban area, and working forever after until the worker becomes unemployed. The value of being employed for a worker, $W^i(.)$, is a function of the real wages paid in the urban and rural areas, i.e. w_u, w_r. The function $W^i(w_u, w_m)$ is continuous and strictly increasing. Let $V^i(w_u, w_r)$ denote the value of searching in region i during the next period. It is the expected present value of future net income given that the optimal strategy will be pursued in the future in region i.

Given the Poisson offer arrival specification, we can write the continuous time version of the analysis, which corresponds to the limiting case of an infinitesimal period length. Then:

$$W^i(w_u, w_r)(d + a_i) = w_i + (a_i)\left\{Max\left(V^i(w_u, w_r), V^j(w_u, w_r) - t\right)\right\} \tag{1}$$

$$V^i(w_u, w_r)(d + l) = z - c + l\left\{Max\left(V^i(w_u, w_r), W^i(w_u, w_r), V^j(w_m, w_r) - t\right)\right\} \tag{2}$$

where d is the interest rate and $a_I = a+r$ if $i = u$ and $a_i = a$ if $i = r$.[9]

In this paper, we are interested in the theoretical results of a model that will be empirically tested using data from the Peruvian LSMS.

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[8] According to Mortensen (1986) using the Poisson process has a natural specification since it imposes the restriction that time is required to find a job and that job opportunities are found sequentially.

[9] A complete description of the search methodology applied to the migration case is available from the author.

Therefore, migration from urban to rural areas is not allowed. Hence for a worker located in urban areas the value of being unemployed there will always be greater than in rural areas[10]. Also, rural to rural migration is allowed in this model. This implies that there exists a difference between the value of being unemployed in rural area A and rural area B.

The results of the model can be summarized with respect to the cases that will be analyzed with the data set from Peru.

Case A   *Workers migrate from rural areas into urban areas.*

From equation (1), the value of being unemployed for a worker in rural areas is lower than the value of being employed. Moreover, the value of being employed covers the cost of migration. Combining equation (1) for a worker in rural areas with the same worker in urban areas we get that the worker will migrate to urban areas if and only if:

$$(w_u - w_r) - r V^u(w_u, w_r) - t > 0 \tag{3}$$

The expected difference in wages is such that the future value of being unemployed in the city plus the migration cost will be completely absorbed.

Case B   *Workers migrate from rural areas into rural areas.*

Here there is a distinction between the value of being unemployed in different rural areas. In equation (1) and (2) this is captured by adding a subscript for the value of being unemployed in rural areas. We also assume that the wage rate paid in rural areas will not change between areas. Combining this information into equation (1) a worker will decide to migrate from one rural area to another if and only if:

$$V_f^r(w_u - w_r) - t - V_{in}^r(w_u, w_r) > 0 \tag{4}$$

Equation (4) states that a worker will migrate from rural areas into other rural areas if the value of being unemployed in the destination rural area (denoted by subscript *f*) minus the cost of migration are high enough to cover the value of being unemployed at the origin rural area (denoted by subscript *in*).

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[10] Another way of stating this restriction is that the value of being unemployed in rural areas in not as high as to cover for migration costs.

4.   Econometric Model Specification

Bivariate Probit

The model consists of two equations describing the binary outcome of migration (one for the individuals that migrate to urban areas and another for the individuals that migrate to rural areas). The dependent variables are then the binomial observations of being in an urban area or in a rural area. The sample observations may be thought of as falling into one of two regimes, therefore the model is a natural extension of the single probit model since we allow for more than one equation. This generalization implies that the disturbance term for each equation might be correlated.

It is assumed that at any point in time, a worker decides to migrate from rural to urban areas if and only if the benefit in terms of the wage gap exceeds the cost, therefore:

$$M_u^* = (w_u - w_r) - rV^u(w_u, w_r) - t > 0 \tag{5}$$

For the case of migration from rural to rural areas, the worker will migrate if and only if the value of being unemployed in the destination area minus the cost of migration is greater than the value of being unemployed in the origin area, therefore:

$$M_r^* = V_f^r(w_u - w_r) - t - V_{in}^r(w_u, w_r) > 0 \tag{6}$$

The wage-rate differential and the value of being unemployed in a specific region depend on the expected income of the area. For instance, if information about the labor market is perfect, workers are certain about the wage rate that is being offered in urban and rural areas. However, the choice of migration takes into consideration expected income due to the fact that in the future there is a positive probability of losing the job, or for instance, to find a better paid job. When the worker loses her job, she will become unemployed. She has the ability of getting a secondary job in the informal economy. The migration cost is a function of the age of the workers, and other individual and regional attributes. The cost of migration, t, and the value of being unemployed, $V^u(.)$, may be represented as a function of the wage rate in a secondary job sw^s, some personal characteristics X_i and location factors Z_i. Therefore, equations (5) and (6) suggest that the migration criterion is a function of wages in main jobs, wages in secondary jobs along with location factors

and personal attributes. This is expressed by the following equations:

$$M_u^* = a_0^{ru} + a_1^{ru}(\log(w_u) - \log(w_r)) + a_2^{ru}(\log(sw^{su})) + a_3^{ru}Age_i - a_4^{ru}X_i - a_5^{ru}Z_i - e_i^{ru}$$

$$(7)$$

$$M_r^* = a_0^{rr} + a_2^{rr}(\log(sw_f^{sr})) - \log(sw_{in}^{sr})) + a_3^{rr}Age_i - a_4^{rr}X_i - a_5^{rr}Z_i - e_i^{rr} \qquad (8)$$

I will explain the differences between the equation that describes migration from rural to urban areas (equation 7) and the one that describes migration from rural to rural areas (equation 8). First, rural-urban migration includes the actual wage-rate differential between these areas measured in logarithms. Using search methodology, our theoretical model suggests that the wage-rate differential for formal jobs between two different rural areas should not be included as a decision variable in the choice of migration, therefore this variable does not appear in equation (8). Second, when the workers are unemployed in rural areas they can earn a wage working in a secondary job, which is a proxy for earnings in the informal economy. Similarly, when workers migrate from rural to urban areas, the secondary job wage rate is also a measure of the value of being unemployed. Finally, in rural-rural migration workers will take in consideration the difference between payments that can be earned in secondary jobs. For both equations it is assumed that the error term is distributed normal with variances s_{ru}^2, s_{rr}^2, respectively, and that error terms are correlated, therefore Cov[e_i^{ru}, e_i^{rr}] = h.

Equations (7) and (8) constitute the structural form of the model, where the endogenous variable is the migration choice and the wage-rate differential in the model constitute the gains from migration. i.e. for those workers that migrate the wage-rate differential is expected to be positive. A dummy variable M_i takes the value of 1 when M_i^* >0 (the individual migrates), and takes the value of zero otherwise. Given that agents can take one of the decision at a time, earnings from migrants are observed only when $M_i = 1$ and for non-migrants when $M_i = 0$. Given the assumption of normality and correlation between the error terms, then maximum likelihood is used to estimate the parameters of the structural bivariate probit model. A detailed description of the model is presented in Long (1997).

Multinomial Logit

When the worker makes the migration choice, she can either migrate to a rural area, to an urban area or not migrate at all. Therefore, we can assume that the migration choice is a nominal outcome that can not be

ordered, and thus can be estimated using a multinomial logit model or a nested logit model depending on the case. If the bivariate probit model satisfies the independence of irrelevant alternatives property, IIA, then the model can be thought of as simultaneously estimating binary logits for all possible comparisons among the outcome categories. In this case a multinomial logit model applies for the estimation of the parameters. However if the correlation term for the residuals in the bivariate probit is different than zero, then a nested logit model will be necessary to esti-mate the parameters of the model. In order to test the correlation of re-siduals in a bivariate probit model a likelihood ratio is performed for the null hypothesis that $h = 0$.

In order to transform equation (5) and (6) into a multinomial logit model, we combine the migration choice into one variable that has 3 nominal outcomes. Let the migration choice, M_i, be equal to 0 if the worker does not migrate. It will be 1 if he migrates to urban areas and 2 if he migrates to rural areas. Also, let the matrix X contain all the exoge-nous variables of the analysis. Then, let $Pr(y = m \mid X)$ be the probability of the observed outcome m given X (the matrix of exogenous variables). This model is written as:

$$\Pr(y_i = 0 \mid X_i) = \frac{1}{1 + \sum_{j=1}^{2} \exp(X_i b_j)}$$

$$\Pr(y_i = m \mid X_i) = \frac{\exp(X_i b_m)}{1 + \sum_{j=1}^{2} \exp(X_i b_j)} \quad \text{form} > 0 \tag{9}$$

The multinomial logit model can also be estimated using maximum likelihood estimation. We want to estimate the b's that maximize the log likelihood equation for the probability of observing outcome m given X with parameters contained in vectors b_1 and b_2. A detailed description of the model is also presented in Long (1997).

5. Estimation Results

Table 4 reports definitions and statistical measurements of the vari-ables that will be used in the econometric analysis. Some of the variables in Table 4 require a brief explanation. There are two variables that quan-tify wage differential, rural-urban wage differential and rural-rural wage differential. Our theoretical model suggests that the former is the urban-rural actual wage differential that was obtained from equation (5). The later is the difference between the value of being unemployed between two different rural areas (equation 6), which will be approximated by the wage that can be earned in a secondary job. Since the Peruvian LSMS

does not contain information on wages in previous places of residence, I calculate the average wage of the main jobs for each of the provinces and impute this wage to each household – both migrants and non-migrants. For example, a migrant from the Amazonas Province into the District of Sayan is considered a rural-urban migrant. His wage-rate differential is actual wage in Sayan minus average wage in Amazonas. A similar procedure was used to calculate the secondary wage of individuals that is used in the rural-rural migration equation.

Table 4. Exogenous Variables Used in the Econometric Models.

Variable	Description	Units	Mean	S.D.
Wages and Compensations				
R_UWDIF	Rural-Urban Main Wage Differential (in logs)	Soles	0.34	1.47
R_RWDIF	Rural-Rural Secondary Wage Differential (in logs)	Soles	0.07	0.61
LNSJWU	Secondary Urban Wage (in logs)	Soles	6.18	0.656
SS	Social Security	0/1	0.92	-
CCAP	Job Training Courses	0/1	0.20	-
Household Characteristics				
AGE	Head of Household's Age	#	44.36	13.46
SEX	Head of Household's Sex (1=male)	0/1	0.65	-
INDIG	Indigenous	0/1	0.22	-
MARRI	Marital Status (1=married)	0/1	0.57	-
HHSIZE	Household Size	#	5.15	2.21
HDEDYRS	Head of Household's Education	#	7.28	4.34
Indexes				
ECSTAT	Economic Status Index	-	-0.11	2.22
PUSTAT	Public Goods Index	-	-0.18	1.77
Regional Characteristics (by Province)				
PR_POOR	Province Poverty Rate	0/1	58.39	19.69
PR_CROW	Crowding Index	0/1	26.83	12.06
PR_INAD	Percent Inadequate Shelter	0/1	27.43	20.86
PR_N0LI	Percent No Electric Light	0/1	48.22	26.51
PR_N0SE	Percent Lack of Sewerage	0/1	64.87	22.39
PR_N0WA	Percent Lack of Clean Water	0/1	57.15	23.36
PESOPOB	Population weight	#	1234.16	378.28

Note: The total sample size was 2947 households. LSMS Peru, 1997.

The estimation of rural-urban migration includes the value of being unemployed in urban areas, which is approximated by the wage rate earned in a secondary job in the cities. Similarly, in urban areas there is a higher probability of getting a job that will pay for compensations, like social security and training courses. Data on regional characteristics at the province level – from the 1992 census - are used in both equations to

control for regional disparities. The location variables include among others the percentage of poor people, the average access to water, the percentage of houses with adequate shelter, the percentage of houses with sanitation. All location variables match the actual province of the head of household. The intuition to use this post migration location matching is to account for pull and push factors at the province level, (i.e. the head of household was pulled by provinces with better access to public services, less poverty, better shelters). Not all of the regional variables will be included in the estimation since there is collinearity among them.

Two variables used in the analysis were calculated using principal component decomposition. The first variable is called ECSTAS and stands for economic status. The second variable is PUSTAT and stands for public goods provision status. Both of these variables are indexes that measure the provision of private and public goods. For example, ECSTAT contains information about durable goods for each household, the number of rooms in the shelter, the kind of material used to build the floors of the shelter, and the type of cooking fuel. Fifteen variables were aggregated and decomposed using principal components. Using eigenvalues, ECSTAT is created as an index that contains 90 percent of the variability of these variables. A similar procedure is used for PUSTAT, but the variables included are provision of pipe water inside the shelter, adequate sewerage and electric light in the shelter.

The equation used to describe migration from rural to urban areas contains information on the difference between primary wages, the wage rate in secondary jobs, age, marital status, sex, education, access to social security, training, economic status, public status, and percentage of poor people in the actual province. Therefore:

$$
\begin{aligned}
M_u^* = {} & a_0^{ru} + a_1^{ru}(\log(w_u) - \log(w_r)) + a_2^{ru}(\log(sw^{su})) + a_3^{ru} Age_i \\
& + a_4^{ru} Age_i^2 + a_5^{ru} marri_i + a_6^{ru} hdedyrs_i + a_7^{ru} ss_i + a_8^{ru} ccap_i \\
& + a_9^{ru} ecstat_i + a_{10}^{ru} pustat_i + a_{11}^{ru} pr\_poor + e_i^{ru}
\end{aligned}
\tag{10}
$$

The equation that describes rural-rural migration contains the wage-rate differential for secondary jobs. It includes basically the same set of individual variables, economic status, public status and province level of poverty. For instance, PUSTAT is included in this choice and we expect that households in the rural areas that already have "good" access to public services will tend not to migrate to rural areas, or possibly not to migrate at all. Equation (11) will be estimated for the choice of rural-rural

migration[11]:

$$M_r^* = a_0^{rr} + a_s^{rr}(\log(sw_f^{sr}) - \log(sw_{in}^{sr})) + a_3^{rr} Age_i + a_4^{rr} Age_i^2 + a_5^{rr} marri_i$$
$$+ a_6^{rr} hdedyrs_i + a_7^{rr} ecstat_i + a_8^{rr} pustat_i + a_9^{rr} pr\_poor + e_i^{rr}$$

(11)

In both equations the variable AGE is included in the decision to re-flect the notion that the probability of migration declines with age. The concavity of the pattern between migration and age of the household is captured by the quadratic age term. Age coefficients are expected to be positive and negative, respectively. The coefficient of MARRI refers to the marital status of a person, one indicates that the person is married. This variable controls for the effect of family ties on the mobility of the individual. The head of household years of education, HDEDYRS, may represent several crossed effects. On the one hand differences in educa-tion between migrants and non-migrants account since educated people have better access to labor market information and therefore move to where jobs are available. But on the other hand, more educated people and better jobs in developing countries are already concentrated in few urban places, hence promoting less mobility from people that already live in these places.

The economic status index is a proxy for wealth. It is difficult to set a priori the sign of its coefficient since this is a variable that accounts for post migration asset accumulation. If migrants were able to cope better with the economic conditions than non-migrants (as concluded by Hentschel 1999), then we expect that this variable will have a positive and significant sign. The public goods index, PUSTAT, quantifies households access to water, sanitation, and electricity. The effect of PUSTAT in the choice of migration is expected to be positive. The public service index is measured in 1997. It is expected that households that migrated before this year had benefited from the provision of public goods in either rural or urban areas, if any provision took place. Finally, only one province variable is incorporated in the equations. The per-centage of poor people in the province is representative of the general situation at the province level. The inclusion of only one province level variable avoids collinearity.

The estimations of the bivariate probit models for rural-urban and rural-rural migrations are presented in Table 5. Rural-urban migration is explained by the wage-rate differential between urban and rural areas.

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[11] In a previous estimation, the coefficients for the variables access to social security and access to training were not significant for the rural-rural migration choice. These variables will not be included in the main equation for rural-rural choice since most agricultural jobs do not pay for these kinds of compensations.

The coefficient estimate of this variable is positive, meaning that an increase in the wage-rate differential will lead to an increase in the probability of rural-urban migration to occur. The wage-rate differential for secondary jobs in rural areas will positively affect the likelihood of migration to rural areas.

The coefficient of age and age squared are both significant with the expected sign for the case of rural-urban migration. The older the head of household the less likely the family will migrate to urban areas. However these coefficients are not significant for the case of rural-rural migration. Marital status has a negative impact on migration from rural to urban areas, but its coefficient is insignificant for rural-rural migration. Household education negatively affects the probability of both rural and urban migration. This parameter indicates that the higher the number of years at school, the less likely the head of household would have chosen to migrate.

Table 5. Bivariate Probit Parameter Estimates for Migration

Variable	Rural-Urban Migration		Rural-Rural Migration	
INTERCEPT	0.302	(0.118)*	0.987	(0.572)
Wages and Compensations				
R_UWDIF	0.415	(0.052)*	N.M.	
R_RWDIF	N.M.		0.426	(0.083)*
LNSJWU	0.022	(0.117)*	N.M.	
SS	0.781	(0.280)*	N.M.	
CCAP	0.415	(0.199)*	N.M.	
Household Characteristics				
AGE	0.090	(0.034)*	0.024	(0.023)
AGE2	-0.001	(0.0003)*	-0.0003	(0.0002)
MARRI	-0.153	(0.157)*	0.016	(0.105)
HDEDYRS	-0.084	(0.023)*	-0.037	(0.015)*
Indexes				
ECSTAT	0.168	(0.049)*	-0.047	(0.032)
PUSTAT	0.543	(0.053)*	-0.438	(0.035)*
Regional Characteristics (by Province)				
PR_POOR	-0.055	(0.004)*	-0.007	(0.003)*

Notes: Asterisks represent significant at 95% level. Standard errors in parenthesis. N.M. stands for "variable not in the model". The number of households is 2,947. Log likelihood equals 2,252.20. Parameters estimated using Limdep statistical software.

Workers tend to look for benefits in the place where they will allocate labor. For instance, the variable access to social security and access to training are both positively related to migration from rural to urban areas. For workers, increasing the likelihood of finding a job in the formal sector of the economy is a pull factor that attracts families to the urban agglomerations. Moreover, economic status of the households is

positively related with migrants that ended up living in urban areas, and not significant for migrants moving into rural areas. I will try to give some intuition to explain this result. Individuals coming from rural areas into cities are likely to adopt some of the consumption patterns of city dwellers. For example, rural migrants living in the city are likely to buy goods such as televisions, own telephones, washing machines, cars, etc., which may account for the positive result obtained in the estimation.

The coefficient on the level of access to public services negatively affects the probability of migrating to rural areas, but it is positively related to the likelihood of urban migration. The intuition behind this result is similar to the one used for economic status since the public status index is also calculated for the household in 1997. For instance, families that migrated to rural areas lagged in their access to public services therefore the negative sign of the parameter captures this effect. This results suggests that rural areas in Peru still lack public services and families that had migrated to rural areas have not benefited. The opposite intuition is true for urban migration.

Finally, province variables are significant determinants of migration, both to urban and rural areas. The coefficient of percentage of poor people in the province has a negative impact on migration, -0.0545 in rural-urban migration and –0.0072 in rural-rural migration. This result indicates that the higher the level of poverty in the province, the less likely the head of the household would have chosen to move to that particular province.

The test for correlation between residuals is performed for the null hypothesis that $h = 0$. The estimated value of the correlation between residuals when the initial value of the parameter is zero is 0.056. Under the null hypothesis, the log-likelihood is the sum of the log likelihoods for the two independent probits (1,431.97+821.58) whereas the alternative hypothesis is the log likelihood of the bivariate probit. Therefore the likelihood ratio equals 2.69. The critical value from the chi-squared table with one degree of freedom is 3.84. The statistic suggest that the hypothesis that $h = 0$ cannot be rejected. Since the independence of irrelevant alternatives is not rejected, a multinomial logit model can allow analysis and hypothesis testing of the parameters.

The multinomial logit estimation is a simultaneous estimation of binary logits for all comparisons between the categories. For the case of migration, the worker can choose from one of the three following categories: first, she can decide not to migrate. Second, she can decide to migrate to an urban area. And thirdly, she can decide to migrate to a rural area. The probability that the worker choses one of these outcomes is determined by the whole set of individual and location characteristics that were included in the probit estimation. Lets define $\boldsymbol{X_i b_i}$ that will be

used to estimate equation (9) by maximum likelihood estimation:

$$X_i \, \boldsymbol{b}_i = \boldsymbol{b}_0 + \boldsymbol{b}_1 \, (\log(w_u) - \log(w_r)) + \boldsymbol{b}_2 \, (\log(sw^{su}) - \log(sw^{sr})) + \boldsymbol{b}_3 \, Age_i$$
$$+ \, \boldsymbol{b}_4 \, Age_i^2 + \boldsymbol{b}_5 \, marri_i + \boldsymbol{b}_6 \, hdedyrs_i + \boldsymbol{b}_7 \, ss_i + \boldsymbol{b}_8 \, ccap_i \tag{12}$$
$$+ \, \boldsymbol{b}_9 \, ecstat_i + \boldsymbol{b}_{10} \, pustat_i + \boldsymbol{b}_{11} \, pr\_poor + \boldsymbol{b}_{12} \, pr\_nose + \boldsymbol{e}_i$$

Results for multinomial logit estimates are presented in Table 6. Since the interpretation of 36 parameters will be tedious, I will interpret just the main results.

The main variable of interest in the migration choice on this setting is the wage differential. The estimated parameters indicate that with re-spect to no migration choice, the increase in either of the wage-rate dif-ferentials will increase the probability of migrating to another area, ei-ther rural or urban. One important observation about the wage-rate dif-ferential for rural-urban migration is that the estimated parameter for the main wage-rate differential is 0.294 while for secondary wages the pa-rameter is 0.311. It is proposed to use the Walt test to prove the hypothe-sis that the effect of this wage differentials is the same in rural-urban mi-gration but different in rural-rural migration. Therefore:

Test A. Rural_Urban: $H_0: \beta^1_{r\_uwdif} = \beta^1_{r\_rwdif}$ <u>vs.</u> $H_1: \beta^1_{r\_uwdif} \neq \beta^1_{r\_rwdif}$
Test B. Rural_Rural: $H_0: \beta^2_{r\_uwdif} = \beta^2_{r\_rwdif}$ <u>vs.</u> $H_1: \beta^2_{r\_uwdif} \neq \beta^2_{r\_rwdif}$

Table 6. Multinomial Logit Parameter Estimates for Migration
              No Migration is the comparison group

Variable	Rural-Urban Migration		Rural-Rural Migration	
INTERCEPT	-1479	(0.623)*	-1.597	(0.776)*
	Wages and Compensations			
R_UWDIF	0.294	(0.036)*	0.124	(0.047)*
R_RWDIF	0.312	(0.076)*	0.813	(0.109)*
SS	0.625	(0.213)*	0.125	(0.225)
CCAP	0.250	(0.119)*	-0.109	(0.234)
	Houshold Characteristics			
AGE	0.976	(0.024)*	0.030	(0.029)
AGE2	-0.0006	(0.0002)*	-0.0003	(0.0002)
MARRI	-0.372	(0.103)*	0.049	(0.135)
HDEDYRS	-0.042	(0.015)*	-0.095	(0.023)*
	Indexes			
ECSTAT	0.024	(0.031)	-0.187	(0.063)*
PUSTAT	0.310	(0.038)*	-0.497	(0.052)*
	Regional Characteristics (by Province)			
PR_POOR	-0.023	(0.004)*	-0.024	(0.005)*
PR_NoSE	-0.011	(0.038)*	0.003	(0.005)

Notes: Asterisks represent significant at 95% level. Standard errors in parenthesis. The number of households is 2,947. Log likelihood equals 2,121.39. Parameters estimated using STATA statistical software.

For the case of rural-urban migration the $\chi^2(1)$ is 0.04 and therefore we accept the null hypothesis that the parameters for the wage-rate differentials for main jobs and secondary jobs are equal. For the case of rural-rural migration the $\chi^2(1)$ is 31.68 and with 95 percent confidence we reject the null hypothesis of equality between the parameters of these two variables. This result leads me to the partial conclusion that main job wages and secondary job wages in urban areas have a similar effect on the migration choice. Moreover, this result is consistent with the analysis of the Peruvian economy since new jobs were created mainly in the informal urban sector of the economy. For rural-rural migration the effect of the wage-rate differential for secondary jobs is higher than the effect of wage-rate differential for main jobs.

Two other determinants of migration will be tested to understand rural-urban migration against rural-rural migration. The first is the effect of public goods on the migration choice. The second is the effect of province level poverty rate on the migration choice. The former is important for policy analysis as a way of decreasing migration patterns towards metropolitan areas. The later explains pull factors toward richer provinces.

Public goods status:

The coefficient of the public good index for rural-urban migration against no migration is 0.3099. As analyzed for the case of probit estimation, this coefficient means that those individuals that migrate to urban areas were able to have better access to public services. The same coefficient for rural-rural migration is –0.4967, indicating a negative relation between the provision of public goods to those families that decide to migrate to rural areas. A Wald test is performed to verify the equality of this parameters, but with opposite sign. Let:

Test C.: $H_0: \beta^1{}_{pustat} = -\beta^2{}_{pustat}$ vs. $H_1: \beta^1{}_{pustat} \neq -\beta^2{}_{pstat}$

The $\chi^2(1)$ is 7.18 and with 95 percent confidence we reject the null hypothesis of equality and opposite sign between the parameters that affects urban migration and rural migration. From a policy analysis perspective, increasing public services in rural areas may have an effect on decentralization and individual's wealth being.

Poverty rate in the province:

The coefficient that relates poverty rate of the province with migration is negative for both choices of migration. This means that workers

will decide not to migrate to a province that has a high poverty rate, hence richer provinces attract individuals. The hypothesis to be tested here is whether this effect is equal for urban migration and for rural migration. The null hypothesis can be written as:

Test D.: H_0: $\beta^1_{pr\_poor} = \beta^2_{pr\_poor}$ <u>vs.</u> H_1: $\beta^1_{pr\_poor} \neq \beta^2_{pr\_poor}$

The $\chi^2(1)$ equal 0.06 and with 95 percent confidence the null hypothesis of equality between the parameters are not rejected. From a regional development analysis this implies that workers will tend not to migrate to poor provinces, no matter if the province is mainly rural or urban.
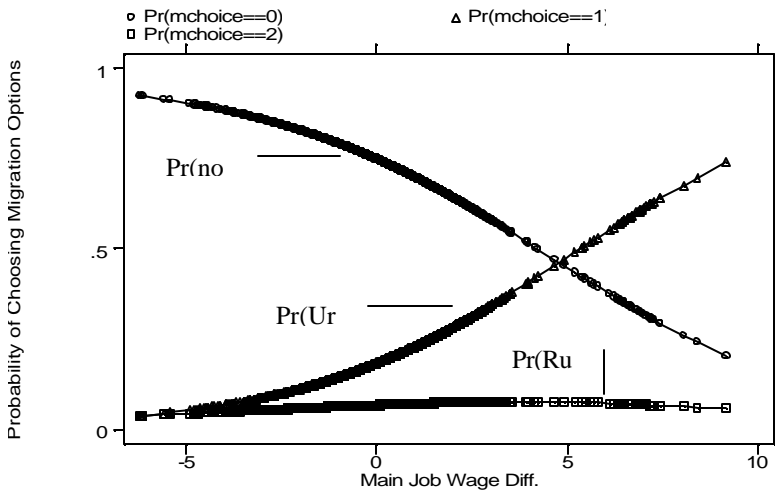
Figure 1. Predicted Probability Main Job Wage Diff.

A deeper analysis of the effect of the wage-rate differential is performed by calculating the predicted probability for a worker to choose each of the different migration choices, including no migration. To determine the variation in the predicted probability of migration when the wage-rate differential for main job changes it is necessary to fix all the rest of the exogenous variables at a certain level. All variables except for marital status, access to social security and training are held at their mean. Marital status is fixed at one, meaning that the individual is married. We allow workers to have access to social security but no training. Figure 1 shows how the predicted probability for choosing migration options changes as the wage-rate differential for main job increases.

As it is shown in Figure 1, the predicted probability of choosing no migration when the wage-rate differential for main jobs is negative is around 90 percent. As the wage-rate differential increases, worker migration to both urban and rural areas starts to increase. Migration to urban areas increases faster than to rural areas, this being evidence of urbanization due to wage-rate differentials.
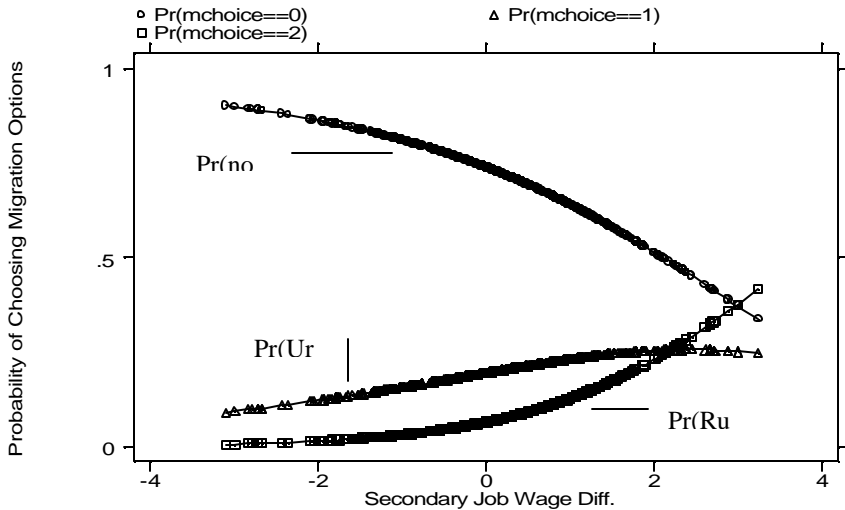
Figure 2. Predicted Probability Secondary Job Wage Diff.

Figure 2 shows the results for the changes in the predicted probabilities of migration outcomes when secondary jobs wage differential increases. Again, consistent with the theoretical model, as the wage rate for secondary jobs is negative the probability of no migration will be relatively high. However, as this wage rate difference increases the probability of migrating to rural areas will increase at a higher rate than for urban areas.

The last stage of the analysis is to measure the partial change in the probability of choosing a migration outcome when one of the continuous exogenous variables changes. To compute this partial change in the probability, we take the derivative of equation (9) with respect to the variable x_k, therefore:

$$\frac{\partial \Pr(y = m \mid X)}{\partial x_k} = \Pr(y = m \mid X) \left[\boldsymbol{b}_{km} - \sum_{j=0}^{J} \boldsymbol{b}_{kj} \Pr(y = j \mid X) \right] \tag{13}$$

The partial change is the slope of the curve relating x_k to the probability of choosing migration outcome *m*, holding all other variables constant. The value of the marginal effect depends on the values of all independent variables and on the coefficients for each migration outcome. Table 7 shows the results of the marginal effect of an increase in the public services access on the probability of the worker choosing a migration outcome.

Table 7. Marginal Change in Probability. Multinomial Logic Model of Migration Outcomes.

Variable	NM	Marginal Change on RUM	RRM
PUSTAT	-0.02007	0.05605	-0.03598
PR_POOR	0.01535	-0.00031	-0.01504

Migration is classified as **NM**=No Migration; **RUM**=Rural-Urban Migration; **RRM**=Rural-Rural Migration.

When the public status index increases by one unit, the probability of no migration decreases by –0.02, holding all other variables at their means and the dummies at the values already mentioned. There is a positive effect between the change in the public good index and its marginal effect on the probability of migrating from rural to urban areas. Another interesting result is the effect of a change in the province poverty rate on the probability of migration to rural or to urban areas. As shown in Table 7, these probabilities decrease by –0.00031 and –0.01504, respectively, when the province poverty rate suffers an infinitesimal increase.

6. Conclusions

Empirical models of migration in developing countries have been focused on the study of rural-urban migration, its population patterns, cultural assimilation of rural immigrants, adaptation to city life, immigrants group formation and demand for public services by rural migrants, among others. The theoretical model and empirical analysis described in this paper aim to extend the analysis of migration by exploring and comparing patterns of rural-urban and rural-rural population movements in Peru. The theoretical model assumes that workers in the economy face a positive probability of being unemployed, which encourages workers to leave their place of origin by paying a migration cost and becoming unemployed in the destination area. One of the interesting results of the theoretical model is that migrants moving from a rural area into an urban area will take into consideration the wage-rate differential

between these areas. But for the case of rural-to-rural migration, workers will considered the value of being unemployed as one main determinant of their migration choice.

An empirical estimation of the theoretical model is performed using data from the Peruvian Living Standard Measurement Survey 1997. First, the model explores whether differences in wages received from main jobs as compared to wages received from secondary jobs have an effect on migration. Also, whether this wage effect is different for the case of urban migrants versus rural migrants. Second, variables such as level of urbanization, amenities, and the housing market have been said to affect push and pull factors into different areas. In this model, I explore the level of poverty at the province level to verify whether rich provinces tend to pull people into the region. Finally, urban bias policies have benefited urban dwellers. Estimations of parameters from the bivariate probit and multinomial logit models are performed using maximum likelihood.

The empirical results show that wage-rate differentials are important determinants for the migrant group. The higher the main job's wage differential between rural and urban areas, the more likely the person chooses to migrate to urban areas. Interestingly, as the wage-rate differential increases for secondary jobs in two different areas, migration is more likely to occur between rural areas. This last result suggests an important complementarity between secondary activities in rural areas and the main agricultural activity. Promoting diversification on the production activities in rural areas, like small businesses, commerce and services can serve as a magnet devise for migrants. The fact that there are several income generating activities for migrants and non-migrants may lead theories of migration to consider these potential differences.

There is evidence that the level of public good provision has been unequal between rural and urban areas. For those families that migrate to urban areas I found evidence of a positive relationship with the access to public services. However, the estimations suggest a negative relationship for households that migrate to rural areas. From a policy perspective, increasing access to public goods in rural areas may contribute to a decrease in urban migration, promote development and increase individual wealth levels. This result provides evidence in favour of Lipton's thesis of urban bias. In this analysis, migrants moving to urban areas accumulated more public goods than migrants that move to rural areas. Finally, migration and the province poverty rate have a negative relationship, suggesting that richer areas tend to agglomerate population, no matter if the area is rural or urban.

Finally, it is important to mention some of the limitations of the analysis. Theoretical limitations occur since the model does not take into consideration social capital issues that are important for migrants at the

moment of searching for jobs, minimizing migration costs, and obtaining networks in the place of destination. The model considers an individual decision-maker and ignores the role of family and community in shaping such choice. Empirical issues arise from the data collection. The Peruvian LSMS does not contain detailed information on wages, wealth and services for migrants at the moment of the decision. Moreover, specific information on previous district of residence was not collected, therefore identification of different migration flows were not possible.

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