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ANALYZING ECONOMIC ATTAINMENT PATTERNS OF FOREIGN BORN LATIN AMERICAN MALE IMMIGRANTS TO THE UNITED STATES: AN EXAMPLE USING HIERARCHICAL LINEAR MODELING

SUMMARY

The paper presents the research which examines and endeavors to account for variation in the economic attainments of immigrants to the United States from Latin America, through the use of Hierarchical Linear Modeling. When analyzing this variation, researchers typically choose between two competing explanations. Human capital theory contends that variation in economic attainment is a product of different characteristics of individuals. Social capital theory contends that variation in economic attainment is a product of differences in characteristics of the societies from which the workers come. The author's central thesis is that we need not choose between human and social capital theories, that we can rely on both theoretical approaches, that it is an empirical and not a theoretical question how much variation can be explained by one set of factors versus the other. The real problem then is to build an appropriate methodology that allows us to partition the variation in economic attainments, identifying how much is explained by individual and how much by group characteristics. Using a multi-level modeling technique, this research presents such a methodology.

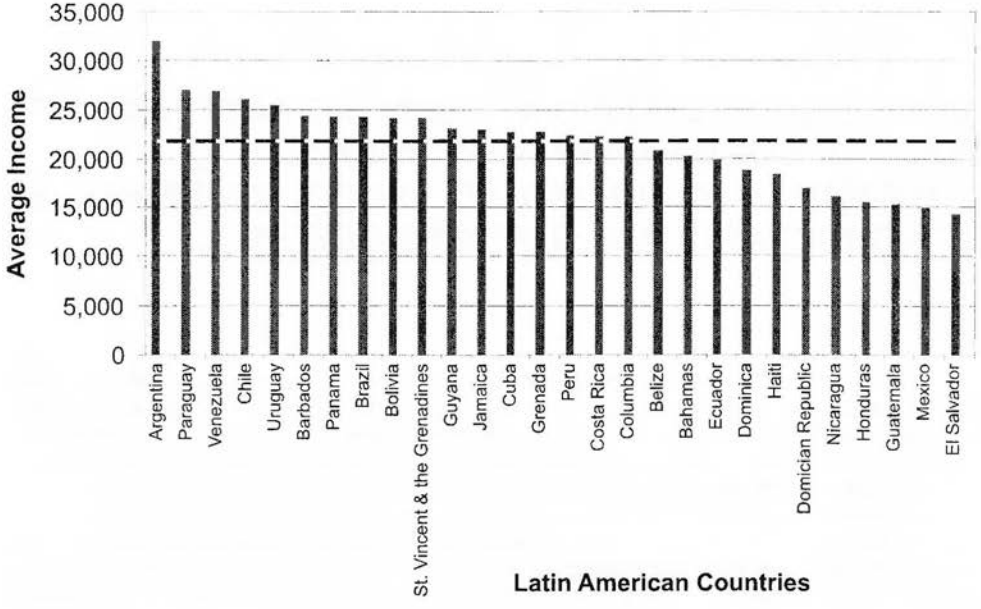
KEY WORDS: migration, social capital, human capital, multi-level modeling, hierarchical linear modeling, economic attainment, social networks

This research examines and endeavors to account for variation in the economic attainments of immigrants to the United States from Latin America, through the use of Hierarchical Linear Modeling. When analyzing this variation, researchers typically choose between two competing explanations. Human capital theory contends that variation in economic attainment is a product of different characteristics of individuals. Social capital theory contends that variation in economic attainment is a product of differences in characteristics of the societies from which the workers come. The choice between these two explanations, however, is not an easy one. Both explanations are plausible and advocates of both have provided impressive evidence in support of their assertions.

Figure 1 presents the mean income for immigrant groups from Central and South America and the Caribbean Basin. The range of average income earned is large with Argentinean immigrants earning the most at $32,019, and Salvadoran

immigrants earning the least at $14,286, or about 45% of the average for Argentineans. Why does this disparity exist? Is the variation explained at the individual level? Does the country of origin play a role in the economic attainment of individual immigrants?

*Figure 1**



*the horizontal line represents the mean income for all male immigrants to the United States from the countries included in this graph.

Methodological Approach

This research will be distinguished by its use of both individual human capital and aggregate social context variables to account for the economic success of immigrants. However, using both types of variables presents a methodological problem. Traditionally, two procedures have been used in this type of research. The first technique involves disaggregating the contextual variables to the individual level. The characteristics of the country would be assigned to the individual immigrant and an Ordinary Least Squares (or another such estimating model) would be used at the individual level. The use of this procedure in fertility research presents a fundamental problem. If we know that women are from the same country, then we also know that they have the same values on the various country characteristics. The assumption of independence of observations may not be used because women are not randomly assigned to countries (De Leeuw and Kreft, 1986).

Another technique involves aggregating individual-level variables up to the contextual level. Analysis would then be done at the aggregate level. This procedure, however, discards within-group variation, which, in some instances could mean as much as 90 percent of the variation is discarded even before the analysis is started.

A multi-level technique is needed to address the potential methodological pitfalls inherent in the two techniques just discussed. Hierarchical Linear Modeling (HLM) is a technique that accounts for these issues. HLM has the ability to more precisely measure the effects of aggregate level variables on individual level variables. It is a regression of regressions utilizing both aggregate and individual level variables, measuring the effect of the first on the slope of the second.

Hierarchical Linear Modeling differs from Ordinary Least Squares by taking a Bayesian approach regarding error terms. The Bayesian outlook views any decision process that does not proceed from some likelihood function and some set of priors as having deficiencies that are objectively verifiable. One of the fundamental features of the Bayesian framework is that there is "available prior information about the parameters and that this may be exploited to find improved, and sometimes substantially improved, estimates" (Lindley and Smith, 1972).

Essentially, the Bayes estimates are a "weighted average of yi=Oi and the overall mean, y, with weights inversely proportional to the variances of yi and Oi. Hence the natural estimates are pulled towards a central value y, the extreme values experiencing most shift" (Lindley and Smith, 1972: 3).

Many kinds of social research involve multi-level data structures. Huttenlocher, Haight, Bryk and Seltzer (1991) studied how differences among children in exposure to language in the home influenced vocabulary development over time. Their research did not involve observations of individuals at the same fixed number of points in time, but rather the number and spacing of points in time varied from individual to individual. These "occasions" were viewed as nested within persons. Mason, Wong and Entwistle (1983) examined differences in national economic development and how such differences interacted with adult educational attainment to effect fertility rates. Braun, Jones, Rubin and Thayer (1983) used hierarchical linear modeling to develop prediction equations for various numbers of minorities in 59 graduate business schools.

Such multi-level research has presented a number of conceptual and technical concerns. Bryk and Raudenbush (1992) identify these concerns as aggregation bias, misestimated standard errors, and heterogeneity of regression. Aggregation bias is described as occurring "when a variable takes on different meanings and therefore may have different effects at different organizational levels" (Bryk and Raudenbush, 1992: 83). The use of hierarchical linear modeling resolves aggregation bias by enabling a "decomposition of any observed relationship between variables...into separate Level-1 and Level-2 components" (1992: 84).

Misestimated standard errors occur with a failure to account for the dependence among individual responses within the same organization. HLM resolves this concern by "incorporating into the statistical model a unique random effect for each

organizational unit" (Bryk and Raudenbush, 1992: 84). When the relationships between individual characteristics and outcomes vary across organizations, the third concern arises, heterogeneity of regression. This is resolved with the ability to "estimate a separate set of coefficients for each organizational unit, and then to model variation among the organizations in their sets of coefficients as multivariate outcomes to be explained by organizational factors" (Bryk and Raudenbush, 1992: 84).

HLM estimates linear equations that explain individual-level outcomes for persons who themselves are nested in groups, i.e., countries. HLM does not need to assume that the person and country characteristics of the individual workers come from simple random samples, as would be the case were ordinary least squares (OLS) regression employed (Arnold, 1992: 59).

HLM can be used in research on the economic attainment patterns of immigrants to the United States. While individual factors such as educational attainment, type of employment, number of hours worked, and so forth, are important predictors of economic attainment, a strong argument may also be made in favor of an aggregate component in predicting economic success. Portes and Bach (1985) argue that the degree to which group-level, or structural, factors are related to patterns of earnings are just as important as individual human capital factors. The "distinct social context which receives and incorporates...(immigrant groups) decisively affect...(their) collective fates regardless of the skills...(that they bring to the U.S.)" (Portes and Bach, 1985: 210). Their notion of the ethnic enclave carries with it the idea that an immigrant moves into a social context which can lead to economic success.

It is the benefit of multi-level analysis that makes HLM a valuable tool in migration research. HLM, for example, enables analysis of the effect of country of origin characteristics on individual human capital variables. It enables an estimation explaining individual-level outcomes for persons who themselves are nested in groups, i.e., countries.

An example in the area of migration is the area of the differential economic success between and among immigrant groups. Research has been done on the prediction value of individual level variables on economic success. Such factors as educational attainment, etc., have been shown to be reliable predictors of economic attainment. The variation between groups, however, is not adequately explained by such individual variables. Does the country of origin affect the ability to translate individual level variables into economic success? Because such a question involves two levels of analysis, HLM provides a valuable tool to use in addressing such issues.

Bryk and Raudenbush (1992) present three benefits of using Hierarchical Linear Modeling. Applied to migration research, it allows improved estimation of individual effects by producing an improved regression model for individual immigrants by "borrowing strength from the fact that similar estimates exist for other...[individual immigrants]" (1992: 5). HLM also allows the formulation and testing of hypotheses concerning how variables measured at one level influence variable relationships at another level. Finally, HLM "draws on the estimation of variance and covariance components with unbalanced, nested data" (1992: 7).

HLM involves the undertaking of regressions of regressions. First, a series of separate regressions of the earnings patterns of the male workers is conducted. One is done for each of the countries analyzed. These are the level-1, or within-country, equations. Their intercepts and coefficients are then used as the dependent variables in an equation across countries, referred as a level-2, or between-country, model. The "variance around each parameter from the first level is also taken into account in the regression...at the next level" (Arnold, 1992: 61). Maximum likelihood and generalized least squares estimation procedures are used to generate the HLM coefficients and variances.

HLM allows the specification of the degree of association between the within-country relationships and level-2 characteristics. These estimates are weighted by the degree of precision of each country's mean earnings estimate (Arnold, 1992) to gauge the degree of association between the level-2 characteristics and average earnings.

Sociological and related literature has maintained the importance of considering the effects of the opportunity structures of specific immigrant environments on achievement. Portes and Bach (1980; 1985), Wilson and Portes (1980), Wilson and Martin (1982) and Roberts (1995), among many others, have shown that immigrants do not arrive as isolated individuals with only their human capital skills available to help them achieve in the U.S. workplace. Various kinds of opportunity structures, networking environments, and other social contexts are also provided to them, varying in degree depending on their country of birth. These country-specific assets "which receive and incorporate...(the immigrant groups) decisively affect...(their) collective fates, regardless of the (human capital) skills...(that they bring to the U.S.)" (Portes and Bach, 1985: 268).

These country-specific assets better allow the immigrant to use individual human capital skills in the workplace. Using both individual-level human capital and country-level social context variables, the following chapter will present a comparison of ordinary least squares regression and hierarchical linear modeling. HLM will allow an examination of the extent to which the dependent variable is effected by independent variables measured at different levels of analysis, and an appraisal of the degree to which country-specific assets improve the immigrant's use of individual human capital skills in the marketplace.

Data and Method

Data for this research are drawn from a six percent file of individual questionnaires from the Public Use Microdata Sample (PUMS) of the 1990 U.S. Census of Population. The male foreign-born workers to be analyzed were born in 28 Central American, South American and Caribbean Basin countries. The sample is restricted to men aged 25–64 who reported themselves working in the United States in 1989 at a job and who received positive earnings in 1989 of at least $1,000. Men who were attending school or in the military in 1990 are excluded be-

cause these activities tend to temporarily depress earnings (Neidert and Tienda, 1984: 301). The sample is also confined to men who worked at least 10 weeks in 1989 and who worked an average of at least 10 hours per week. We used the general rule that to be included in the sample, a country must have a sample population of at least 100 members. Since the database is a six percent sample of the U.S. population, each group of male workers analyzed, after the above restrictions are applied, has a minimum size in the United States population of about 2,400.

The distribution of *annual earnings* is conceptualized as a function of human capital endowments. The dependent variable of annual earnings is operationalized as the sum of earnings and self-employed income based on self-reported information in the 1990 census for the year of 1989. *Annual earnings* is measured in actual dollars. Other functional forms of earnings (such as its natural logarithm) were considered and rejected because dollar earnings is more amenable to interpretation in terms of direct dollar payoffs, and provides a better linear fit across subsamples of the population. It is also more appropriate within the context of human capital theory (Hodson, 1985; Mosteller and Tukey, 1977).

Eight possible individual human capital variables were considered for this research including *years of school completed*, *professional status*, *marital status*, *number of weeks worked in 1989*, *number of hours worked per week in 1989*, *English proficiency*, *labor force experience*, and *self-employment*. Zero-order correlation matrices including all eight individual-level independent variables and the dependent variable of *earnings* were run for each country group. The variables *years of school completed*, *professional status*, *marital status*, *number of weeks worked in 1989*, and the *number of hours worked per week in 1989* had the highest coefficients with annual earnings in a matrix of correlations among all immigrants (see Table 1). For the purpose of this example, two of the five variables were arbitrarily chosen. *Number of years of school completed* and *professional status* had the highest correlation coefficients, both above 0.3.

Table 1: Correlation matrix of individual-level predictors of income attainment

	Income	Professional Status	Years of School	English Proficiency	Marital Status	Self-Employed	Labor Experience	Hours Worked, 1989	Weeks Worked, 1989
Income	1.000								
Professional Status	0.334	1.000							
Years of School	0.323	0.366	1.000						
English Proficiency	0.249	0.212	0.401	1.000					
Marital Status	0.090	0.016	-0.021	0.006	1.000				
Self-Employed	0.134	0.091	0.059	0.032	0.038	1.000			
Labor Experience	0.053	-0.018	-0.138	-0.070	0.089	0.086	1.000		
Hours Worked, 1989	0.183	0.043	0.014	0.021	0.030	0.063	-0.023	1.000	
Weeks Worked, 1989	0.290	0.084	0.127	0.138	0.014	0.021	0.041	0.089	1.000

The *number of years of school* completed has been demonstrated to be one

of the strongest predictors of economic attainment (Becker and Chiswick, 1966; Becker, 1975; Martin and Poston, 1977; Martin et al., 1980).

Professional status is also considered for analysis. It is operationalized as a dummy variable coded 1 if the immigrant has a professional status job, and 0 if otherwise. Occupational variables have been demonstrated as influential in variability of earnings (Portes and Bach, 1985; Hodson, 1985; Nee and Sanders, 1985).

These two level-one variables are centered about their country means. The intercept of the individual-level equation then becomes a true average income in each country before the effects of individual-level independent variables are examined.

HLM allows the use of roughly one aggregate-level variable per ten cases. With 28 countries in the analysis, two to three aggregate-level variables may be used. Two were chosen for this example. *Mean years of education completed* is the first aggregate variable proposed for analysis. This variable differs from the individual-level variable in that it is measured for the entire immigrant population 25 years of age and over living in the U.S. from each of the respective Central and South American and Caribbean Basin countries. The hypothesis is that the higher the average level of education of the country group, the greater access to opportunities and networks available to the foreign-born males from that country. This aggregate variable has an average value of 9.07 among the 28 countries in the sample, and ranges from a low of 7.8 in Mexico to a high of 12.2 in Argentina.

The second aggregate variable proposed for this example analysis is the *percentage of the population that is naturalized.* The hypothesis here is that the higher the rate of naturalization of the specific population, the more it is integrated and assimilated into the society and is, therefore, more able to make available economic livelihood possibilities to immigrants. Merton (1984) has maintained the importance of "socially expected durations" in the success of immigrants to the U.S. A group with a high naturalization rate indicates the expected duration of immigrants to be permanent, with a greater ability to assimilate into society and presenting certain advantages to such groups over those with low rates of naturalization. Roberts argues that "resident aliens are subject to certain regulations and fiscal penalties that do not apply to citizens" (1995: 61).

This contextual-level variable is calculated for the entire population of each of the 28 countries in the study. All aggregate-level variables are centered about their grand mean. Descriptive statistics already gathered show that the naturalization rate for the 28 countries averaged 25.8, and ranged from a low of 14.4 for Nicaragua to a high of 49.8 for Cuba.

The Method of Ordinary Least Squares Regression

The "method of least squares" provides a prediction line that minimizes the amount of difference between the actual values and the predicted values of the dependent variable. This is accomplished by minimizing the sum of the squares of the

prediction errors (SSE) (Lewis-Beck 1980). Using the equation for the sum of squares for error:

$$SSE = \Sigma(Y - \hat{Y})^2$$

where

$$\hat{Y} = a + bX$$

The equation becomes

$$SSE = \Sigma[Y - (a + bX)^2]$$

"Thus the method of least squares chooses values for *a* and *b* that minimize the SSE. Stated differently, the method of least squares chooses the regression line that describes a bivariate relation with the least amount of error" (Ott et al., 1992: 471).

Least squares regression provides, in the *b* value, "the average change in Y associated with a unit change in X_k, when the other independent variables are held constant" (Lewis-Beck, 1980: 49). In other words, the method of least squares regression, in a multivariate analysis, provides a picture of the slope of the effect of an independent variable on the dependent variable while controlling for the effects of other independent variables.

Table 2 provides the results of an ordinary least squares regression model using the individual-level variables listed above. The *beta* values (the standardized regression coefficients) reveal that the independent variable *weeks worked in 1989*, with a $\beta = .217$, accounts for the greatest average change in the *income* holding *the number of years of school completed* and the other independent variables constant.

Table 2: Ordinary least squares regression coefficients for level-1 variables

Income 9	Coef.	Std. Err.	t	P≤|t|	Beta
pro	11811.550	115.277	102.462	0.000	.215
yearsch9	710.218	8.848	80.270	0.000	.181
lang	3616.505	76.916	47.019	0.000	.100
married	2810.560	74.486	37.733	0.000	.073
selfemp	5080.767	126.954	40.020	0.000	.078
laborexp	119.126	3.374	35.305	0.000	.070
hour89	242.746	3.278	74.063	0.000	.144
week89	343.680	3.130	109.793	0.000	.217
-cons	-23279.150	218.884	-106.354	0.000	.

Prob ≤ F = 0.0000
R-squared = 0.2650

Table 3 presents the results of an ordinary least squares regression using the two group-level variables. The units of analysis are the 28 countries. Again, both variables are significant at the p≤.001 level. *Mean number of years of school* accounts for the greatest average change in income holding *percentage of the popu-*

lation that is naturalized constant ($\beta = .179$). The level-2 variables only explain 7 percent of the variation in the *income* variable (R-squared = 0.0709).

Table 3: Ordinary least squares regression coefficients for level-2 variables

Income 9	Coef.	Std. Err.	t	P≤|t|	Beta
Meansch	1625.378	20.090	80.905	0.000	.179
Natural	6214.385	83.176	74.714	0.000	.166
-cons	-86.203	196.947	-0.438	0.662	

Prob ≤ F = 0.0000
R-squared = 0.0709

A third approach using ordinary least squares disaggregates all the country-level variables to the level of the individual. Since this research is examining the effects of country-level characteristics on the ability of individuals to succeed economically, country-level variable values would be assigned to individual migrants. Table 4 presents the results of an ordinary least squares regression using the two individual-level variables and assigning the aggregate-level variables to individuals. In this model, *professional status* has the greatest effect on individual earnings with a Beta of .233. This model explains 17 percent of the variation in individual income (R-squared = .1720).

Table 4: Ordinary least squares regression coefficients for level-1 variables and level-2 variables assigned to individuals

Income 9	Coef.	Std. Err.	t	P≤|t|	Beta
yearsch9	745.60	9.474	78.7	0.000	.190
pro	12831.65	122.392	104.8	0.000	.233
meansch	493.06	20.847	23.7	0.000	.054
natural	4042.96	79.862	50.6	0.000	.108
-cons	2921.15	188.459	15.5	0.000	.190

Prob ≤ F = 0.0000
R-squared = 0.1577

A problem with this technique however is that individuals from the same country have the same values on the various country variables. Individual migrants are not assigned randomly to country groups. The fundamental assumption of independence of observations does not apply. The technique, therefore, is not statistically correct.

While OLS provides an enlightening picture of the effect these variables have on the income of a male immigrant, this procedure has a fundamental weakness. Where the least squares regression method fails is its inability to account for the extent to which the dependent variable is effected by independent variables measured simultaneously at different levels of analysis.

In this research, not only are we interested in observing the effects of both aggregate-level and individual-level variables on income attainment, we are also interested in gauging the influence of the aggregate-level factors in providing a

context in which individual immigrants might fully utilize their personal human capital. The least-squares method of analysis is not able to estimate linear models with nested structures (Bryk and Raudenbush, 1992). "In social research, these limitations have generated concerns about aggregation bias, misestimated precision, and the 'unit of analysis' problem (see Chapter V). They have also fostered an impoverished conceptualization, discouraging the formulation of explicit multilevel models with hypotheses about effects occurring at each level and across levels" (Bryk and Raudenbush, 1992: 2,3). Hierarchical linear modeling provides a method in which this later concern can be addressed.

Hierarchical Linear Modeling

In the HLM analysis, four separate models are used, the first three leading up to the final model. The first model is an analysis of variance (ANOVA). This model gives an initial evaluation of the dependent variable of annual earnings. It estimates how much of the variation in annual earnings occurs among individuals and how much occurs among countries.

The individual-level equation to be estimated is:

$Y_{0j}=\beta_{0j}+r_{ij}$

Y_{0j} is the annual earnings of individual worker i from country j. β_{0j} is the intercept of country j from the country-level equation described below, and r_{ij} is an error term for each individual i in each country j.

Before the individual-level equation can be estimated, attention must be given to the country-level equation that will provide the intercepts for all the countries (β_{0j}). The equation that provides these intercepts is modeled as a function of the grand mean of earnings plus a random error. Its equation is:

$\beta 0j=\gamma 00+u_{0j}$

The two equations are then combined into one individual-level equation, a one-way ANOVA, with a grand mean with a country-level effect and an individual-level effect. The equation is

$Y_{ij}=\gamma_{00}+u_{0j}+r_{ij}$

Table 5, top panel, shows the maximum likelihood estimates of the variance parameters associated with the HLM equation of this first model. At the level-1 (or individual-level), the variance in annual earnings is 204,013,397. At the level-2 (or country-level), the variance in annual earnings is 19,171,009. These estimates indicate that most of the variation in the annual earnings of immigrant male workers born in countries of Central and South America and the Caribbean Basin is at the individual-level, though there is a non-trivial proportion of the variance explained by the country-level variables.

The intraclass correlation, representing the proportion of variance in earnings that is between country-groups, can be estimated using the formula:

$$p = 19,171,009 / (19,171,009 + 204,013,397) = 0.086$$

This means that 8.6% of the variance in annual earnings occurs between country-groups, while 91.4% of the variance occurs at the individual level, or within country groups. The remaining three models will provide a more detailed accounting of these two variances.

HLM also provides a reliability estimate of .979, which indicates that the sample means for the country groups on annual earnings tend to be very reliable as indicators of the true country-group means on annual earnings. The sample mean of a country group's annual earnings as a reliable estimate of the true mean will vary from country-group to country-group because of sample size. But Bryk and Raudenbush (1992: 63) argue that an overall measure of the reliability is the average of the country-group reliabilities.

If the estimated value of the variance in the country-level means is not significantly different from zero, the assumption can be made that all groups of male workers from Central and South American and Caribbean Basin countries have the same mean earnings. In such a case, there would be no need to do a multi-level analysis. The Chi-square test statistic of 23,261.09 with 27 degrees of freedom (top panel of Table 5), however, indicates a high degree of probability that all country groups of male workers do not have the same mean earnings. There is, in fact, significant variation among country groups in regard to their mean levels of annual earnings.

Table 5: Variance parameters associated with four hlm models

	Model/Variables	Variance		df
	X^2			
I.	Baseline (ANOVA) Model			
	Between Country-groups	19,171,009	27	23261.1*
	Within Country-groups	204,013,397		
II.	Regression with Means as Outcome Model			
	Between Country-groups	4,068,723	24	1369.7*
	Within Country-groups	204,012,443		
III.	Random Coefficient Model			
	Between Country-groups			
	Intercept	19,114,464	27	27038.2*
	Years of School Slope	98,402	27	2244.7*
	Professional Slope	3,741,336	27	154.8*
	Within Country-groups	174,521,229	27	
IV.	Intercepts and Slopes as Outcomes Model			
	Between Country-groups			
	Intercept	4,057,763	24	1613.8*
	Years of School Slope	45,312	24	227.6*
	Professional Slope	3,843,430	24	158.2*
	Within Country-groups	174,519,701		

*p≤ .000

The second model of the HLM analysis is the "regression with means as outcomes." With this model, the extent to which the two level-2 predictors successfully predict the mean levels of earnings attainment among the country-groups of the sample male workers is ascertained. In this stage of the analysis, the two country-level predictor variables are introduced into the equation (*average number of school years* and *naturalization rate*).

While the individual-level HLM equation used here is the same as in the first ANOVA model, the country-level equation is expanded to include the two country level independent variables.

$$Y_{ij} = \gamma_{00} + \gamma_{01}(\text{Mean Years of School}) + \gamma_{02}(\text{Naturalization Rate}) + u_{oi} + r_{ij}$$

The estimated parameter between country-level mean years of education and mean earnings is 2669.52, t = 9.8. This indicates a highly significant relationship (Table 6), and may be interpreted as follows: for every one-unit gain in years of education completed by the population, there is an increase of $2,670 in mean earnings. The estimated parameter between the country-level naturalization rate and mean earnings is 193.25, t = 1.24; however, it is not significant (p = 0.181).

Table 6: Effects (gamma coefficients) of individual and country-group variables on earnings attainment of male immigrants to the U.S. from Central and South American and Caribbean basin countries

Model/Variables	Gamma Coefficient	Standard Error	*t*Value
Regression with Means as Outcomes Model			
Intercept	-7,485.21	3403.29	-2.20
Mean Years of School	2,669.52	273.07	9.78**
Naturalization Rate	193.25	155.32	1.24
Random Coefficient Model			
Intercept	24,132.77	833.54	28.95**
Years of School Slope	1,139.32	64.22	17.74**
Professional Slope	10,264.73	440.62	23.30**
Intercept and Slopes as Outcomes Model			
On Intercept			
Intercept	21662.18	431.63	50.19**
Mean Years of School	2490.65	293.28	8.49**
Naturalization Rate	257.74	882.58	.29
On Years of School Slope			
Intercept	1329.59	59.66	22.29**
Mean Years of School	285.40	38.98	7.32**
Naturalization Rate	58.06	120.82	.48**
On Professional Status Slope			
Intercept	11356.38	667.00	17.03**
Mean Years of School	501.55	445.91	1.13
Naturalization Rate	-179.03	1360.51	-0.13

*p≤.05
**p≤.001

By comparing the now reduced amount of residual variance in earnings between countries (4,068,723), (see Table 5) with the value from the preceding ANOVA equation (19,171,009), it is possible to ascertain how much of the proportion of the variance between country groups in earnings attainment is explained by these two country-level predictors. This value referred to as R^{2*} (Arnold, 1992) is obtained by subtracting the residual variance obtained in this second model from that obtained in the first model and dividing the difference by the variance from the first model.

$R^{2*} = (19{,}171{,}009 - 4{,}068{,}723) / 19{,}171{,}009 = .788$

This indicates that 78.8% of the between-country variance in earnings attainment is accounted for by the two country-level predictors of *average years of education* and the *naturalization rate.*

HLM also provides an indication as to whether there is significant variation in country-group mean earnings after controlling average years of education and naturalization rate. The Chi Square of 1369.7 with 25 degrees of freedom, a $p < .000$, indicates that there is still a significant amount of variation among country-groups in earnings remaining to be explained. We would thus wish to entertain additional level-2 variables as predictors.

The third model is referred to as the "random-coefficient" model. In this individual-level phase of the analysis, the third model ascertains the degree to which the two human capital predictors of annual earnings, years of completed education, and whether or not a worker is in a professional occupation successfully predict annual earnings. Level-1 equations are estimated for all the workers from each of the 28 country groups.

$$Y_{ij}=\beta_{0j}+\beta_{ij}(Education_{ij} - Education\text{-}bar._j) + \beta_{2j}(Professional_{ij} - Professional\text{-}bar._j)$$

Note that in this individual-level equation, the two independent variables have been "centered" about their means. Their values were subtracted from their country-means, so that their new means are now zero. This procedure enables the interpretation of "...the intercepts of the within-unit (i.e., within country-group) equations...as the average (earnings) before the effects of the (independent variables) have been taken into account" (Arnold, 1992: 77–78).

The gamma coefficient of the education-earnings slopes (Table 6), which is a pooled within-country regression coefficient, is estimated to be 1139.32, with a *t* of 17.7. This significant value indicates that, on average, educational attainment is positively related to individual economic attainment, and may be interpreted as follows: every one-unit increase in educational attainment results in an increase of $1,139 in individual earnings. Additionally, the coefficient of the professional-earnings slopes, which is also a pooled within-country regression coefficient, is 10,264.73, with a *t* value of 23.3. This indicates a significant and positive relationship between professional status and individual economic attainment. A male worker born in a Central or South American or Caribbean Basin country may increase his earnings by $10,265 if he is a professional worker.

As was done in model 2 with the level-2 values, this third model allows the estimation of the variance among the individuals, (see the third panel of Table 5), and compare it with that previously obtained in the ANOVA model. An index of the pro-

portion of reduction in variance, R^{2*}, can be developed with the following equation:

$R^{2*} = (204{,}013{,}397 - 174{,}521{,}229) / 204{,}013{,}396 = 0.145$

When the two human capital independent variables of educational attainment and professional status are used as level-1 predictors of annual earnings attainment, the variance is reduced by 14.5%. Or, these two variables account for 14.5% of the individual-level variance in annual earnings.

The association between the two independent variables and earnings is much stronger at the country level (explaining 78.8% of the level-2 variance) than at the individual level (only 14.5% of the level-1 variance explained). Remember, however, that there was far more variance in earnings to be explained at the individual-level than at the country-level. We have shown earlier that only 8.6% of the variance in annual earnings occurs at the country level, while 91.4% of the variance occurs at the individual-level.

The fourth HLM model is referred to as the "intercept and slopes as outcomes" model. In this model, the level-2 model is expanded so that each country-group's mean earnings attainment score will be predicted by the two level-2 predictors of average number of school years completed and the naturalization rate. The level-1 equation is the same as in the preceding model. Combined with the country-level equations, the following equation is estimated:

$$Y_{ij} = \gamma_{00} + \gamma_{01}(\textit{Mean Years of School})j + \gamma_{02}(\textit{Naturalization})_j + \gamma_{10}(\textit{Education}_{ij} - \textit{Education-bar.}_j) + \gamma_{11}(\textit{Mean Years of School})_j\,(\textit{Education}_{ij} - \textit{Education-bar.}_j) + \gamma_{12}(\textit{Naturalization})_j\,(\textit{Education}_{ij} - \textit{Education-bar.}_j) + \gamma_{20}(\textit{Professional}_{ij} - \textit{Professional-bar.}_j) + \gamma_{21}(\textit{Mean Years of School})_j\,(\textit{Professional}_{ij} - \textit{Professional-bar.}_j) + \gamma_{22}(\textit{Naturalization})_j\,(\textit{Professional}_{ij} - \textit{Professional-bar.}_j) + r_{ij}$$

The main equation to be estimated, in this phase of the analysis, has as the dependent variable the individual male worker's outcome on earnings attainment. It may be summarized as follows:

– the overall intercept, γ_{00}, which in this case is the grand mean on earnings attainment across the country groups,

– the main effect of *mean school years*, γ_{01},

– the main effect of the *naturalization rate*, γ_{02},

– the main effect of the individual worker's *education*, γ_{10}

– the main effect of the individual worker's *professional status*, γ_{20}

– the following cross-level interactions involving

  – *mean school years* with *education*, γ_{11}

  – *naturalization* with *education*, γ_{12}

  – *mean school years* with *professional status*, γ_{21}

  – *naturalization* with *professional status*, γ_{22}

– a random error, $u_{0j} + u_{1j}(\textit{Education} - \textit{Education.j}) + u_2(\textit{Education}$

$\textit{Education.}_j) + u_{1j}(\textit{Professional}$

$\textit{Professional.}_j) + u_2(\textit{Professional} - \textit{Professional.}_j)$

The bottom panel of Table 6 shows the gamma coefficients representing the various effects of the predictors. *Mean school years* is positively related to earnings attainment, 2490.65, and is highly significant p = 0.00. For each additional year of school completed in a country group, the individual male worker's annual average income of the country-group increases by $2,491. While the *naturalization rate* is also positively related to mean annual earnings, it is not significant.

The individual level predictors are also both positively associated with annual income and are both significant at the p = 0.000 level. *Professional status* increases annual earnings by $11,356. Each year of an individual's *educational attainment* increases annual earnings by $1,330.

Cross-level interactions indicate a distinct tendency for country-groups with high *mean school years* to have larger education-earnings slopes than country-groups with low means (the gamma parameter is 285.40). This is a significant interaction and is interpreted for each increment in a country's mean school years, the slope of educational attainment on earnings increases by $285. There is also a tendency for the country-groups in the sample with high *naturalization rates* to have larger education-earnings slopes than country-groups with low rates (the gamma parameter is 58.06). The slope of *educational attainment* on earnings is increased by $58 with each percent increase in a country's *naturalization rate*. However, this effect is not statistically significant.

The cross-level interactions representing the effects of the two level-2 variables on the professional status-earnings slope produce gamma coefficients not significant at either the .05 or .10 level. The effect of *naturalization rate* on the *professional status*-earnings slope is negative and not significant on any of the level 1 variables' slopes. These findings regarding *naturalization rates* may indicate the need to re-examine the view that such is a predictor of assimilation into American society.

The bottom panel of Table 5 shows the residual variance estimates for each of the random coefficients in the level-1 model. These can be compared with the values from the random-coefficient model to ascertain the amount of improvement when the three level-2 predictors are added.

$R^{2*} = (19,114,464 - 4,057,763) / 19,165,956 = 0.786$

Introducing the two level-2 predictors of *mean years of school* and *naturalization rate* into the model, 78.6% of the parameter variation in mean earnings is explained.

This example has illustrated the use of hierarchical linear models to conduct a multi-level analysis of the economic attainment patterns of male immigrant workers to the United States who were born in countries of Central and South America and the Caribbean Basin. At issue was the extent to which characteristics of the individual immigrants, and the characteristics of their countries, influence their levels of earnings in 1989. Two individual-level human capital variables were used, the *number of school years completed* and whether the worker was in a professional job. Two group-level variables were used; the country's *mean level of educational attainment* and its *naturalization rate*. All these variables were related to the patterns of annual earnings of the individual male immigrant worker.

At the individual level, the two variables were significantly correlated with the amount of earnings attained. At the country or structural level, the *mean years of school* was a powerfully influential predictor, while *naturalization rate* was not significant. Within country-groups, male immigrants with high levels of educational attainment (controlling for their professional status) and immigrants in professional jobs (controlling for levels of educational attainment) had higher levels of earnings. Between countries, those with high average levels of education had high levels of earnings attainment. These findings are consistent with previous research, especially with regard to the importance of educational attainment on earnings at both the individual-level and country-level.

That the group-level variable *naturalization rate* had no significant effect on individual earnings attainment was surprising. Roberts (1995) argues that naturalization rates indicate whether a group as a whole has made long term commitments to stay in a society. Using Merton's concept of socially expected durations, Roberts maintains that groups with intentions of staying permanently have an advantage over those with temporary commitments, with the latter penalized with fiscal restrictions (1995: 61). The findings in this research indicate a statistically insignificant effect on individual earnings slopes and a negative effect on professional status as a predictor of individual earnings.

The HLM modeling has allowed the measurement of the micro and macro relationships more precisely, and in ways that would not have been possible with OLS regressions. HLM allowed the determination of the magnitude of the variability in earnings among immigrants due to variance within countries versus that due to variance between countries. The greatest amount of variation in earnings achievement was at the individual level (91.4%), while 8.6% of the variance occurred between countries. This research will attempt to explain these two variances in greater detail than shown in this example, using hierarchical linear modeling.

Hierarchical linear modeling involved producing a separate regression equation for each country in the sample. The intercepts and slopes from these equations were then averaged across the countries and, as Arnold states (1992: 74), "weighted by the inverse of the standard error of each estimate."

HLM also allowed the specification of the degree of association between the within-country relationships and two level-2 characteristics. These estimates were weighted by the degree of precision of each country's mean earnings estimate (Arnold, 1992: 74) to gauge the degree of association between the level-2 characteristics and average earnings.

HLM permitted the examination of the influence of country characteristics on both the *education-earnings* and the *professional-earnings* slopes. This procedure allowed the degree to which the level-2 (country-level) variables influenced the two level-1 associations between *educational attainment* and *earnings* and *professional status* and *earnings*.

This last benefit of HLM is the most important to this research, as the research question concerns the influences of micro and macro variables on *earnings attain-*

ment. Literature has maintained the importance of considering the effects of the opportunity structures of specific immigrant environments on achievement. Portes and Bach (1980; 1985), Wilson and Portes (1980), Wilson and Martin (1982) and Roberts (1995), have shown that immigrants do not arrive as isolated individuals with only their human capital skills available to help them achieve in the U.S. workplace. Various kinds of opportunity structures, networking environments, and other social contexts are also provided to them, to varying degrees depending on their country of birth. These country-specific assets "which receive and incorporate...(the immigrant groups) decisively affect...(their) collective fates, regardless of the (human capital) skills...(that they bring to the U.S.)" (Portes and Bach, 1985: 268).

These country-specific assets better allow the immigrant to use individual human capital skills in the workplace. HLM allows an appraisal of the degree to which this is the case. Specifically, this example shows evidence of a definite tendency for males from sample countries with high *mean school years* to have larger education-earnings slopes than males from countries with low means. In other words, an immigrant from a country with a high mean in the variable of *educational attainment* is able to translate his individual educational achievement into more earnings than is a person from a country with a low mean educational score.

Although this example found a tendency for males in sample countries with high *naturalization rates* to have larger education-earnings slopes than those from countries with low rates, the effects on the slopes of the two level-1 variables were not statistically significant. The effect of *naturalization rates* on the ability to translate *professional status* into greater earnings was negative. These results lead to a re-examination of the use of *naturalization rates* as a predictor of assimilation. There is certainly an indication that an individual's ability to translate human capital variables into increased earnings is not enhanced by whether other immigrants from the same country of birth are characterized by high rates of naturalization.

The HLM analysis, however, did not show evidence of similar effects of the same two level-2 variables on the slopes for male immigrants of *professional status* on earnings. The fact that an immigrant was from a sample country with high or low levels of average education, or high or low rates of naturalization had no statistically significant influence on the slope of male immigrants converting their *professional status* into earnings. These kinds of empirical assessments could not have been made without hierarchical linear modeling.

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David J. Gotcher

ANALIZA UZORAKA EKONOMSKIH POSTIGNUĆA MUŠKARACA IMIGRANATA U SJEDINJENIM AMERIČKIM DRŽAVAMA ROĐENIH U LATINSKOJ AMERICI: PRIMJER UPORABE HIJERARHIJSKOG LINEARNOG MODELA

SAŽETAK

Ovo istraživanje ispituje i nastoji razjasniti razliku u ekonomskim postignućima imigranata iz Latinske Amerike u Sjedinjenim Američkim Državama korištenjem hijerarhijskog linearnog modela. Analizirajući tu promjenu istraživači obično biraju između dvaju konkurentskih objašnjenja. Teorija ljudskog kapitala tvrdi da je razlika u ekonomskom postignuću rezultat različitih individualnih karakteristika, a teorija društvenog kapitala da je ta promjena rezultat različitih karakteristika društava iz kojih radnici potječu. Izbor između tih dvaju tumačenja nije nimalo lagan. Oba su vjerojatna i moguća i zagovoratelji svakog od njih iznose impresivne dokaze kako bi potkrijepili svoje tvrdnje. Autorova središnja teza jest da ne moramo birati između teorije ljudskog i teorije društvenog kapitala, nego se možemo osloniti na oba teoretska pristupa. Do koje se mjere promjena može objasniti jednim skupom čimbenika a ne drugim, predstavlja empirijsko, a ne teorijsko pitanje. Zato stvarni problem nije izbor teorija, nego izgradnja prikladne metodologije koja nam omogućava da razdijelimo promjene u ekonomskim postignućima, prepoznavanjem (identificiranjem) koliko se one mogu objasniti individualnim a koliko skupnim karakteristikama. Korištenjem tehnike višeulaznog modela ovo istraživanje prikazuje takvu metodologiju koja ne samo da identificira promjene nastale u pojedinaca i skupina, nego prepoznaje i djelovanje varijabli društvenog kapitala skupina na varijable individualnog ljudskog kapitala. Istraživanje se odlikuje uporabom varijabli i individualnog ljudskog kapitala i skupnog društvenog konteksta kako bi se objasnio ekonomski uspjeh imigranata. Uporaba obaju tipova varijabli predstavlja, međutim, metodološki problem. U takvom tipu istraživanja tradicionalno su se upotrebljavala ta dva postupka. Prva tehnika uključuje rastavljanje kontekstualnih varijabli do individualne razine. Karakteristike zemlje pripisuju se imigrantu pojedincu pa se model najnižih ćelija (ili neki drugi model ocjenjivanja) upotrebljava na individualnoj razini. U istraživanju fertiliteta korištenje tog postupka predstavlja osnovni problem. Ako znamo da žene potječu iz iste zemlje, tada isto tako znamo da posjeduju jednake vrijednosti različitih karakteristika zemlje. Pretpostavka nezavisnosti promatranja ne može se upotrijebiti jer žene nisu slučajno nasljednici zemlje (De Leeuw i Kreft, 1986). Druga tehnika uključuje sakupljanje varijabli na individualnoj razini do kontekstualne razine. Analiza bi se tada napravila na skupnoj razini. Međutim, taj postupak ne uzima u obzir promjene unutar skupine što u nekim slučajevima može značiti da se čak i do 90% promjena odbacuje prije nego što je analiza uopće započela. Višeulazna tehnika je potrebna kako bi se označile moguće metodološke stupice svojstvene tim dvjema tehnikama. Hijerarhijski linearni model (HLM) je tehnika koja objašnjava te probleme te može preciznije izmjeriti djelovanje (učinke) varijabli skupne razine na varijable individualne razine. Uporaba varijabli i skupne i individualne razine i mjerenje djelovanja prvih na uspon drugih je regresija regresije.

KLJUČNE RIJEČI: migracija, društveni kapital, ljudski kapital, višeulazni model, hijerarhijski linearni model, ekonomsko postignuće, društvene mreže

David J. Gotcher

ANÁLISIS DE PATRONES DE LOGROS ECONÓMICOS EN HOMBRES LATINOAMERICANOS QUE EMIGRAN A LOS ESTADOS UNIDOS: UN EJEMPLO DEL USO DEL MODELO LINEAL JERÁRQUICO

RESUMEN

Esta investigación examina e intenta dar cuenta de la variabilidad en los logros económicos de los emigrantes de Latinoamérica hacia los Estados Unidos, mediante el uso del Modelo Lineal Jerárquico. Para analizar la variabilidad, los investigadores generalmente eligen entre dos explicaciones alternativas: la teoría del capital humano sostiene que la variabilidad en los logros económicos es el resultado de las diversas características de los individuos; la teoría del capital social sostiene que la variabilidad en los logros económicos es el resultado de las diferencias entre las características de las sociedades de las cuales provienen los trabajadores. Sin embargo, la elección entre estas dos explicaciones no es fácil. Ambas explicaciones son posibles y los defensores de ambas han proporcionado evidencias impresionantes en apoyo de sus afirmaciones. El tesis central del autor es que no necesitamos elegir entre la teoría del capital humano y la del capital social, que podemos confiar en ambos puntos de vista teóricos, y que el conocimiento sobre qué tanto puede explicarse la variabilidad con base en un conjunto de factores o en otro es un asunto empírico y no teórico. El verdadero problema, entonces, no es hacer una elección teórica sino construir una metodología adecuada que nos permita subdividir la variabilidad en los logros económicos identificando cuánta se explica por características individuales y cuánta por características de grupo. Esta investigación presenta una metodología de este tipo que, aplicando una técnica con modelos multi-nivel, no solamente identifica la variabilidad que queda explicada tanto por los individuos como por los grupos de los que ellos forman parte, sino que también identifica los efectos que las variables de grupo del capital social ejercen sobre las variables individuales del capital humano. Esta investigación se caracterizará por utilizar tanto las variables individuales del capital humano como las variables agregadas del contexto social para dar cuenta del éxito económico de los emigrantes. Sin embargo, la utilización de ambos tipos de variables presenta un problema metodológico. Tradicionalmente se han usado dos procedimientos en este tipo de investigación. La primera técnica involucra la desagregación de las variables contextuales para constituir las variables de nivel individual. Las características del país se asignarían al individuo emigrante y se utilizaría al nivel individual una estimación mediante mínimos cuadrados (o cualquier otro modelo de estimación). La utilización de este procedimiento en las investigaciones sobre fertilidad presenta un problema fundamental. Si sabemos que las mujeres provienen de un mismo país, entonces también sabemos que ellas tienen los mismos valores con respecto a las diversas características del país; por lo tanto, no puede usarse la hipótesis de nulidad porque las mujeres no están distribuidas aleatoriamente con referencia a los países (De Leeuw y Kreft, 1986). La otra técnica involucra la agregación de las variables de nivel individual para constituir las variables del nivel contextual. El análisis se haría, entonces, a nivel de agregados. Sin embargo, este procedimiento descarta la variabilidad dentro del grupo, lo cual podría significar que en algunas ocasiones se elimina hasta el 90 porciento de la variabilidad aún antes de que se inicie el análisis. Se necesita una técnica multi-nivel para corregir las potenciales fallas metodológicas inherentes a las dos técnicas que se acaban de discutir. El Modelo Lineal Jerárquico (HLM por sus siglas en inglés) es una técnica que da cuenta de estos problemas. HLM tiene la capacidad de medir muy precisamente los efectos de las variables del nivel de agregados sobre las variables del nivel individual. Es una regresión de regresiones que utiliza las variables de ambos niveles, el de agregados y el individual, y mide el efecto de la primera curva sobre la pendiente de la segunda curva.

PALABRAS CLAVE: migración, capital social, capital humano, modelo multi-nivel, modelo lineal jerárquico, logros económicos, redes sociales