TIME ALLOCATION AND REMITTANCE FLOWS: THE CASE OF TEMPORARY MEXICAN MIGRATION TO THE U.S.

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by

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ABSTRACT

In this paper, a theoretical and empirical analysis of temporary migrant behavior, including remittance flows and time allocation between point of origin and destination, is presented. The theoretical model allows for intertemporal utility maximization by migrants who may have dependents to support and cultural ties to their region of origin.

Data on temporary Mexican migration to the U.S. collected by the Mexican National Center of Labor Information and Statistics (CENIET) was used. The results suggest that wage rates, family characteristics, and arrests are important predictors of temporary migratory behavior.

RESUME

Ce rapport présente une analyse théorique et empirique du comportement des migrants temporaires, y compris les remises monétaires et l'allocation du temps entre le point d'origine et la destination. Le modèle théorique permet la maximisation d'utilité intertemporelle par des migrants ayant de la famille à soutenir et des liens culturels dans la région d'origine.

L'analyse traite des données sur l'émigration vers les Etats-Unis recueillies par le CENIET (Mexican National Center of Labor Information and Statistics). Les résultats indiquent que les salaires, la structure familiale et les arrestations sont des facteurs qui influencent d'une manière significative le comportement des Mexicains faisant une migration temporaire.

TABLE OF CONTENTS

		Page
ABSTRACT		iii
LIST OF TABLES		vii
I.	INTRODUCTION	1
II.	THEORETICAL FRAMEWORK	2
	A. The Model	4
	B. Time Allocation and Remittance Functions	6
III.	AN EMPIRICAL APPLICATION	9
	A. Data Description	9
	B. Estimation Procedure	11
	C. Regression Results	13
IV.	CONCLUSION	20
NOTES		23
BIBLIOGRAPHY		25

LIST OF TABLES

Table		Page
I.	Summary of Notation	3
II.	Relationships between Variables Used in Empirical and Theoretical Analyses	10
III.	Sample Averages	14
IV.	Regression Results	15
V.	Remittance Regressions: Parameters Depending Upon Length of Stay	18

I. INTRODUCTION

Two basic questions concerning temporary Mexican migration to the U.S. are addressed in this paper. First, given that a Mexican migrates temporarily to the U.S., what are the determinants of the fraction of total time (in 1978) spent in the U.S.? And second, what are the determinants of the amount of money saved or remitted per unit of time in the U.S. by these temporary migrants? Both theoretical and empirical analyses are presented.

The theoretical model used allows for intertemporal utility maximization by migrants who are allocating their time between two locations: a high wage, high cost of living area (the U.S.), and a low wage, low cost of living region (Mexico). The family orientation of the decision making is also incorporated. Data collected in Mexico by the Centro Nacional de Informacion y Estadisticas del Trabajo (CENIET) are utilized in the empirical application. These data include information on wages in both countries, legal status, and apprehensions, as well as a variety of individual and family characteristics.

Theoretical background is provided by literature on permanent migration and studies of labor supply by peasant families. The standard Harris-Todaro (1970) or Todaro (1976) migration models suggest that migrants move to the area with the highest expected wage rate. Return migration might occur under two circumstances: i) The expected wage rate differential changes signs due to, for example, changes in relative unemployment rates, or perhaps individual characteristics (i.e. education) that have differential returns in the two areas; ii) "Failure" return migration occurs when opportunities in the receiving area don't live up to expectations. That is, the ex post actual wage differential has the opposite sign of the ex ante expected wage differential. Given the large, continuing difference in wage rates between the U.S. and Mexico, neither of these explanations of return migration is fully satisfactory for temporary migration from Mexico to the U.S. Thus, while the standard migration model yields insights into who migrates, it is difficult to derive predictions about time allocation and remittance flows for individuals facing a relatively fixed (and large) expected wage differential.

A second type of model more amenable to the issues of the allocation of working time to two regions is that of labor supply of peasant families. [See Rosenweig (2980), Barnum and Squire (1979), and Hansen (1969) for recent applications.] Generally, the "optimizing peasant" is predicted to allocate time so as to equate the value of the marginal product of work on the land with both the value of the marginal utility of leisure and the going wage rate, given that a corner solution does not arise. A key to the analysis is the diminishing value of time in the nonwage activities. Otherwise all time is spent at the activity with the highest implicit value. For the case of temporary Mexican migration to the U.S., however, many workers appear to have relatively fixed (but different) wage-earning opportunities in the two countries, yet still choose to allocate some working time to each area.

The descriptive literature concerning this migratory phenomenon gives some direction for strategies in model-building. [See Cornelius (1982), Mines (1981), Reichert and Massey (1980), Selby and Murphy (1982) and citations therein.] Three reasons for the temporariness of the migration are most frequently cited:

1. The cost of living is "too high" in the U.S. It would be very expensive for the entire family to live in the U.S., and dollars earned can significantly raise the standard of living in Mexico;
2. There is disutility directly associated with being away from home, or being in the U.S. This may be due to separation from family and friends, cultural and language differences, or discrimination;
3. The migrants must return to Mexico to maintain asset holdings in Mexico. For example, ejidatarios must by law return within 2 years or lose their plot of land.

These three aspects are first incorporated into a theoretical model of temporary Mexican migration to the U.S. Predictions are made concerning the determinants of time allocation and remittance flows. Finally, the empirical analysis is presented and shown to be quite consistent with the predictions.

II. THEORETICAL FRAMEWORK

The above discussion suggests that a theoretical model of Mexican migration to the U.S. should incorporate the following characteristics: a) the migration is temporary and often repetitive in nature, in spite of continuing large wage differentials; and b) family ties in Mexico and consideration of family welfare are important inputs into migration decision making.

The theoretical model used is a finite time horizon, intertemporal utility maximization model for a migrant with family members in Mexico. (See Table I.) He must choose time paths of consumption, leisure, and support of dependents, as well as the amount of time to spend in the U.S. It is realistically assumed that the expected wage rate in the U.S. exceeds that in Mexico, and also that the cost of living in the U.S. is higher. Costs of migration are positive, due both to transportation costs and

TABLE I.

SUMMARY OF NOTATION

c^i	= consumption in area i
c^f	= per capita consumption by dependents
s^i	= leisure in area i
f	= number of dependents
M	= fixed costs of migration
p^*	= cost of living in U.S.
q	= fraction of total time spent in U.S.
U_x	= direct marginal utility of being in Mexico
w^i	= wage rate in area i
x	= dummy variable for location
$\bar{Y}$	= outside income
λ	= marginal utility of income

* denotes value of parameter or variable in U.S.

costs incurred in crossing the border. The possibility of moving the entire family permanently to the U.S. is not explicitly considered here since the data do not capture this phenomenon.

A. The Model

The individual maximizes utility over the time period, for example one year. Utility at any instant of time depends on own consumption and leisure, per capita support of dependents, and location. Thus, the problem is:

$$(1) \quad \max \int_0^T U(c_t, s_t, c_t^f, x_t) e^{-\rho t}\, dt$$

where U is a concave utility function; c is consumption; s is leisure; c^f is per capita support of dependent family members; x is a dummy variable for location; and ρ is the rate of time preference. It is assumed that the marginal utility is positive for all arguments in the utility function. Only two locations are considered: Mexico and the U.S. We shall denote the increment in utility derived from being in Mexico rather than the U.S., holding all other goods fixed, as U_x, or the "direct" marginal utility of being in Mexico. This is assumed to be nonnegative.

The budget constraint over the year depends on labor earnings, outside income (including contributions from other working family members), expenditures on support of dependents, and fixed migration costs. It is assumed that the wage rates (w) earned in both the U.S. and Mexico and the costs of living (p) are constant over the year, with the cost of living in Mexico as the numeraire. Thus changes in w and p occur over time to the individual only through changes in location. For simplicity it is also assumed that net savings over the year is zero, although a savings motive could easily be added. Because of the fixed migration costs, at most one trip is made to the U.S. Thus, the budget constraint can be expressed as:

$$(2) \quad \int_0^T [(1-s_t)w_t - p_t c_t - f c_t^f]\, e^{-rt}\, dt + \bar{Y} - zM = 0$$

where z=1 if any time is spent in the U.S. and is 0 otherwise, f is the number of dependents; r is the relevant interest rate; $\bar{Y}$ is outside income, and M is fixed migration costs.

Maximizing utility subject to the budget constraint, the first order conditions for consumption, leisure, and support of dependents are straightforward. For each t,

$$(3) \quad U_c/p = U_s/w = U_{(c^f)} = \lambda e^{(\rho - r)t}$$

where λ is the marginal utility of income evaluated at initial time and subscripts denote marginal utilities of consumption and leisure. That is, the value of the marginal utility is equated across goods, where w is the price of leisure in the relevant location.

Without loss of generality, total time is set equal to 1, and it is specified that the first fraction q of that period is spent in the U.S.[1] Then the first order condition for q can be written as:

$$(4) \quad \begin{aligned} & U(c^*,s^*,c^{f*},x^*) - U(c,s,c^f x) \\ & +\lambda\{[(1-s^*)w^* - p^*c^* - fc^{f*}] - [(1-s)w - pc - fc^f]\} = 0 \\ & \text{if } 0 < q < 1, \end{aligned}$$

where * denotes values in the U.S. (at the last moment there) and unstarred values correspond to values in Mexico (at the first moment there). If $0 < q < 1$, then the marginal utility of spending more time in Mexico, $[U(c,s,c^f,x) - U(c^*,s^*,c^{f*},x^*)]$, divided by the "price" of staying home, $\{[(1-s^*)w^* - p^*c^* - fc^{f*}] - [(1-s)w - pc - fc^f]\}$, is equal to the marginal utility of income. Note that even if location does not enter directly into the utility function, temporary migration may be chosen.

Because of the fixed migration costs, the following condition must also hold for any positive amount of time to be spent in the U.S.:

$$(5) \quad \Omega(q^*) > \Omega(0) \text{ is } q > 0$$

where $\Omega(0)$ is the solution to the maximization problem subject to q=0 and setting z=0, and $\Omega(q^*)$ is the solution when requiring that M must be paid but allowing q to be positive. This implies that q will never be chosen very close to zero. Also note that q is constrained by an upper bound of 1.

Now we examine the case where some but not all time is spent in the U.S. It is assumed for simplicity that location and per capita support of dependents enter as additively separable components of the instantaneous utility function. This implies that U_x is constant and can be treated as a parameter in the model, and that $c^f = c^{f*}$.

The differentiated first order conditions and budget constraint can be seen to take a block recursive form. Differentiating condition (4) we get:

$$(6) \quad -U_x + \lambda[(1-s^*)dw^* - c^*dp^* - (1-s)dw] + gd\lambda = 0$$

where g is the "price" of staying in Mexico noted above. Under the assumptions that $U_x > 0$, $w^* > w$, $p^* > 1$, and $q < 1$, it can be shown that the marginal utility of being in Mexico and thus the price (g) must be positive. Any comparative static changes in λ

(assuming that $0 < q < 1$ is maintained) can be easily calculated from (6) with the appropriate parameter change. Holding r and ρ fixed, and assuming that consumption, leisure, and support of dependents are normal goods, demand functions can be expressed as:

$$\text{(7)} \quad \text{(a)} \quad s_t = s_t[\overset{-}{\lambda}, \overset{?}{p^i}, \overset{-}{w^i}]$$

$$\text{(b)} \quad c_t = c_t[\overset{-}{\lambda}, \overset{-}{p^i}, \overset{?}{w^i}]$$

$$\text{(c)} \quad c_t^f = c_t^f\ [\overset{-}{\lambda}]$$

where $p^i = p*$ and $w^i = w*$ if in the U.S., and $p^i = 1$ and $w^i = w$ if in Mexico. Signs of partial derivatives are shown above each variable.

Lastly, the budget constraint must be fully differentiated. Most importantly, note that an increase in λ, holding q and parameters fixed, relaxes the budget constraint since consumption and leisure in both countries decline. Thus, to compute the effect of a parameter change on q, first the change in λ is observed from (6). That and the parameter change are used in (7) to find changes in demand. Finally these solutions can be substituted into the differentiated budget constraint, again with the parameter change, to find the change in the fraction of time spent as a migrant. If the budget constraint is relaxed, for example, the migrant can afford to spend more time in Mexico.

B. Time Allocation and Remittance Functions

The implications of the model for predicting the amount of time as a migrant (q) and remittance flows to the U.S. are now easily summarized. Remittances here are defined broadly as the total amount saved while in the U.S. for any time t. Thus we are not distinguishing between money actually sent back and money brought back at the end of the trip.

As described above, the fraction of time spent in the U.S. can be derived as a function of exogenous variables:

$$\text{(8)} \quad q = q(\overset{+}{M}, \overset{+}{f}, \overset{-}{\bar{Y}}, \overset{-}{U_x}, \overset{?}{w*}, \overset{?}{p*}, \overset{-}{w})$$

Predicted signs are shown above each variable. Of the above exogenous variables, four of them enter into the determination of changes in the marginal utility of income: w,

w^*, p^*, and U_x. The others affect q only by directly changing the budget constraint. Thus, an increase in M or f or a decrease in $\bar{Y}$ makes existing income fall short of expenditures, but does not alter the choices of the c's or s's. To increase income the length of stay in the U.S. must increase. An increase in U_x, the direct marginal utility of being in Mexico, requires that λ increase for migration to continue to be optimal. This increase in λ relaxes the budget constraint by decreasing leisure and consumption, so that the migrant can afford to spend more time at home in Mexico.

An increase in the wage rate in the U.S. does not necessarily result in an increase in the length of stay. The increased wage directly increases the price of staying home, implying a reduction in λ and thus increases in consumption and leisure. However, the wage increase also results in an increase in income through its direct effect on the budget constraint, and an indirect increase through the substitution effect acting to reduce leisure in the U.S. The net effect on the budget constraint (holding q fixed) is ambiguous. Thus, the sign of the change in q for the new utility optimum cannot be predicted theoretically. Similarly, an increase in the cost of living in the U.S. has an ambiguous impact on length of stay. There is a substitution effect away from staying in the U.S., but a negative income effect which suggests a long stay.

An increase in the wage in Mexico, however, unambiguously decreases the length of stay in the U.S. Here the price of staying home falls, increasing λ. There is again a direct increase in income, as well as a substitution away from leisure in Mexico. All effects relax the budget constraint, so that q unambiguously declines with an increase in w.

Predictions for the remittance function can also be calculated. Savings at time t in the U.S., R_t, is equal to $[\, w(1-s) - pc \,]$ evaluated at t. Thus remittance flows are affected directly by changes in the U.S. wage and price level, and indirectly through changes in the marginal utility of income.

$$R_t = R_t(\overset{0}{M}, \overset{0}{f}, \overset{0}{\bar{Y}}, \overset{+}{U_x}, \overset{?}{w^*}, \overset{?}{p^*}, \overset{+}{w}) \tag{9}$$

The impact of changes in exogenous variables will be largely absorbed through changes in the length of stay rather than in remittance flows. As exogenous income ($\bar{Y}$) increases or costs (M or f) decrease, the migrant spends less time in the U.S. while the marginal utility of income remains unchanged. Thus total remittances decline, but remittances at any time t in the U.S. remain constant as long as wages and the cost of living are unchanged. An increase in the direct marginal utility of being in Mexico, however, requires an increase in λ and thus an increase in remittances at time t.

Once again the role of wages is more complex. If the migrant's wage in the U.S. increases there are two opposing forces: i) There is not only an increase in earnings for a given amount of work, but a substitution effect away from leisure. This would lead to an increase in remittances. ii) There is an exogenous increase in the price of staying home, so that λ falls. This induces the migrant to work less, consume more, and thus send less remittances per unit of time. Again the analysis for changes in the cost of living in the U.S. is similar, with the signs of the effects reversed.

An increase in the wage in Mexico results in an increase in remittances per unit of time if the migrant chooses a length of stay less than one. There is an exogenous decline in the price of staying home (and thus an increase in λ), and as noted, length of stay in the U.S. decreases. The wage in Mexico, however, remains lower than in the U.S. so that the family suffers a decline in total income. This is compensated to some extent by more work and less leisure while in the U.S., and thus more remittances per unit of time away.

In examining remittance behavior it also proves interesting to somewhat relax a previous assumption. As the model is specified, the direct marginal utility of being in Mexico (U_x) is independent of the fraction of time spent in Mexico. We shall continue to assume that this is the case if the stay in the U.S. is short enough. However, in addition, we now assume that if the stay in the U.S. is long enough there is a point at which returning home becomes imperative (i.e. the loss in utility from staying in the U.S. approaches infinity). That is, there exists for each individual a $\bar{q}$, $\bar{q} \leq 1$, such that if $q > \bar{q}$, U_x approaches infinity. One would expect that as length of stay increases we would observe more and more migrants constrained by $\bar{q}$. That is, they do not adjust their length of stay in the U.S. in response to marginal parameter changes.

The remittance function for those spending their maximum amount of time in the U.S. can also be computed:

$$(10) \quad R = R(\overset{+}{M}, \overset{+}{f}, \overset{-}{\bar{Y}}, \overset{0}{U_x}, \overset{?}{w^*}, \overset{?}{p^*}, \overset{-}{w})$$

If the individual is unwilling to alter the amount of time spent in the U.S. ($q=\bar{q}$), then changes in remittance behavior will depend on the standard income and substitution effects. Any positive income effect (such as an increase in $\bar{Y}$ or decrease in f or M) increases the migrant's leisure and consumption which reduces remittances. Since length of stay is fixed, an increase in U_x has no impact on remittances here.

An increase in the U.S. wage has the standard positive income effect for consumption and leisure, but also has a substitution effect towards work while in the U.S. Thus, the net effect of an increase in the migrant's wage on remittances is ambiguous, but in general will be greater than for those unconstrained by $\bar{q}$. The sign for changes in the cost of living in the U.S. is also indeterminate for similar reasons.

Lastly, an increase in the wage in Mexico has a negative effect on remittances here. The increased wage increases total income, thereby increasing consumption and leisure while in the U.S.

III. AN EMPIRICAL APPLICATION

A. Data Description

The data used in the analysis is from the Encuesta Nacional de Emigracion a la Frontera del Norte y a los Estados Unidos (ENEFNEU). It was collected and analysis was permitted by the Centro Nacional de Informacion y Estadisticas del Trabajo (CENIET) of the Mexican Secretaria del Trabajo y Prevision Social. Only male, noncommuters from the return migrant portion of the survey were included. These are men at least 15 years old who have been to the U.S., either working or looking for work, during the five years preceding the interview. Return migrants were in Mexico when the interview took place in December of 1978 or January of 1979. A more detailed description of the data set can be found in CENIET (1982). Information on the number of days spent in the U.S. in 1978 and remittance flows and savings during that year are examined here.

The required step before moving to the estimation is relating the exogenous variables used in the theoretical framework to available data. Variables used and their assumed relationships to theoretical variables are shown in Table II. Some variables correspond directly, but others require some explanation. When analyzing Mexican migration to the U.S. the legal aspects must be taken into account. Four related variables are available. Dummy variables for those having working papers for the U.S. (WORKING PAPERS) or some other type of entry paper such as a mica (PERMIT) were included in the analysis. Having papers can be incorporated into the model in two ways. First, it increases the expected wage for remaining in the U.S., since the chance of apprehension is diminished and job search mobility increased. This would probably affect length of stay decisions more than remittance decisions, which depend primarily on actual wages earned. Second, having some legal status is likely to decrease the disutility of being away from home.

The third variable related to legality has to do with the costs of migration. Financial costs of migration include not only transportation costs, but sometimes payment for assistance in border crossing. A dummy variable (COYOTE) is included

TABLE II.

RELATIONSHIPS BETWEEN VARIABLES USED IN EMPIRICAL AND THEORETICAL ANALYSES

ENEFNEU Variable	Description	Assumed Relationship
USWAGE	Daily wage in U.S.	w^*
MEXICAN WAGE	Daily wage in Mexico	w
DEPENDENTS	Number of dependents	f, $U_x(+)$
IN US DEC77	Dummy if left before Jan78	$U_x(-)$
LIVED WITH	Dummy if lived with friend, relative, or boss in U.S.	$p^*(-)$, $U_x(-)$
OTHER FAMILY WORKERS	Number of other family members contributing to family income	$\bar{y}(+)$
PERMIT	Dummy if has papers to be in U.S., but not to work	$Ew^*(+)$, $U_x(-)$
WORKING PAPERS	Dummy if has working papers for U.S.	$Ew^*(+)$, $U_x(-)$
TRANSPORT	Transportation costs	$M(+)$
COYOTE	Dummy if paid for assistance in border crossing	$M(+)$
APPREHENDED	Number of times apprehended in 1978	$M(+)$, truncation
SINGLE	Dummy if not married	$U_x(-)$
AGE	Age	$\bar{y}(+)$
HECTARES	Number of hectares farmed in Mexico	$\bar{y}(+)$, $w(+)$
YEARS SCHOOLING	Number of years of school	$w(+)$, $Ew^*(+)$
NO WORK IN MEX	Dummy if didn't work in Mexico	$w(?)$
UNPAID AGR IN MEX	Dummy if unpaid farmer in Mexico	$w(?)$

for those reporting this type of payment. Lastly, the number of apprehensions reported for 1978 (APPREHENSIONS) is included. Being apprehended can be treated as a fixed cost to some extent, but largely acts to prevent the migrant from fulfilling his desired length of stay and savings in the U.S.

An additional problem in the empirical application is that a number of migrants reported no wage rate in Mexico. In some cases they were unemployed in the usual sense, but others reported not wishing employment in Mexico. Still others were landowners or other agricultural workers that did not receive payment in wages. Dummy variables were used to account for these two groups: (NO WORK IN MEXICO) and (UNPAID AGR IN MEXICO).

The remaining structure of the model can be quickly summarized. There are four variables in the theoretical model not directly observed. Outside income ($\bar{Y}$) is represented by OTHER FAMILY WORKERS (the number of other family workers contributing to family income), HECTARES (the number of hectares farmed, and AGE (age in years), representing a life cycle model of saving. Fixed migration costs (M) are related to TRANSPORT (transportation costs paid in pesos), COYOTE (dummy variable), and APPREHENDED (number of apprehensions in 1978). Lastly, the direct marginal utility of being in Mexico (U_x) is assumed to be negatively related to IN US DEC77 (dummy if migrant left Mexico before January of 1978), LIVED WITH (dummy if migrant lived with friend, relative, or boss while in U.S.), PERMIT and WORKING PAPERS as mentioned above, and SINGLE (dummy if single). Lastly, the only available measure for the cost of living in the U.S. is LIVED WITH.

Two dependent variables are analyzed. LENGTH OF STAY is the number of days spent in the U.S. during 1978. REMITTANCES is the total dollars sent to Mexico during 1978 plus the total taken back to Mexico, all divided by the number of weeks spent in the U.S. during 1978.

B. Estimation Procedure

In the ENEFNEU sample of return migrants, approximately half were in the U.S. working or looking for work in 1978. In estimating the length of stay equation for those who were in the U.S. in 1978, sample selection bias is likely to be a problem. A simple ordinary least squares procedure suggested by Olsen (1981) is used in the analysis.[2]

The model follows quite directly from the theoretical framework. Let I_i be a binary variable equal to 1 if the individual was in the U.S. in 1978 and 0 otherwise. We assume that,

$$(11) \quad \Omega(q^*)_i - \Omega(0)_i = Z_i\gamma + v_i, \text{ so that}$$

$$I_i = 1 \text{ iff } v_i > -Z_i\gamma .$$

The Z_i's are row vectors of exogenous variables determining utility under the two options of migrating and staying at home, and γ a column vector of unknown coefficients.

Now consider the length of stay function, with y_i representing the number of days in the U.S. and X_i row vectors of exogenous variables with β the corresponding coefficients, and ε_i the error term with mean 0. Since y_i is observed only if $I_i = 1$, the conditional expectation of y_i is:

$$(12) \quad E(y_i \mid X_i, v_i > -Z_i\gamma) = X_i\beta + E(\varepsilon_i \mid v_i > -Z_i\gamma)$$

In the estimation we assume that the conditional expectation of ε_i given v_i is linear in v_i, and also that the v's are uniformly distributed over $[0,1]$.[3] The resulting estimating equation, where $\tilde{\gamma}$ is the estimated value of γ, is

$$(13) \quad y_i = X_i\beta + \delta(Z_i\tilde{\gamma} - 1) + \mu_i$$

The term BIAS is included in the second LENGTH OF STAY regression to represent $(Z_i\tilde{\gamma}-1)$.[4]

A number of least squares regressions are estimated for the remittance equation. In the first it is assumed that REMITTANCES is an accurate measure for any R_t, and the proposed theoretical equation used. Note that this is strictly only the case when r is equal to ρ. In this case R is constant over the time period in the U.S., and average remittances per unit of time is an appropriate measure for any R_t. If $\rho > r$, however, leisure and consumption are falling over time so that R is rising. An increase in time in the U.S. (holding λ constant) would imply an increase in average remittances, even though R for any t might remain fixed. The reverse is true if $r > \rho$. Thus we include LENGTH OF STAY as an explanatory variable in the second REMITTANCES regression.

We want to allow for an increase in the number of migrants constrained by their maximum length of stay as length of stay increases. Two methods are used for examining structural changes in the parameters of the remittance function as length of stay increases. First, a continuous linear shift is assumed, as suggested by Farley and Hinich (1970), so that each estimated coefficient is specified as a linear function of length of stay. The hypothesis of structural change is rejected if all interaction terms are insignificantly different from zero. If in fact the second remittance equation (R) discussed above, where $q=\bar{q}$, becomes more relevant as time in the U.S. increases, we would expect interaction terms representing M, f, and w* to be positive, and those for $\bar{Y}$, U_x, and w to be negative.

Finally, a switching regression is estimated, where all coefficients are assumed to change at a given length of stay. [See Judge, et al., (1980), p. 389.] The switch point is estimated jointly with the coefficients using a simple maximum likelihood procedure. We then examine the two sets of coefficients to see if in fact those with the shorter length of stay show remittance functions corresponding to the first remittance equation above, while the group staying longer has the second type of remittance function.

C. Regression Results

Sample means are reported in Table III, and regression results in Tables IV and V.[6] They appear to be quite consistent with the proposed theoretical framework. Responses of length of stay to wages are significant but small. The results suggest that a 20 percent increase in the U.S. wage would increase the length of stay by about 6 days, while a 20 percent increase in the Mexican wage would reduce the length of stay by about 1 day on average. Having dependents is significant in increasing the length of stay in the U.S., as is being in the U.S. in December of 1977. Being apprehended is estimated to reduce the length of stay by about 2 weeks.

The reader should be reminded at this point of the limitations of the data used. Changes in length of stay predicted here do not include those that change their migration decision, that is, those that after the parameter change would now choose to migrate or now choose to return home in December of 1978. In addition, in estimating the length of stay equation, no attempt has been made to separate out those constrained by the upper boundary on time away ($\bar{q}$). If this is important, as the remittance equations suggest, then the length of stay regression equation is a summary of the composite behavior of the two different types of migrants. Lastly, because of heteroskedasticity, standard errors in the second regression are strictly correct only if sample selection bias is absent.

The first two remittances regressions are included in Table IV. The results appear to be a mixture of the two types of remittance functions discussed earlier. Both the U.S. and Mexican wages are positively and significantly related to remittances. Thus, for example, the coefficient for the Mexican wage coincides with the initial model of temporary migration. However, dependents and other working

TABLE III.

SAMPLE AVERAGES

Regression	Length of Stay	Remittances: Length of Stay < 215	and ≥ 215 Days
REMITTANCES		52.30	61.97
LENGTH OF STAY	157.08	111.86	285.24
US WAGE ($)	24.79	23.64	27.98
MEXICAN WAGE (pesos)	69.72	69.52	60.31
DEPENDENTS	3.69	3.65	3.93
IN US DEC 77	0.24	0.18	0.41
LIVED WITH	0.69	0.69	0.72
OTHER FAMILY WORKERS	1.45	1.51	1.22
PERMIT	0.14	0.14	0.16
WORKING PAPERS	0.05	0.04	0.08
TRANSPORT	823.82	760.17	1014.44
COYOTE	0.39	0.36	0.44
APPREHENSIONS	0.26	0.29	0.17
SINGLE	0.33	0.32	0.32
AGE	31.53	32.00	31.08
HECTARES	1.10	0.87	1.85
YEARS SCHOOLING	4.83	4.53	5.55
NO WORK IN MEXICO	0.18	0.15	0.26
UNPAID AGR WORKER	0.18	0.19	0.18
Number of Observations	404	285	99

TABLE IV.

REGRESSION RESULTS

Variable	Length of Stay: Basic Regression	Length of Stay: Including Bias	Remittances: Basic Regression	Remittances: Including Length of Stay
USWAGE ($/day)	1.199*	1.215*	1.189*	1.210*
	(0.367)	(0.367)	(0.176)	(0.179)
MEXICAN WAGE	-6.110	-6.619**	5.817*	5.715*
(100 pesos)	(3.766)	(3.778)	(1.819)	(1.826)
DEPENDENTS	5.635*	5.138*	1.706**	1.799**
	(1.572)	(1.876)	(0.876)	(0.887)
IN US DEC77	53.635*	52.882	-5.878	-5.026
	(10.384)	(10.374)	(4.939)	(5.088)
LIVED WITH	14.708	13.304	-4.169	-3.980
	(9.651)	(9.688)	(4.635)	(4.646)
OTHER FAMILY WORKERS	-3.710	-1.665	-3.009**	-3.087**
	(3.633)	(3.900)	(1.778)	(1.782)
PERMIT	-12.044	-15.363	3.263	2.998
	(14.494)	(14.660)	(7.031)	(7.046)
WORKING PAPERS	24.150	18.870	7.513	7.966
	(21.450)	(21.738)	(10.341)	(10.368)
TRANSPORT	0.488	0.454	-0.283	-0.273
(100 pesos)	(0.381)	(0.382)	(0.181)	(0.182)
COYOTE	11.487	11.216	4.341	4.550
	(10.014)	(10.002)	(4.819)	(4.830)
APPREHENDED	-15.861**	-14.885**	-8.096*	-8.368*
	(8.429)	(8.446)	(4.135)	(4.002)
SINGLE	5.284	12.145	-6.336	-6.222
	(12.221)	(13.115)	(5.937)	(5.943)
AGE	-0.332	-0.580	0.125	0.121
	(0.513)	(0.541)	(0.244)	(0.244)
HECTARES	0.169	0.057	0.328	0.331
	(1.008)	(1.010)	(0.471)	(0.471)
YEARS SCHOOLING	3.413*	3.321*	0.176	0.240
	(1.572)	(1.572)	(0.770)	(0.776)

REGRESSION RESULTS (continued)

Variable	Length of Stay		Remittances	
NO WORK IN MEXICO	16.097 (13.191)	14.351 (13.230)	5.027 (6.213)	5.338 (6.233)
UNPAID AGR IN MEXICO	-7.529 (13.117)	-9.213 (13.152)	10.993** (6.156)	10.899** (6.162)
BIAS		-107.268 (75.090)		
LENGTH OF STAY			-0.017 (0.024)	
CONSTANT	80.094* (24.638)	42.407 (36.075)	19.573 (11.588)	20.881 (11.743)
Sample Size	404	404	384	384
R^2	.179	.183	.234	.235

Note: A 5% significance level according to the estimated standard error is denoted by *, and 10% by **.

family members have a negative and positive effect on remittances, respectively, which corresponds to the second remittance function for constrained temporary migration. It can also be seen from the second remittances regression that the length of stay is insignificant as a predictor.

In Table V the regressions allowing for structural change in parameters are shown. The first equation specified parameters as linear functions of length of stay. The trend is shown in the second column. As predicted, the interaction term for w is negative and highly significant, while those for the U.S. wage and number of dependents are positive and significant. If having someone to live with in the U.S. or being single decreases U_x, then these positive estimated coefficients are also consistent with the theory. Other variables are insignificant or do not have unambiguously predicted signs.

The last two columns of Table V show the coefficients allowing for a structural change at a given length of stay. The switch point maximizing the likelihood function was 215 days, and coefficients and standard errors presented are conditional on that estimate. Those staying more than 215 days show quite different behavior from those staying a shorter time. These differences appear to be largely consistent with differences in predictions of those with $0 < q < \bar{q}$ and those where $q=\bar{q}$. For those staying less than 215 days, both the U.S. and Mexican wage have positive, significant effects on remittances. A 10 percent increase in the U.S. and Mexican wage suggest increases of 2.19 and 0.59 dollars per week, respectively. This suggests that those with better wage opportunities in Mexico may in fact stay for shorter periods of time, but work harder and have a higher savings rate while in the U.S. Being single and having someone to live with in the U.S. also significantly diminish remittances, consistent with the theory if these variables are inversely related to the direct marginal disutility of being in Mexico. Also, notice that neither the number of dependents nor the number of other family workers significantly affect the amount remitted. Assuming that these variables have a direct impact on the budget constraint (but do little to affect U_x), this is again in agreement with the predictions of the model.

The results are very different for those staying more than 215 days. The response to the U.S. wage is larger, and to the Mexican wage smaller, and in fact negative. Being single is no longer significant, and having someone to live with is positively related to remittances here. Also, an increase in the number of dependents now significantly increases remittance flows.

TABLE V.

REMITTANCE REGRESSIONS: PARAMETERS DEPENDING UPON LENGTH OF STAY

Variable	Parameters as Linear Function of Length of Stay		Structural Change When Length of Stay Equals 215	
	Intercept	Slope	<215	>215
USWAGE ($/day)	0.499 (0.356)	0.004* (0.002)	0.925* (0.204)	1.825* (0.325)
MEXICAN WAGE (100 pesos)	10.783* (2.649)	-0.043* (0.015)	8.485* (2.042)	-2.435 (3.463)
DEPENDENTS	-1.463 (1.692)	0.025* (0.009)	0.756 (0.973)	6.310* (1.914)
IN US DEC77	-4.405 (10.331)	-0.001 (0.051)	-0.883 (6.151)	-13.707 (9.018)
LIVED WITH	-22.422* (8.692)	0.124* (0.050)	-13.289* (5.158)	20.394* (10.169)
OTHER FAMILY WORKERS	0.371 (3.614)	-0.022 (0.021)	-1.956 (1.950)	-4.816 (4.053)
PERMIT	-12.119 (13.276)	0.103 (0.072)	-1.407 (8.014)	27.131** (13.919)
WORKING PAPERS	25.503 (22.315)	-0.084 (0.108)	9.356 (12.713)	9.097 (14.423)
TRANSPORT (100 pesos)	-0.035 (0.403)	-0.001 (0.002)	-0.158 (0.218)	-0.532 (0.325)
COYOTE	7.129 (9.507)	-0.014 (0.052)	4.333 (5.408)	0.880 (9.778)
APPREHENDED	-13.189** (7.978)	0.022 (0.049)	-9.116* (4.117)	-1.667 (11.164)
SINGLE	-32.689* (11.453)	0.151* (0.626)	-12.513** (6.700)	6.227 (11.553)
AGE	0.666 (0.477)	-0.004 (0.003)	0.239 (0.281)	-0.607 (0.491)
HECTARES	2.117 (1.612)	-0.008 (0.007)	1.423 (0.971)	0.280 (0.541)

REMITTANCE REGRESSION RESULTS (continued)

Variable	Intercept	Slope	<215	>215
YEARS SCHOOLING	4.187* (1.598)	-0.025* (0.008)	1.139 (0.886)	-3.275* (1.460)
NO WORK IN MEXICO	13.474 (12.974)	-0.030 (0.068)	14.015** (7.375)	-6.245 (11.278)
UNPAID AGR IN MEXICO	-9.834 (12.688)	0.111 (0.069)	6.577 (7.223)	14.365 (12.389)
CONSTANT	27.484 (22.426)	-0.057 (0.120)	18.278[1] (22.481)	4.519 (26.171)
CONSTANT			18.278 (22.481)	
Sample Size	384		384	
R^2	.328	.328	.327	.327

Note: A 5% significance level is denoted by *, and 10% by **.

[1] Applies to entire sample.

IV. CONCLUSION

In this paper the determinants of time allocation between Mexico and the U.S. and the flow of remittances and savings of temporary migrants are examined. Since data are available on the individual level, the utility maximization model is formulated for individual decision making that takes into account actions and welfare of other family members.

Once the decision to migrate has been made, the length of time spent in the U.S. is shown to depend on the direct marginal disutility of being in the U.S., exogenous variables entering into the budget constraint, and exogenous parameters affecting the implict price of being away. This price is simply the difference between the individual's savings per unit of time in the U.S. and Mexico. Using this model it is predicted that any drain on income (i.e. increased transportation costs, more dependents) will increase the fraction of time spent in the U.S., as will a decrease in the wage rate in Mexico. Changes in the U.S. wage or cost of living have an ambiguous effect. The empirical results suggest that wage rates have a significant but relatively small effect on time spent in the U.S.; the elasticities with respect to the U.S. and Mexican wage are about 0.19 and -0.03, respectively. The number of dependents and being in the U.S. in December of the previous year both increase length of stay (5 days and 53 days, respectively), while being apprehended diminishes length of stay by about 15 days. A one-year increase in years of schooling increases time in the U.S. by approximately 3 days. Increased transportation and border crossing costs increase length of stay, but are not highly significant.

Remittance flows are also predicted from the model. If the length of stay is flexible, increases in the Mexican wage theoretically increase remittances per unit of time. The implied shorter length of stay reduces total income, and is somewhat compensated by more savings while in the U.S. Similarly, an exogenous increase in the marginal disutility of being in the U.S. is predicted to decrease time in the U.S. but increase remittance flows. Exogenous changes in the budget constraint (i.e. changes in fixed transportation costs, the number of dependents or other family members contributing to income) are predicted to be absorbed by changes in length of stay rather than remittances per unit of time. These predictions are supported by the empirical results for the migrant staying less than 215 days.

Different implications result if the migrant feels obligated to cut the length of stay in the U.S. from its economic maximum in order to maintain ties in Mexico. With the length of stay fixed, the usual income and substitution effects result. An increase in the Mexican wage has a positive income effect, increasing leisure and consumption while in the U.S. So, remittances per unit of time decline. Similarly exogenous increases in income result in a decrease in remittance flows. Here increases in the marginal disutility of being away are simply a fixed cost and do not affect remittance decisions. Again the empirical results are largely consistent with the predictions. Those staying more than 215 days show a negative response (though not significant) of remittance flows to Mexican wages, while an increase in dependents significantly increases remittance flows. Being single is not significant for remittance flows for this group. These results all differ in the predicted manner from the group staying less than 215 days.

In sum, a model of temporary migration focusing on intertemporal optimization permitted by wage and price level differentials and on family and cultural ties to Mexico is suggested, and in general supported by the data. While the model is inherently abstract and limitations on the sophistication of econometric techniques were present, the analysis does seem to provide insight into the motives of temporary migration and magnitudes of responses to parameter changes.

Directions for future research are numerous. In addition to undertaking modifications of the analysis presented here, a multitude of other issues arise. In particular, what are the determinants of the choice of temporary vs. permanent migration? What characteristics determine wage-earning opportunities in both countries? How does job market experience in the U.S. affect occupational mobility in Mexico? And on a more aggregate level, what are the implications of this migratory phenomenon for wages, prices, and income distribution in Mexico and the U.S?

NOTES

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1. Qualitatively identical results arise if the last fraction of time is spent in the U.S. In fact, the timing technically depends on (ρ - r), and in the real world probably depends on minor fluctuations in the opportunity cost of time in each area.

2. A maximum likelihood procedure for estimating a probit function was not available at CENIET in Mexico City. This procedure appears to be most appropriate given the computational constraints.

3. For a discussion of the implications of these assumptions see Olsen (1980). He suggests that on a priori grounds there is little reason to prefer the more common Mill's ratio method of correction [See Heckman (1976)] to this because of the distributional restrictions implied.

4. Since both error terms v_i and μ_i are heteroskedastic, t ratios formed for coefficients using computed standard errors are correct under the null hypothesis that selection is absent.

5. To aid in determining an appropriate cutoff time, all observations were included in a regression which included interactive terms for length of stay with all exogenous variables. The coefficient for MEXICAN WAGE became 0 at 237 days. DEPENDENTS became significantly different from 0 (2 standard deviations away) at 196 days.

6. BIAS represents the correction for sample selectivity bias. It was computed from the following estimated equation according to the procedure described above:

$$
\begin{aligned}
I = \underset{(.316)}{0.869} &- \underset{(.002)}{.002}*\text{AGE} - \underset{(.004)}{.003}*\text{HECTARES} + \underset{(.049)}{.0565}\text{SINGLE} - \underset{(.006)}{.0007}*\text{YEARS} \\
&\text{SCHOOLING} + \underset{(.014)}{.022}*\text{OTHER FAMILY WORKERS} - \underset{(.007)}{.003}*\text{DEPENDENTS} + \\
&\underset{(.038)}{.011}*\text{AGWORK} - \underset{(.0000)}{.0001}*\text{DISTANCE} + \underset{(.002)}{.005}*\text{APP RATE} - \underset{(.003)}{.0002}*\text{RECRUIT} + \\
&\underset{(.002)}{.001}*\text{POVERTY} - \underset{(.003)}{.005}*\text{LITERACY RATE}, \text{ where AGWORK} = 1 \text{ if an}
\end{aligned}
$$

agricultural worker in Mexico, DISTANCE = average transportation costs (100 pesos) paid by those in state of origin who went to U.S. in 1978, APP RATE = percentage of people in sample from state of origin apprehended per trip to U.S., RECRUIT = percentage of people in sample from state of origin who made their first trip to U.S.

during the bracero period, POVERTY = percentage of people in state of origin under a poverty level of 300 pesos per month (from 1970 Mexican census), and LITERACY RATE = state of origin literacy rate (from 1970 Mexican census). Standard errors are shown in parentheses under coefficients.

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