An empirical examination of the factors affecting remittance by Mexican migrants in the United States

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I. Introduction

Remittances across the world have continued to increase over the past three decades to equal approximately $230.5 billion in 2004 (World Development Indicators, 2007) Mexico has reported worker's remittances to equal $8.9 billion in 2001, $9.8 billion in 2002, $13.4 billion in 2003, and 16.6 billion in 2004 (Congressional Budget Office). The 2004 remittances constituted nearly 2.5 percent of Mexico's GDP, exceeding the inflows from direct foreign investment and aid. This significant amount and historical increase in annual remittances for Mexico and the world have drawn attention to the determinants of who remits and how much.

Economic models of remittances are an extension of the model to explain rural to urban migration (Todaro, 1969). The decision to migrate is a function of the expected urban-rural wage differential, where the urban wage is discounted by the probability of getting urban employment. The rural marginal product of labor may be lower than what is needed for subsistence. An informal agreement is often hypothesized in these models that entitles each family member to the average product of the family's output. The decision to migrate is also viewed as a family decision and it could be regarded as an extension of the informal contract whereby the migrant remits part of his income to remaining family members for "services rendered", as a form of individual insurance against urban unemployment (Poirine, 1997, Stark, 1991, Stark and Levhari, 1982, Liu and Reilly, 2004) or to secure a bequest upon returning home (Hoddinott, 1994).

Another approach views remittances as motivated by altruism (Lucas and Stark 1985; Agarwal and Horowitz 2002). Altruism implies that the utility function of the migrant's consumption as well as that of other non-migrants (Stark 1995, Magee and Thomson, 2006, Glytsos, 2002, and Bouhga-Hagbe, 2004). The reduced form that is used to estimate remittance levels includes a constant term to account for the altruism and/or implicit contract motives and other income-dependent variables to account for "affordable" remittances. Other theories link the two approaches (Lucas and Stark 1985).

Prior theoretical models seem to be primarily concerned with modeling the motivations to remit, but not with the capacity to remit. Despite the motivational differences between the contrasting theories (which may depend upon ambiguous definitions) most theoretical models are similar in that a migrant is maximizing his/her utility function with respect to certain constraints. A utility maximization approach accommodates most of the contrasting theories. In addition, it permits us to handle the concept of ability to remit subject to income and costs constraints.

While theoretical applications attempt to control for non-remitters as a sample selection problem, no theoretical model incorporates net income in the formal theoretical model. One of our goals is to provide a general theoretical model for remittances that accommodates prior approaches but includes a net income constraint. We contend that remittances flow out of net income, defined as the difference between real income and the cost for the migrant to live at a

self-determined minimum living standard. For some migrants this could be a subsistence level that provides only for the necessities to sustain life. It is easy to imagine a migrant living in poverty-like conditions, while remitting as much as possible to provide for family members whom reside in the home country or to support investment in the home country. If this net income is positive the migrant may be willing to remit.

We contend that the decision to actually remit is also a function of transactions costs. Most empirical estimates do not take into account the impact of actual transactions costs of remitting funds, particularly through formal channels. Intra-country urban-rural remittances largely use informal channels and the costs are probably minimal. Remittances to Mexico and Latin America, however, go through a variety of formal channels. Data for 1999-2000 showed that 66 percent of the remittances to Mexico went through non-bank money transfer methods (MTFs), 12 percent through informal channels and 17 percent through commercial banks (Amuendo-Dorantes, Bansak and Pozo, 2004). The share of MTFs is higher for funds remitted to rural areas, and for illegal migrants. The costs vary by type of institution, country of destination and requested speed of delivery. MTFs charges fell from 15 percent in the 1990s to 5 percent by 2005 (CBO, 2005) and they vary by type of service selected. Credit Unions, on the other hand, charge a flat fee of less than one percent and no foreign currency conversion fees. MTFs and banks also levied charges on the recipient when converting the funds into Mexican currency, and these fees are variable (CUNA and Affiliates, 2003). Therefore, if the subsistence needs and the total costs of sending the remittances equal or exceed the migrant's income the migrant will choose not to remit. The determinants of remittances are then based on motivations to remit and the capacity to remit, which is contingent on a positive net income (after paying all transactions costs).

We therefore suggest as a theoretical approach the use of a utility maximization model where a positive net income becomes an additional constrain to a standard budget constraint. If the net income constraint is non-binding then the amount remitted is determined by either the utility maximization problem subject to an income constraint or some idiosyncratic political or social elements that may not be directly observable. We then use this approach to generate estimates from our particular sample of Mexican migrants to the United States. We apply a modified Generalized Ordered Probit model to test hypotheses that follow from our theoretical model. The attempt to validate the net income constraint theory is facilitated by obtaining a more complete understanding of the effects of the factors of remittances.

Hoddinott (1992) states that prior empirical work on remittances does not address the distinction between the explanatory variables' effects on the likelihood of remitting and the level of remittances. He addressed this distinction by the use of a generalized (Type II) Tobit model (also called a Heckit model) that allows the censoring process to be determined by a different index function than the rest of the distribution. Because we have categorical remittance data, we adapt the generalized ordered Probit model to allow the probability of no remittance to be

determined by a different index function than the level of remittances (given that remittances are positive).

The paper is organized as follows. Section II consists of a theoretical model and a set of hypotheses to be tested. Data and the empirical model are described in Section III. A discussion of the results is in Section IV, and section V concludes.

II. Theory

Consider the following time frame and decision process. A Mexican worker chooses to migrate if the expected benefits of doing so outweigh the costs. The migrant comes to US, acquires a job offer and accepts if $Y^{us} \geq Y^{mx}$, assuming that Y^{mx} is available upon return to Mexico. Given that a job is offered, accepted, and maintainted, the migrant decides mow much to remit per month. At a minimum, Subsistence level consumption plus remittances must be covered by income, so $Y^{us} \geq R^{us} + \underline{C}$, where $\underline{C}$ is a subsistence requirement. Remittances from the U.S. are defined as the remittances received in Mexico (measured in U.S. dollars), plus the remittance fees and costs: $R^{us} = R(1+d) + T$, where R is the remittance received in Mexico, d = percentage transfer fee, and T is a lump-sum per remittance fee.[1] The working migrant solves the constrained maximization problem

$$L(C,R) = U(C,R;\mathbf{Z}) + \lambda\left(Y^{us} - C - \left(R(1+d)+T\right)\right) + \gamma\left(\underline{C} - C\right),$$

where $U(C,R;\mathbf{Z})$ is utility as a function of consumption in the U.S. C, remittances R, and a vector Z of personal characteristics. The first constraint is the budget constraint, with Lagrange multiplier λ, and the second is the subsistence constraint with Lagrange multiplier γ. Given this formulation, the marginal price of consumption C is 1, and the marginal price of R is $(1+d)$. The first-order conditions for this problem are

$$\begin{aligned}
C: &\quad U_C(\mathbf{Z}) - \lambda - \gamma = 0 \\
R: &\quad U_R(\mathbf{Z}) - \lambda(1+d) = 0 \\
\lambda: &\quad Y^{us} - C - \left(R(1+d)+T\right) = 0 \\
\gamma: &\quad \left(\underline{C} - C\right) \leq 0; \text{ if } < 0 \text{ , then } \gamma = 0,
\end{aligned}$$

where subscripts denote derivatives. Assuming necessary conditions hold for a maximum, remittance demand is $R^* = R(Z, Y^{us}, T, d, \underline{C})$. Consider the comparative statics with respect to

[1] The subsistence constraint is equivalent to imposing a discontinuity in the utility function at $\underline{C}$ such that utility drops to zero at and below the subsistence level of consumption.

income first. If the subsistence constraint is not binding, $\gamma^*\left(\mathbf{Z}, Y^{us}, T, d\right) = 0$ and (if strictly nonbinding) $\partial\gamma^* / \partial Y^{us} = 0$. In this case, the text-book income effects result. Presuming that the benefits accruing through both consumption and remittances are viewed as normal goods, then we expect to see remittances increase with income ($\partial R^* / \partial Y^{us} > 0$).

If the subsistence constraint is binding ($\gamma^* > 0$), remittances will be zero for lower income levels and then increase, possibly with a discontinuous jump, depending on the marginal cost of remitting and the curvature of the migrant's utility function at $\underline{C}$. Figure 1 shows the expansion path of remittances and consumption with increases in income. Based on the constraints, $\min(C) = \underline{C}$ for subsistence, and if $Y^{us} - \left(\underline{C} + T\right) \leq R\left(1 + d\right)$, then remittances are zero. If the inequality strictly holds, remittances will not increase with an increase in income, such that $\partial R / \partial Y^{us} = 0$. For the range $Y^{us} - \left(\underline{C} + T\right) \geq R\left(1 + d\right)$, remittance/consumption expansion proceeds such that the price ratio equals the marginal rate of substitution between remittances and consumption. Figure 2 shows the relationship between income and remittances. For Y^{us} and T such that the subsistence constraint is binding, $R^* = \max\left\{0, \frac{Y^{us} - \left(C^* + T\right)}{1+d}\right\}$, represented by the discontinuous thick line. The minimum remittance is $\underline{R} = \frac{Y^{us} - \left(\underline{C} + T\right)}{1+d}$. Below this level, remitting is not worth the lump-sum cost T.

The available data do not include estimates of subsistence consumption or lump-sum remittance costs explicitly. Although known by the remitter, let $\varepsilon_i = \underline{C}_i + T_i$ represent a random variable from the perspective of the researcher.[2] Then we can characterize the probability of individual i submitting a remittance as $\Pr\left(\varepsilon_i < Y^{us} + R^*\left(1 + d\right)\right)$, and the expected remittances from the researchers' perspective as $E\left[R^*\right] = R^* F\left(Y^{us} + R^*\left(1 + d\right)\right)$, where $F(.)$ is the cumulative distribution function of ε_i (with $f(\cdot)$ the associated density function). For a given optimal remittance level and income,

$$\frac{\partial E\left[R^*\right]}{\partial Y^{us}} = \left(F(\cdot)\frac{\partial R^*}{\partial Y^{us}} + f(\cdot)R^* \right) \geq 0.$$

[2] In fact, the ffull remittance costs may often be unknown by the remitter. Although the remitter will know the costs of remittances on the front end in the U.S., he/she may not know the costs incurred at the back end of the transaction in Mexico. For example, the remittances are received as Pesos, and the exchange rate can change daily, as does the exchange rate premium charged by the money transfer firm. Anecdotal evidence indicates the transmitters may view these costs as a variable cost also (Dorantes et. al 2005).

For low R^*, $f(\cdot)R^*$ will be small, $F(\cdot)$ -- the probability of remittance -- will be small, and given a sinusoidal CDF (such as a normal distribution), even $f(\cdot)$ is likely to be small. Therefore, $\partial E\left[R^*\right]/\partial Y^{us}$ will be small and statistically weak relative to the effect of income at higher reported remittance levels. This logic supports the following hypothesis:

Hypothesis 1: *The marginal effect of income will have a small and weak estimated effect on remittances at low reported remittance levels, and will be positive at higher remittance categories.*

Marginal and lump sum remittance costs will affect remittance levels in a straightforward way. Given that migrant consumption and remittances are substitutes (as must be the case in a two-good world), an increase in the marginal cost of remitting will lead to a lower level of remittances and will cause some migrants with a high subsistence consumption level or low income to not remit at all. Lump sum remittance costs will increase the likelihood of not remitting. Two hypotheses that are testable by proxy given our data that relate to remittance transaction costs are:

Hypothesis 2: *High marginal remittance costs will lead to less remittance in dollar terms given that remittance is positive.*

Hypothesis 3: *High fixed costs of remittance will reduce the probability of remittance*.

Other personal characteristics will affect remittance levels of a migrant. Presuming a family utility function applies, more family consumption capacity in Mexico, and/or lower family income generation in Mexico will tend to induce more remittances at the margin. [3]

Hypothesis 4: *More (fewer) family members in Mexico and fewer (more) family members in the U.S. will lead to higher (lower) remittances at the margin.*

The migrant's security in the U.S. and his/her plans for returning to Mexico also are likely to be important determinants of remittances. If a migrant has a secure, steady job for any reported income level, the expected value of income will be higher and the variance of income will be lower. It follows that remittances will be higher if given stronger job security and even moreso to the extent that the migrant is risk averse in consumption in the U.S. relative to family consumption in Mexico. If a migrant has strong investment interests in Mexico, the value of remittances at the margin are likely to be higher. Also, if the migrant is planning on being in the U.S. for only a short period of time, or if the migrant's stay in the U.S. is tenuous (perhaps

[3] This result is based on the idea that if relatively more family members are in Mexico, the family utility function will be flatter in R-C space (as in Figure 1), this providing a relatively larger marginal rate of substitution of R for C in the relevant ranges.

having no legal papers or due to job insecurity itself, this may mean that (s)he will personally benefit more from remittances sooner, so that the family expected value of remittances at the margin are larger for a given level of remittance. A couple more hypotheses follow:

Hypothesis 5: *Less secure employment and residence security in the U.S. will lead to higher remittances.*

Hypothesis 6: *Stronger financial ties to the U.S. (Mexico) will lead to lower (higher) remittance levels.*

Each of the above hypotheses will be tested. The following section describes the data and estimation method used.

III. Data and econometric model

The data come from survey questionnaires that were administered by the Pew Hispanic Center (PEW).[4] The surveys were conducted from July 2004 through January 2005 at Mexican Consulates in the following U.S. cities: Los Angles, New York, Chicago, Atlanta, Dallas, Raleigh, and Fresno. The data from the surveys consists of people that were applying for a Matricula Consular, which is an identification card.

The data used in the statistical analysis are described in Table 1, and Table 2 provides their summary statistics. Given an ordinal categorical dependent variable (Remittances), we use a generalized ordered Probit (GOProbit) regression model to estimate the probability of an individual being in a given remittance category. We generalize the standard GOProbit slightly to allow for different variables to affect the choice not to remit from the choice of which level to remit given positive remittance. As a result, the model we employ is the ordered probit counterpart to a type-II Tobit model (Heckit), which allows the index function of the censoring process to differ from the index function of the continuous part of the error distribution. Formally, we characterize the decision process in terms of an underlying latent remittance demand, R^*. Our observed data are ordered categorical, so that we observed seven categories ranging from no remittance to remittances over $500 per month, and we want to allow flexibility in the sample range of observed R, while still admitting our imperfect (categorical) observation of it. As such, we begin by characterizing an unconstrained spline regression as a piecewise linear approximation to R^* (see Greene (2003), section 7.2.5 for a further description):

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[4] "The Pew Hispanic Center bears no responsibility for the interpretations offered, or conclusions made based on analysis of the Pew Hispanic Center Survey of Mexican Migrants data."

$$R_i^* = G(\mathbf{x}_i'\boldsymbol{\beta}, \varepsilon_i) \cong \left(d_i^0\left(\mu_0 + \mathbf{x}_i^0'\boldsymbol{\beta}_0\right)\right) + \sum_{j=1}^{J}\left(d_i^0\left(\mu_j + \mathbf{x}_i'\boldsymbol{\beta}_0\right)\right) + \varepsilon_i,$$

where $\mathbf{x}_i^0$ are variables affecting R_i^* in the range of no remittances, $\mathbf{x}_i$ are explanatory variables (possibly different than $\mathbf{x}_i^0$) that affect $R_i^* > 0$, and

$$d_i^j = \begin{cases} = 1 & \text{if } \mu^{j-1} \le R^* < \mu^j \\ = 0 & \text{otherwise.} \end{cases}$$

Where μ^k Thus, for a given range, $R^* \mid \mu^{j-1} \le R^* < \mu^j = \mathbf{x}_i'\boldsymbol{\beta}_j + \varepsilon_i$. Thus, the probability of remittance falling within each of the specific categories is

$$\begin{aligned}
&\Pr(R_i = 0 \mid \mathbf{x}_i^0) &&= \Pr\left(\mathbf{x}_i^0'\boldsymbol{\beta}_0 + \varepsilon_i < 0\right) = \Phi(-\mathbf{x}_i^0'\boldsymbol{\beta}_0) \\
&\Pr(R_i = 1 \mid \mathbf{x}_i, \mathbf{x}_i^0) &&= \Phi(\mu_1 - \mathbf{x}_i'\boldsymbol{\beta}_1) - \Phi(-\mathbf{x}_i^0'\boldsymbol{\beta}_0) \\
&\Pr(R_i = 2 \mid \mathbf{x}_i) &&= \Phi(\mu_2 - \mathbf{x}_i'\boldsymbol{\beta}_2) - \Phi(\mu_1 - \mathbf{x}_i'\boldsymbol{\beta}_1) \\
&\Pr(R_i = 3 \mid \mathbf{x}_i) &&= \Phi(\mu_3 - \mathbf{x}_i'\boldsymbol{\beta}_3) - \Phi(\mu_2 - \mathbf{x}_i'\boldsymbol{\beta}_2) \\
&\vdots \\
&\Pr(R_i = 6 \mid \mathbf{x}_i) &&= 1 - \Phi(\mu_6 - \mathbf{x}_i'\boldsymbol{\beta}_6).
\end{aligned}$$

where $\Phi(\cdot)$ represents the cumulative standard normal density function.[5] The likelihood function for this type-two ordered Probit is

$$L = \prod_{i=1}^{N}\left(\Phi_{i,0}{}^{d_0} \cdot \prod_{j=1}^{7}\left(\Phi_{i,j} - \Phi_{i,j-1}\right)^{d_j}\right)$$

where $\Phi_{i,0} = \Phi(-\mathbf{x}_i^0'\boldsymbol{\beta}_0^0)$, $\Phi_{i,k} = \Phi\left(\mu_k - \mathbf{x}_i'\boldsymbol{\beta}_k\right)$ for $k \le 6$ and $\Phi_{i,7} = 1$. Indicator variables d^j take the value 1 for $y_i = j$ and zero otherwise. The log likelihood function is then

$$L = \sum_{i=1}^{N}\left(d_0 \ln \Phi_{i,0} + \sum_{j=1}^{7} d_j \ln\left(\left(\Phi_{i,j} - \Phi_{i,j-1}\right)\right)\right).$$

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[5] This representation assumes two identification constraints: $\mu_0 = 0$ and the variance of Φ (σ^2) is normalized to one. It should be noted that because parameters are allowed to vary across categories, negative predicted probabilities are possible with the generalized ordered probit for extreme values of independent variables (McCullagh and Nelder, 1989 p. 155). This issue does not arise in empirical analysis.

Given the nonlinearity of the effects of an explanatory variable on the probability of the response being in a given category, the parameter estimates are not equivalent to the marginal effects. The change in the probability of being in category *j* with respect to a change in x_i (the marginal effect of an explanatory variable) is

$$\frac{\partial \Phi_{i,0}}{\partial \mathbf{x}_i^0} = -\boldsymbol{\beta}_0 \phi_{i,0} = -\frac{\partial \Phi_{i,1}}{\partial \mathbf{x}_i^0}$$

$$\frac{\partial\left(\Phi_{i,j} - \Phi_{i,j-1}\right)}{\partial \mathbf{x}_i} = -\boldsymbol{\beta}_j\left(\phi_{i,j} - \phi_{i,j-1}\right), \text{ for } j > 1.$$

where $\phi_{i,k}$ is the probability density function value associated with $\Phi_{i,k}$. For all but the first and last category, the sign of the marginal effect may be either the same or different than the sign of the parameter estimates $\boldsymbol{\beta}_j$, because the effect of an increase in explanatory variables with $\boldsymbol{\beta}_j > 0$ is to move some of the density into a category from below, and some of the density to the next larger category. Thus, if a variable x tends to lead uniformly to higher remittances, then the marginal effect of x on the probabilities of low remittance categories will tend to be negative, and the marginal effect of x on the probabilities of high remittances will be positive.

The unconstrained generalized ordered probit allows the parameters associated with a given explanatory variable to differ for each category.[6] For model parsimony, Wald tests are performed to test for differences within of each set of *j* parameters associated with a given explanatory variable. If a test statistic for the null hypothesis of no difference among the *j* parameters is not rejected in a preliminary regression, then the parameters are constrained to be equal for that specific explanatory variable in the final regression.[7]

Recall that we allow the variables that affect the probability of no remittance to differ from the other categories. For our purposes given our data, we use all available data in the first (no remittance) category, except data that do not exist for that category. Specifically, one survey question asks what mode of remittance they use (e.g. Western Union, bank card, through a friend, etc.). Data for this question are missing for non-remitters. Therefore, we omit the indicator variables related to this question from the vector that applies to the non-remitter category. This is easily done in this case by setting the variables to an arbitrary value for the

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[6] Estimation is performed in Stata 9.3 with the GOLOGIT2 routine with the Probit link function, and using the MFX2 routine for calculating marginal effects.

[7] To illustrate: if we failed to reject equality of parameters for each explanatory variable, the standard ordered Probit would result. The literature on generalized ordered probit models refers to the standard ordered probit/logit models as *proportional odds* or *parallel lines* models because they restrict the slope parameters to be the same across all categories. The restricted generalized ordered probit that restricts a subset of parameters to be the same across categories is sometimes called a *partial proportional odds model*.

non-remitters, and then restricting the first-category parameters for these variables to be zero. This is equivalent to omitting the variables from the part of the likelihood function that corresponds to category 0 (the non-remitters).

IV. Results and discussion

Parameter estimates are reported in Table 3. Because these parameters are harder to interpret than marginal effects for this model, we will not discuss them in detail. However, note that when the tests fail to reject the null hypothesis that a variable's parameters do not vary across categories, we restrict these categories to be equal in the final model. In fact, for all but three variables, this *parallel lines* (or *proportional odds*) restriction is applied. The three exceptions are *age, earnings per week*, and *remits via Western Union type*. This last variable applies only to remitters, so the parameter is restricted to equal zero for non-remitters to account for this selection problem.

Marginal effects of each explanatory variable within each category of remittances are presented in table 4. As discussed below, virtually all significant results are consistent with the hypotheses that follow from our model. Although a substantial number of the estimated marginal effects are not statistically significant at conventional levels, most of the signs are consistent with our theory as well. We will discuss these results in the context of the hypotheses developed earlier in the paper.

The marginal effects for *earnings per week* (the 14th row of marginal effects) show that the marginal effect for category 1 is negative but not significant at the 10 percent level, negative and significant at the one percent level for categories two and three, and positive and significant at the five percent level or less for the remaining categories. Taken together, these results are exactly consistent with hypothesis 1. The effect of income on the probability of remitting zero is insignificant as expected. For those remitting less than $100 a month, a larger income has little effect in terms of changing the probability that they remain in that category. Based on our model this is because many of the individuals in this category are constrained by subsistence requirements and are less likely than others to find it worthwhile to accept any lump-sum remittance costs they face. For those remitting already, an increase in income leads to a reduction in the probability of being in one of the two lower remittance categories (from >$0 to $200), and an increase in the probability of being in each of the higher categories ($200+).

Hypotheses 2 and 3 related to marginal and lump-sum remittance costs, respectively. We do not have direct measures of these costs, but several survey responses may be closely related to these two different types of costs. First, money transfer companies such as Western Union and Moneygram have historically been the largest remittance mode. A survey in Los Angeles by the US Comptroller of the Currency found that 37 percent of those remitting to Latin America used wire transfers, compared to 14 percent of non-immigrants who did the same (Bernanke, 2004).

Due to substantial changes in the market for transfers in the last decade, many of these companies have changed rates structures substantially. However, using several instruments such as lump-sum transfer fees, inflated exchange rates relative to bank-posted exchange rates, and other instruments, their fees tend to amount to a per-dollar-remitted fee plus a lump sum per transfer.[8] Although it is impossible to know for sure, the other types of remittance processes ("a bank", an "electronic cashier", "a credit union", "a cash card", "a friend, relative, or other person", or "post office mail") most likely do not generally charge such a per-dollar transfer fee. The extent to which these transfer companies are more costly either in lump-sum terms or in marginal terms, we expect to see a lower remittance level, given remittances, for individuals remitting by Western Union than by other methods. We therefore include the variable *Sends money via Western Union or similar*. As noted before, the value of this variable is not in the sample if an individual chose not to remit, so the parameter is restricted to zero for the zero remittance category. For the other remittance categories, the results are mixed, but interesting. The only significant parameter estimates are a positive marginal effect of 0.0857 for category 3 ((R=$100 to $199) and a negative effect for category 6 (R=$400 to $499). The rest are negative but insignificant. One interpretation of these results, considering the statistically strong results, is that Western Union facilitates smaller remittance levels rather than other modes of remittances, which is consistent with the apparent fact that Western Union remittance modes tend to be more expensive than other modes, and may be used primarily by those who do not maintain bank accounts for any of a number of reasons.

The distribution of family members between Mexico and the U.S. has the expected effect on remittances (hypothesis 4). If the remitter's spouse lives in Mexico, they are less likely to remit less than $200 per month, and more likely to remit larger amounts and each of the estimated marginal effects is significant at the five percent level or less. A larger number of children living in Mexico are associated with lower probabilities of remitting less than $200 but higher probabilities of remitting more than $200, and each of these marginal effects is significant at the 10 percent level. In contrast, as the number of children in the U.S. increases, the probability of remitting in each category less than $200 increases while the probability of remitting in each category more than this decreases. All but the first marginal effect is significant at the 10 percent level.

The parameter estimates for the proxies for residence, employment, and financial security in the United States are not statistically significant, but the pattern of signs are generally as expected. Remitters who have been in the United States longer tend to remit more, perhaps because they have become established in their living situation are more likely to have paid off moving debts, and are likely to be making a higher wage than those who have just moved, and so

[8] Pricing for remittances have changed substantially over the last eight to ten years. As of May 2007, Western Union charges a flat fee for the economy transfer from the U.S. to Mexico.

are more likely to be able to cover the subsistence and lump-sum remittance requirements necessary to remit larger amounts. If the remitter plans on remaining in the U.S. for more than 10 years, the probability of remitting in categories less than $200 increase, and the probabilities of remitting more than that decrease (though not significantly so). Those who indicated that they will stay in the U.S. as long as possible are, by their response, indicating some uncertainty about their future in the U.S. Indeed, those who provided this response are less likely to remit small amounts and more likely to remit larger amounts. The interpretation here is that the uncertainty they face reduces their expected stay, and so they account for this in their remittance levels. Remitters who have been unemployed for more than one month in the last year tend to remit less than those who have not, and those with health insurance are more likely to remit more than those without. Again, none of these parameters are significant at conventional levels, but all of these results are qualitatively consistent with a higher capacity to remit under less income/expenditure uncertainty.

Asset ownership in Mexico and the U.S. also affects the amount of remittances. If a remitter owns real estate or land in Mexico, they are significantly less likely to remit in any category less than $200, and more likely for categories greater than $200. Interestingly, the effect of owning a business in Mexico is statistically weak, but it tends to be associated with low levels of remittance rather than high levels. In contrast, if the remitter is an owner or proprietor of a business in the U.S., they are less likely to remit less than $200 and more likely to remit more (each of these marginal effect is significant at the one percent level).

V. Conclusion

Migrant remittances from the United States to other countries are increasing, public policy with respect to undocumented migrants is under serious debate and the market, for remittance modes is changing rapidly. This paper examines some of the determinants of migrant remittance choices. The paper is unique in its formal application of a net income hypothesis and explicit treatment of remittance transaction costs. The data call for the use of what we term a Type II generalized ordered Probit model.

Results are virtually all consistent with the testable hypotheses developed in this paper, although some of these results are statistically weak. The income effect is of central interest. We find that income has no effect on the probability of remitting, but has statistically significant positive effects on the remittance levels in the sense that as income increases, the probability of remitting low amounts decreases, and the probability of remitting larger amounts increases. We find also that migrants with more family members in Mexico and fewer family members in the U.S. remit more; migrants with assets (land, other real estate) in Mexico tend to remit more, and migrants who are owners or proprietors of businesses in the U.S. remit more. Measures that capture uncertainty regarding U.S. income, expenditures, or residency status all show that increases in

uncertainty of the migrant lead to larger remittances compared to those who face lower uncertainty in these measures.

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Table 1: Data descriptions

Variable Name	Description of Variables
Remittance level (Q43)	0 =no remittances sent, 1 = less than $100, 2 = $100 to $199, 3 = $200 to $299, 4 = $300 to $399, 5 = $400 to $499, and 6 = more than $500.
Gender [male=1] (Q2)	Categorical variable of gender where 1 indicates male and 0 otherwise.
Age (Q3)	Age in years.
Education level (Q5)	1 =did not attend or complete any schooling, 2 = completion of K-11 but not finishing High School, 3 = completion of a secondary education at a Technical School, 4 = High School or equivalent graduation, 5 indicates college or more.
Marital status (Q7)	Categorical variable of marital status where 1 indicates married and 0 otherwise.
Spouse lives in Mexico (Q8)	1 if spouse living in Mexico and 0 otherwise.
# children in the U.S. (Q10)	The number of respondent's children living in the United States.
# children in Mexico (Q9-Q10)	The difference between the total number of respondent's children and the number of children in the U.S.
# years in the U.S. (Q22time)	Categorical variable indicating number of years in U.S. where 1 indicates 5 or less years, 2 indicates 6-10 years, 3 indicates 11-15 years, and 4 indicates more than 15 years.
Own land, Own real estate, Own business in Mexico (Q19)	Equals 1 if respondent owns land, real estate, or a business in Mexico and 0 otherwise, respectively.
Owner/proprietor of business in U.S. (Q34.3)	Equals 1 if respondent is an owner or proprietor of a business in the U.S.
Earnings (Q39)	Income per week. 1 = $1-$100, 2 =$101-$199, 3 = $200-$299, 4 = $300-$399, 5 = $400-$499, 6 = more than $500.
Unemployed > 1 month last year (Q35)	Equals 1 if the respondent had been unemployed for more than one month last year.
Paid in cash; check, direct deposit (Q40.1)	Categorical variables equaling 1 if paid in cash, by check, or by direct deposit, respectively.
Bank account in the U.S.	Equals 1 if respondent has a bank account in the U.S.

(Q46)	
Has health insurance (Q48)	Equals 1 if the respondent has health insurance
Expects to remain in U.S. >10 years (Q23)	Response to the question: how long do you think you will remain in the U.S.?
Will stay in U.S. as long as possible (Q23)	Response to the question: how long do you think you will remain in the U.S.?
Remits via Western Union type (Q44.1)	Equals 1 if the respondents remit via a company like Western Union or a money gram. Alternatives include a bank, electronic cashier, a credit union, a cash card, through a friend or relative, or through a post office.

Table 2. Summary statistics of variables used in regressions. Survey question numbers in parentheses.

Variable (N=1852 for all)	Mean	Std. Dev.	Min	Max
Remittance level (Q43)	2.72	1.55	0	6
Gender [male=1] (Q2)	0.63	0.48	0	1
Age (Q3)	35.51	12.55	18	97
Education level (Q5)	2.90	0.91	1	5
Marital status (Q7)	0.82	0.39	0	1
Spouse lives in Mexico (Q8)	0.17	0.38	0	1
# children in the U.S. (Q10)	2.79	1.46	1	7
# children in Mexico (Q9-Q10)	0.72	1.26	0	6
Owns land in Mexico (Q19.1)	0.16	0.36	0	1
Owns real estate in Mexico (Q19.2)	0.31	0.46	0	1
Owns business in Mexico (Q19.3)	0.03	0.16	0	1
# years in the U.S. (Q22time)	2.28	1.22	1	4
Owner/proprietor of business in U.S. (Q34.3)	0.17	0.69	0	3
Unemployed > 1 month last year (Q35)	1.63	0.48	1	2
Earnings per week (Q39)	3.69	1.30	0	6
Paid in cash (Q40.1)	0.27	0.45	0	1
Paid by check (Q40.2)	0.68	0.47	0	1
Paid by direct deposit (Q40.3)	0.04	0.20	0	1
Bank account in the U.S. (Q46)	0.66	0.48	0	1
Has health insurance (Q48)	1.66	0.48	1	2
Expects to remain in U.S. >10 years (Q23)	0.04	0.19	0	1
Will stay in U.S. as long as possible (Q23)	0.45	0.50	0	1
Remits via Western Union type (Q44.1)	0.72	0.45	0	1

Table 3. Parameter estimates, Generalized Type II Ordered Probit regression

variable	Remittance category					
	zero	<100	100to199	200to299	300to399	400to499
Gender [male=1] †	0.194***	0.194***	0.194***	0.194***	0.194***	0.194***
Age	0.0030	0.00303	0.00303	0.00303	0.00303	0.00303
Education level	0.0352	0.0812**	-0.0356	-0.0317	-0.0267	-0.0968*
Marital status	-0.0105	-0.0105	-0.0105	-0.0105	-0.0105	-0.0105
Spouse lives in Mexico	0.230***	0.230***	0.230***	0.230***	0.230***	0.230***
# children in the U.S.	-0.0382*	-0.0382*	-0.0382*	-0.0382*	-0.0382*	-0.0382*
# children in Mexico	0.0504*	0.0504*	0.0504*	0.0504*	0.0504*	0.0504*
Owns land in Mexico	0.290***	0.290***	0.290***	0.290***	0.290***	0.290***
Owns real estate in Mexico	0.143***	0.143***	0.143***	0.143***	0.143***	0.143***
Owns business in Mexico	-0.217	-0.217	-0.217	-0.217	-0.217	-0.217
# years in the U.S.	0.00236	0.00236	0.00236	0.00236	0.00236	0.00236
Owner of business in U.S.	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***
Unempl'd > 1 mo. last year	-0.0204	-0.0204	-0.0204	-0.0204	-0.0204	-0.0204
Earnings per week	0.0287	0.156***	0.239***	0.249***	0.256***	0.328***

Paid in cash	0.106	0.106	0.106	0.106	0.106	0.106
Paid by check	0.242**	0.242**	0.242**	0.242**	0.242**	0.242**
Paid by direct deposit	0.0762	0.0762	0.0762	0.0762	0.0762	0.0762
Bank account in the U.S.	-0.0847	-0.0847	-0.0847	-0.0847	-0.0847	-0.0847
Has health insurance	0.0555	0.0555	0.0555	0.0555	0.0555	0.0555
Expects to be in U.S. >10 years	-0.108	-0.108	-0.108	-0.108	-0.108	-0.108
Will stay in U.S. as long as possible	-0.0788	-0.0788	-0.0788	-0.0788	-0.0788	-0.0788
Remits via Western Union type	0††	0.119	-0.137**	-0.158**	-0.186**	-0.0769
Constant	1.380***	-0.419*	-1.305***	-1.919***	-2.327***	-2.851***

*** p<0.01, ** p<0.05, * p<0.1; N=1852

†Identical parameter estimates across categories result from a constraint of equality, imposed if an F-test failed to reject the null hypothesis of equality across remittance categories.

† † Constrained to be zero due to variable truncation for nonremitters

Table 4: Marginal Effects.

	Remittance levels						
Explanatory variable	zero	<100	100to199	200to 299	300to399	400to499	>500
Gender [male=1]	-0.0101***	-0.0410***	-0.0245***	0.0185***	0.0178***	0.0159***	0.0233***
Age	-0.00015	-0.000632	-0.000410	0.000280	0.000280	0.000253	0.000379
Education level	-0.00174	-0.0192**	0.0349***	-0.00445	-0.00397	0.00654	-0.0121*
Marital status	0.000517	0.00219	0.00144	-0.000967	-0.000973	-0.000882	-0.00133
Spouse lives in Mexico	-0.00977***	-0.0453***	-0.0361**	0.0182***	0.0208***	0.0199***	0.0323**
# children in the U.S.	0.00189	0.00798*	0.00517*	-0.00353*	-0.00353*	-0.00319*	-0.00478*
# children in Mexico	-0.00249*	-0.0105*	-0.00681*	0.00465*	0.00465*	0.00420*	0.00630*
Owns land in Mexico	-0.0118***	-0.0561***	-0.0471***	0.0216***	0.0259***	0.0253***	0.0422***
Owns real estate in Mexico	-0.00669***	-0.0292***	-0.0205**	0.0125***	0.0131**	0.0121**	0.0187**
Owns business in Mexico	0.0132	0.0480	0.0220**	-0.0232	-0.0200	-0.0169	-0.0232
# years in the U.S.	-0.000117	-0.000492	-0.000319	0.000218	0.000218	0.000197	0.000295
Owner/proprietor of business in U.S.	-0.00511***	-0.0216***	-0.0140***	0.00955***	0.00956***	0.00864***	0.0130***
Unemployed > 1 month last year	0.00101	0.00426	0.00276	-0.00188	-0.00188	-0.00170	-0.00255
Earnings per week	-0.00142	-0.0388***	-0.0538***	0.0190**	0.0215***	0.0124***	0.0410***

Paid in cash	-0.00497	-0.0216	-0.0150	0.00932	0.00970	0.00892	0.0137
Paid by check	-0.0132*	-0.0518**	-0.0293**	0.0238**	0.0223**	0.0197**	0.0285**
Paid by direct deposit	-0.00351	-0.0155	-0.0111	0.00660	0.00699	0.00648	0.0101
Bank account in the U.S.	0.00407	0.0175	0.0118	-0.00763	-0.00780	-0.00712	-0.0108
Has health insurance	-0.00274	-0.0116	-0.00751	0.00512	0.00513	0.00464	0.00695
Expects to remain in U.S. >10 years	0.00590	0.0232	0.0129	-0.0108	-0.00999	-0.00874	-0.0125
Will stay in U.S. as long as possible	0.00393	0.0165	0.0106	-0.00732	-0.00728	-0.00656	-0.00980
Sends money via Western Union or similar	0†	-0.0316	0.0857***	-0.00534	-0.00807	-0.0308**	-0.00987

*** p<0.01, ** p<0.05, * p<0.1

† Constrained to be zero due to truncation in non-remitters sample

Figures

Figure 1. Budget lines and indifference curves for the consumption/remittance choice with lump-sum remittance costs and a subsistence constraint. Note that remittances R jump from zero to $\underline{R}$. Below this point, the indifference curve is less steep than the budget line at the subsistence level of consumption.

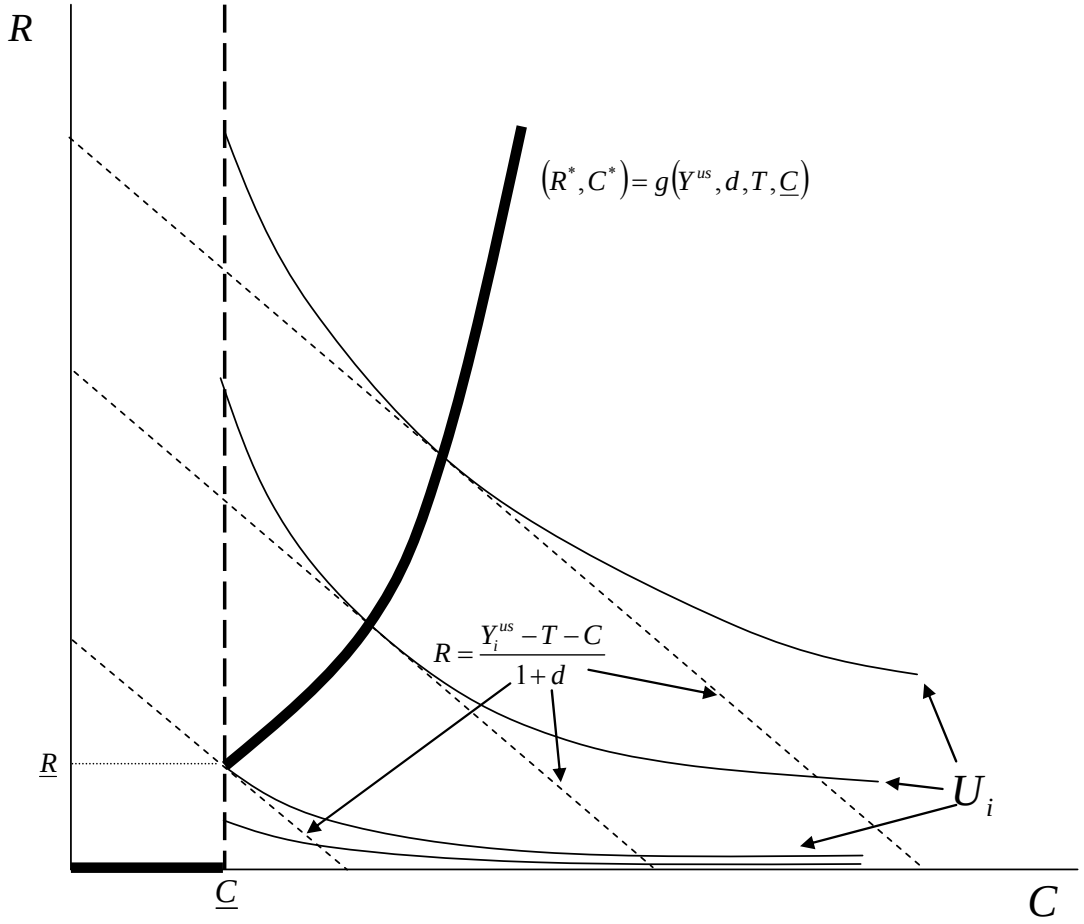

Figure 2: The thick line represents the relationship between income and remittances. An increase in the lump sum cost of remittances T will increase the level of income needed for remittances to be sent, but if the marginal utility of consumption is discontinuous and sufficiently steep at $\underline{C}^{+}$, then remittances will jump from zero to $\underline{R} = \frac{Y_i^{us} - T - \underline{C}}{1+d}$ (see figure 1). For comparison, the other lines represent remittance levels with consumption and/or T held at zero. Holding consumption to zero results in a steeper remittance curve, and holding $\underline{C} + T$ at zero forces the remittance curve through the origin.