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THE CHECK IS IN THE MAIL: HOUSEHOLD CHARACTERISTICS AND MIGRANT REMITTANCE FROM THE U.S. TO MEXICO

By

Adam McCoy, Mudziviri Nziramasanga, and Jonathan Yoder

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Adam McCoy
School of Economic Sciences
Washington State University

Mudziviri Nziramasanga
School of Economic Sciences
103H Hulbert Hall
Washington State University
Pullman, WA 99164-6210
509-335-8008
nziramasangam@wsu.edu

Jonathan Yoder (contact)
School of Economic Sciences
203G Hulbert Hall
Washington State University
Pullman, WA 99164-6210
509-335-8596
yoder@wsu.edu

Abstract

We develop a household model of migrant remittance that accounts for the effects of transaction costs on remittances. The model supports testable hypotheses about the effect on remittances of migrant income, family composition and distribution, transaction costs, income and residence security, and other household characteristics on remittance levels and frequency. We test these hypotheses using survey data on individual Mexican migrants in the United States. The results are broadly consistent with our hypotheses.

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I. Introduction

Remittances by international migrants to developing countries are now as important as foreign direct investment in terms of their impact on the balance of direct payments and poverty alleviation. According to World Bank data, worker remittances sent to developing countries through market channels rose from $31.0 billion in 1990 to $189.5 billion in 2005 (World Bank, 2007), and the International Fund for Agricultural Development (IFAD) estimated the 2006 flows at $301 billion. In contrast, net foreign direct investment in 2005 was $280.8 billion (World Bank, 2007). Remittances on averaged 4 percent of GDP in Africa and were the equivalent of 13 percent of exports in Latin America and the Caribbean (IFAD, 2007).

The macroeconomic impact of remittances manifests itself largely through the balance of payments. Some estimates suggest that exchange rate appreciation could lessen the positive impact or even negate it, but this is not a widely held view (Adams, 2007). Remittances also augment domestic savings and stimulate small business activity (IFAD, 2007). Poverty alleviation from remittances is such that recipient families spend on consumption relative to

investment items like education, housing and other entrepreneurial activities. The relative size and growth rate of remittances has drawn attention to their potential development impact in the recipient countries as well as factors that determine who remits and how much they remit.

This paper develops a household model of remittances and tests several implications of the model using survey data on individual Mexican migrants in the United States. Our theoretical model allows for variation in the distribution of household assets and liabilities across the home and host countries, and explicitly addresses the impact of remittances transaction costs by mode of remittance. The model provides testable implications regarding the effect of migrant income, transaction costs, and other household characteristics on migrant remittance levels. Remittance frequency and mode are endogenous determinants that are related to transaction costs. We generate instruments that correct for potential estimator inconsistency due to endogeneity and reflect endogenous transaction costs. Our model results are broadly consistent with our hypotheses regarding of income effects, household distribution of assets and liabilities, expected stay in the U.S., and transaction costs. Even when the estimated relationships are not individually statistically significant, there are compelling patterns in the results that are consistent with the theory.

Economic models of remittances can be approached as extensions of models for explaining rural to urban migration. In 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. Migration can also viewed as an informal intra-household contract requiring the migrant remits part of his income to remaining family members for household services rendered at home, or as a form of individual insurance against unemployment, to secure

a bequest upon returning home, or even a combination of these reasons (Stark and Levhari, 1982; Stark, 1991; Hoddinott, 1994; Poirine, 1997; Liu and Reilly, 2004).

Another perspective is that remittances are motivated by altruism (Lucas and Stark 1985; Agarwal and Horowitz 2002). Altruism implies that the migrant's utility is a function of the migrant's consumption as well as the utility of other household members (Stark, 1995; Magee and Thomson, 2006; Glytsos, 2002; Bouhga-Hagbe, 2004). Other models link the altruism and contractual perspectives on migration and remittances (Lucas and Stark 1985).

Empirical results have generally supported the altruism hypothesis (Boughba-Hagbe, 2004; Agarwal and Horowitz, 2002) or altruism and self-interest (Lucas and Stark, 1985). There are some contradictions, however. Time series evidence shows a negative elasticity of remittances with regard to per capita GDP, which would support the altruism motive and the constant consumption ratio hypothesis. Results based on pooled data across countries show a positive GDP elasticity (Adams, 2007). This suggests that investment or portfolio diversification, rather than altruism, may drive remittances. Other studies estimate the level of remittances as a function of country or cultural characteristics, such as the desire to inherit the family assets upon return (Hoddinott, 1994), support of a national cause (Magee and Thompson, 2006) or the repayment of informal loan arrangements (Ilahi and Jafarey, 1988).

Remittances are also a function of transactions costs. 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 of total transaction value 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).

Migrant workers make their migration decisions based in part on imperfect information about their future income and living costs in the host country. Once employed, it is not inconceivable for a migrant to live in nothing more than minimum subsistence 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.[1] Having moved to the host country and securing a job, if actualized income is above the migrant's subsistence level, the migrant may be willing to remit. If the migrant's needs and the total costs of sending the remittances equal or exceed the migrant's income the migrant will not to remit, despite possible plans to do so.

Thus, the determinants of remittances are based on motivations to remit and the capacity to remit, which in turn is contingent on a positive net income, and the costs of remitting.

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[1] There are no comprehensive income statistics for migrants. In the US, however, Bureau of the Census data on the Hispanic population (of which Mexican migrants are a subset) show that 40 percent of the documented and 32.2 percent of the undocumented migrants are employed in agriculture with an hourly wage below the national average. Hispanics had the lowest distribution by level of education, with 39 percent having less than a high school diploma and 52 percent of the total population had a family income of less than $35,000 in 2004 prices (US Bureau of the Census, 2004).

IFAD(2007) and Bernanke (2004) argue for a reduction in remittance fees as a way of increasing total remittance flow, but do not offer any evidence on the expected level of response. Theoretical models recognize the existence of remittance charges but either assume a single remittance mode (Magee and Thompson, 2006) or informal channels where costs are insignificant (Boughba-Hagbe 2004; Lucas and Stark, 1985).

Our paper contributes to both the theoretical and the empirical literature on remittances by examining the relationship between remittances levels, the frequency of remittances and remittance costs. The current literature recognizes the importance of transaction costs and the relatively low income of migrants (IFAD, 2007; Bernanke, 2004; Magee and Thomson, 2006; Boughba-Hagbe, 2004). However, transaction costs have not been incorporated in a formal way into the published theoretical and empirical economic studies. We develop a utility maximization model in which an income constraint is added to a budget constraint that accounts for both marginal and per-transfer remittance costs. The amount remitted is determined by utility maximization subject to the income constraint and exogenous household characteristics.

This theoretical model provides several hypotheses that we test using data from a survey of Mexican migrant workers in the United States. Because of the characteristics of our data, we use a modified Generalized Ordered Probit model to test hypotheses that follow from our theoretical model. Hoddinott (1992) observed that prior empirical work on remittances had not addressed the distinction between the explanatory variables' effects on the likelihood of remitting and the level of remittances. He corrected the omission by using 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 (that is, remittance=0) to be determined by an index function that differs from the remittance level index (given positive remittances). We also account for endogenous remittance frequency in estimation using an instrumental variable approach.

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

II. Theory

We start with Lucas and Stark's (1985) utility function, but modify it to account for the impact of household composition differences between the U.S. and Mexico. The migrant may bring some family members to the U.S. while others remain in Mexico, and households may have varying portfolios of assets and liabilities in Mexico and the U.S. This will affect the marginal rate of substitution between household consumption in the U.S. versus remittances sent to Mexico. For our purposes, the migrant's utility function will be defined as

$$U\left(C,R,n;\mathbf{Z}\right)=U\left(\sum_{i=1}^{p^{us}}a_i u(c_i,n),\sum_{i=1}^{p^{mx}}b_i u(r_i,n);\mathbf{Z}\right), \tag{1}$$

where $C=\sum_{i=1}^{p^{us}+p^{mx}}c_i$ is total household consumption summed over p^{us} household members in the U.S. and p^{mx} household members in Mexico; $R=\sum_{i=1}^{p^{mx}}r_i$ is the total remittance received in Mexico and distributed as r_i for individual *i* over p^{mx} household members; *n* is the number (frequency) of remittances per year, and ***Z*** are household characteristics. Family member weights a_i and b_i may differ in the migrant's utility (e.g. the spouse relative to the children, children in Mexico relative to children in the U.S.). Utility in Mexico is dependent on remittance frequency

n, and the dollar amount of each remittance, *R/n*.[2] Annual average per person remittances are $r = R/p^{mx}$.[3]

Consider the following timeframe and decision process. A Mexican worker chooses to migrate if the expected benefits of doing so outweigh the expected opportunity costs. Once in the U.S., the migrant accepts a job offer if real annual income Y^{us} is sufficient relative to the income Y^{mx} available upon return to Mexico. Given that a job is offered, accepted, and maintained, the migrant decides the amount to remit, and how often to remit per year. At a minimum, income must cover subsistence level consumption plus any remittances, i.e. $Y^{us} \geq R^{us} + \underline{C}$, where R^{us} is the total present value of annual remittances, including transaction costs, sent from the U.S. by the migrant, and $\underline{C}$ is a subsistence requirement. The inequality allows for the inclusion of a (constant) minimum subsistence requirement.[4] This remittance requirement plays only a minor role in our analysis, but is included as a reflection of the subsistence standard of living of those migrants with the more extreme remittance practices.

Remittances from the U.S. are defined as the remittances received in Mexico (measured in U.S. dollars), plus the remittance fees and costs. Then annual remittances plus costs from the migrant's perspective are

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[2] To be clear, remittances are split two ways: across remittance events so that per-transaction remittance is *R/n*, and average per person annual remittance, which is $r = R/p^{mx}$. Thus, per person, per transaction remittance is $r/n = R/np^{mx}$.

[3] We define each remittance to be in present value terms to simplify notation.

[4] 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.

$$R^{us} = (1+d)R + nt = (1+d)R + T \tag{2}$$

where d is the percentage transfer fee, t is a lump-sum fee per transaction, so that T is the present value of annual lump-sum transaction costs. The lump sum cost provides an incentive to the migrant to save up and remit less frequently.[5] However, surveys conducted in Mexico reveal that 80 to 90 percent of the remittance receipts are spent on such basic needs as school fees, food and healthcare. Most of the recipients lack financial access and financial literacy. In addition, small accounts incur heavy bank charges and there are limitations on the number of withdrawals from savings accounts. As a result, remittances are usually characterized as "cash-to-cash" instead of account-to-account (IFAD, 2007). This lack of financial services coupled with the day-to-day needs of the recipients make frequent remittances preferable to recipients. We thus assume a positive but diminishing marginal benefit to the household of more frequent remittance. Given this setting, the working migrant solves the constrained maximization problem:

$$L(C,R) = U(C,R,n;\mathbf{Z}) + \lambda\left(Y^{us} - C - \left[(1+d)R + nt\right]\right) + \gamma(\underline{C} - C) \tag{3}$$

Where $U(\cdot)$ is given by equation (1). Given this formulation, the marginal price of consumption is 1, the marginal cost of remittance dollars sent is $(1+d)$, and the marginal cost of increasing the number of remittances per year is t. The first-order conditions for the migrant's remittance/consumption problem are

[5] Note that these fixed and variable transaction fees can include a broad array of opportunity costs, such as time and money spent traveling to and from money transmission locations at both ends of the transaction. The variable cost d can represent explicit per unit fees and other per-unit costs, as well as exchange rate differentials.

$$
\begin{aligned}
c: &\quad U'(\cdot)\left(\sum_{i=1}^{p^{us}} a_i u_{c_i}\right) - \lambda - \gamma = 0 \\
r: &\quad U'(\cdot)\left(\sum_{i=1}^{p^{mx}} b_i u_{r_i}\right) - \lambda(1+d) = 0 \\
n: &\quad U'(\cdot)\left(\sum_{i=1}^{p^{us}} a_i + \sum_{i=1}^{p^{mx}} b_i\right) - \lambda t = 0 \\
\lambda: &\quad Y^{us} - C - \left(R(1+d) + T\right) = 0 \\
\gamma: &\quad \left(\underline{C} - C\right)\gamma = 0
\end{aligned}
\tag{4}
$$

where subscripts other than the index *i* denote derivatives. Assuming necessary conditions hold for a maximum, annual remittance demand and the optimal number of remittances per year respectively are

$$
R^* = R\left(\mathbf{Z}, Y^{us}, t, d, \underline{C}\right); n^* = n\left(\mathbf{Z}, Y^{us}, t, d, \underline{C}\right). \tag{5}
$$

We are interested specifically in 1) the effect of income on remittances, 2) the relationship between remittance amounts and the frequency of remittances, and 3) the effect of differences in household marginal rates of substitution between consumption and remittance that follow from differences in the distribution of family and assets between the U.S. and Mexico.

We first consider the comparative statics with respect to income. If the benefits accruing through consumption, remittances, and remittance frequency are normal goods, then remittance per period increase with income ($\partial R^* / \partial Y^{us} > 0$), and remittance frequency increases with income ($\partial n^* / \partial Y^{us} > 0$). Thus, a first and straightforward hypothesis that follows from our model is,

Hypothesis 1: *A larger income will be associated with a higher (lower) probability of being in a higher (lower) remittance category*.

If the subsistence constraint is binding ($\gamma^* > 0$) there will be a discontinuity in both the expansion path of remittances and the income-remittance relationship. Figure 1 shows the expansion path of remittances and consumption with increases in income. Assume briefly for graphical simplicity that optimal remittance frequency is economically separable from everything other than the per-transaction fee *t* so that $T = n^* t$ is fixed in the graph.[6] Within the range $Y^{us} - \left(\underline{C} + T^*\right) \leq 0$ remittances are zero and will not increase with an increase in income. For the range $Y^{us} - \left(\underline{C} + T^*\right) \geq 0$, remittance/consumption expansion path is 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^* the optimal level of remittances is $R^* = \max\left\{0, \left(Y^{us} - \left(C^* + T^*\right)\right) \Big/ (1+d)\right\}$, which is represented by the discontinuous bold line in Figure 1. The minimum remittance is $\underline{R} = \left(Y^{us} - \left(\underline{C} + T^*\right)\right) \Big/ (1+d)$. Below this level, remitting is not worth the lump-sum cost T^*.

Now consider the relationship between remittance levels and remittance frequency. Assuming the budget constraint holds exactly and for a fixed budget Y^{us}, the following equality holds:

$$(1+d)\,\mathrm{d}R^* + t\,\mathrm{d}n^* + \mathrm{d}C^* = 0$$

Rearranging, we have

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[6] In reality, income effects would likely lead to reductions in remittance frequency, thus lowering total transaction costs.

$$\frac{(1+d)\mathrm{d}R^*}{\mathrm{d}n^*} + \frac{\mathrm{d}C^*}{\mathrm{d}n^*} = -\frac{t}{(1+d)} < 0. \tag{6}$$

If $\frac{\mathrm{d}R^*}{\mathrm{d}n^*}$ and $\frac{\mathrm{d}C^*}{\mathrm{d}n^*}$ are both the same sign in the relevant range, then both are negative. This amounts to an income effect of remittance costs on total annual remittances, and expecting a negative sign for both is reasonable given that both *R* and *C* are normal goods.[7] At the subsistence level of consumption, n^* will equal zero because no remittances will be made. Further, the larger the optimal number of remittances, the larger the gap will be between zero and the minimum nonzero remittance as in figures 1 and 2.

A more intuitively straightforward hypothesis (that we do not formally show) is that the demand for remittance frequency is downward sloping in per-transaction remittance costs. Given positive remittances as the per-transaction cost *t* increases for a chosen (optimal) remittance mode, fewer transactions will be made. This discussion suggests the following two testable hypotheses:

Hypothesis 2: *High remittance frequency implies high total remittance costs, and will be associated with relatively low total remittance.*

Hypothesis 3: *As the marginal cost of a remittance transaction increases, the frequency of remittances decreases.*

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[7] Note that this is not a comparative static result with respect to the per-transaction fee *t*. A change in this parameter would lead to both an income and substitution effect in each choice variable. Unfortunately, we do not have transaction cost data to sufficiently characterize the menu of transaction modes for empirical analysis.

Next consider the effect of differences in household marginal rates of substitution between consumption and remittance that follow from differences in the distribution of family and assets between the U.S. and Mexico. The marginal rate of substitution of total consumption in the U.S. for total remittances implied by the model is

$$MRS_{R,C} = \frac{U'(R)}{U'(C)} = \sum_{i=1}^{p^{us}} a_i \Big/ \sum_{i=1}^{p^{mx}} b_i . \qquad (7)$$

The willingness to substitute remittances for consumption in the U.S. is weighted by the relative importance the migrant attaches to the utility of the family members in each location. We have no compelling *a priori* notions as to the weights attached to individual family members. However, assume, for the moment, that $a_i = b_i$ and the rate of substitution is based purely on relative numbers in the US and Mexico. As the number of household members in Mexico decrease relative to those in the U.S. the marginal rate of substitution of *c* for *r* increases, so the migrant is willing to send lower remittances for a given set of relative prices and income. Similarly, if the relative number of family members in the U.S. decreases, the amount remitted will increase. Graphically, if relatively more family members are in Mexico, the household utility function will be flatter in R-C space (as in Figure 1), providing a relatively larger marginal rate of substitution of *c* for *r* in the relevant ranges.

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

The migrant's job security, U.S visitation security, and his/her plans for returning to Mexico also are likely to be important determinants of remittances. If a migrant has a secure and steady job for any reported income level during their expected stay, the expected value of income will be higher and the variance of income will be lower, so remittances will be higher given

stronger job security. 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 having no legal papers or because of job insecurity itself), the household may in expected value terms benefit from more remittances during their time in the U.S. Finally, if a migrant has strong investment interests in Mexico that must be financially serviced in Mexico, the value of remittances at the margin are likely to be higher. Two more hypotheses follow:

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

Hypothesis 6: *Larger capital assets and liabilities in Mexico (U.S.) will lead to higher (lower) remittance levels.*

Each of these hypotheses will be tested and discussed using the methods described in the following section.

III. Data and econometric model

The data used in the statistical analysis are described in Table 1, and Table 2 provides their summary statistics. The data come from survey questionnaires administered by the Pew Hispanic Center (PEW).[8] The surveys were conducted from July 2004 through January 2005 at Mexican Consulates in Los Angles, New York, Chicago, Atlanta, Dallas, Raleigh, and Fresno, and the respondents were all applying for a Matricula Consular, which is an identification card.

[8] 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.

Matricula consular cards have been around for about 130 years (US Congress, 2003). They are issued by foreign governments to migrants, identifying them as citizens of a particular country in case of an emergency or if stopped by law enforcement agencies. Since 2001 the government of Mexico has issued over one million of the cards, and has urged their acceptance by local authorities in the United States. As of 2003, more than 800 law enforcement agencies and 74 banks accept the matricula consular for identification purposes, and some local authorities accept it as a basis to grant benefits, including subsidized housing (US Congress, 2003). Applicants in the Pew sample could therefore have been remitting funds without the certificate, and were acquiring it for the other benefits. For example, they could use it to open a bank account and thus diversify channels of remitting funds.

The data are from Mexican migrants who chose to apply for a matricula consular. This raises the possibility of sample selectivity and estimation bias in relation to the population of Mexican migrants as a whole. Unfortunately, we have no data on Mexican migrants who have not or will not find it in their interest to apply for the card, This limits our ability to know the extent to which it is a problem and to effectively address it.[9] However, if we presume that matricula consular cards are used primarily by people who otherwise do not have sufficient identification for their purposes, then migrants who have entered the U.S. illegally might be over-represented relative to the general population, and that this might be the most dominant selection criterion. If it is also the case, ceteris paribus, that illegal migrants face an uncertain future in the U.S. and therefore remit more than they otherwise would if they were in the U.S.

[9] A standard Heckman approach would suggest that selectivity is a problem if the unobserved heterogeneity (the disturbance process) in the selection equation were correlated with the disturbance process in the equation of interest, which in this case has income as the dependent variable. (see Greene (2003) p. 782) .

legally, then we would expect that our sample to have higher remittance levels on average than the population as a whole. Although the categorical nature of our remittance data make a direct comparison difficult, note from Table 3 that the mode remittance level is in the category of remittances between $100 and $200, which corresponds to an annual remittance between $1200 and $2400. IFAD (2007) reports an average remittance of $2,128 per migrant from Latin American and the Caribbean, which falls within the modal category for our remittance data. This suggests, albeit weakly, that the sample selectivity may not introduce substantive estimation and inference problems.

Our empirical goal is to estimate the effect of various migrant characteristics on remittance levels and frequency. The response variables of interest are therefore remittance per unit time and the frequency of remittance. In our dataset, the measure of remittances per month is a categorical variable with seven categories ranging from $0 to >$500 in increments of $100 (Table 3). An ordered Probit regression would be a reasonable model to estimate the probability of an individual being in a given remittance category apply, except for two issues. First, we expect a different type of income response for the first category (zero remittance), so the standard Probit model is too restrictive. Therefore, we use the more flexible generalized ordered Probit (GOProbit) regression model. Second, some of our data pertains to chosen remittance mode, and these data are missing for migrants who do not remit anything. We therefore generalize the standard GOProbit slightly to allow the set of variables that affects the choice not to remit or not to differ from the set of variables that affects the level of remittance given positive remittance. As a result, the model we employ is the generalized 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.[10] Formally, we characterize the decision process in terms of an underlying latent remittance demand and frequency, R^* and $n*$. 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):[11]

$$R_i^* = G\left(\mathbf{x}_i'\boldsymbol{\beta}, \varepsilon_i\right) \cong d_i^0\left(\mu_0 + \mathbf{x}_i^{0'}\boldsymbol{\beta}^0\right) + \sum_{j=1}^{J} d_i^j\left(\mu^j + \mathbf{x}_i'\boldsymbol{\beta}^j\right) + \varepsilon_i \tag{8}$$

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

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

[10] This "Type II" approach is similar in spirit to a double hurdle model, but is based on a univariate disturbance process rather than a bivariate disturbance process. In a double hurdle model the choice to remit is determined by a separate regression (with a separate disturbance process) than that which determines remittance level given remittance. In this case, we treat the zero remittances as the lower end of a continuum of remittance categories, but add flexibility to allow the determinants to differ for that first category.

[11] Note that knots are not imposed on this regression line, so this is not a linear spline. Because knots are not imposed in the Generalized Ordered Probit regression model described below, this piecewise linear regression rather than a spline is the appropriate analogue.

The μ^k are nodes at which the regression line for *R* may change slope in the sample space of **X**. Thus, the functional specification of R_i can then be modeled as $R_i \mid (\mu^{j-1} \le R^* < \mu^j) = \mathbf{x}_i'\boldsymbol{\beta}^j + \varepsilon_i$. The probability of remittance falling within each of the specific categories is

$$\begin{aligned}
\Pr(R_i = 0 \mid \mathbf{x}_i^0) &= \Pr\left(\mathbf{x}_i^0{}'\boldsymbol{\beta}^0 + \varepsilon_i < 0\right) = \Phi(-\mathbf{x}_i^0{}'\boldsymbol{\beta}^0) \\
\Pr(R_i = 1 \mid \mathbf{x}_i, \mathbf{x}_i^0) &= \Phi(\mu^1 - \mathbf{x}_i'\boldsymbol{\beta}^1) - \Phi(-\mathbf{x}_i^0{}'\boldsymbol{\beta}^0) \\
\Pr(R_i = 2 \mid \mathbf{x}_i) &= \Phi(\mu^2 - \mathbf{x}_i'\boldsymbol{\beta}^2) - \Phi(\mu^1 - \mathbf{x}_i'\boldsymbol{\beta}^1) \\
\Pr(R_i = 3 \mid \mathbf{x}_i) &= \Phi(\mu^3 - \mathbf{x}_i'\boldsymbol{\beta}^3) - \Phi(\mu^2 - \mathbf{x}_i'\boldsymbol{\beta}^2) \\
&\vdots \\
\Pr(R_i = 6 \mid \mathbf{x}_i) &= 1 - \Phi(\mu^6 - \mathbf{x}_i'\boldsymbol{\beta}^6),
\end{aligned} \tag{9}$$

where $\Phi(\cdot)$ represents the cumulative standard normal density function.[12] The likelihood function for this type-II ordered Probit is $L = \prod_{i=1}^{N}\left(\left(\Phi_i^0\right)^{d_0}\prod_{j=1}^{7}\left(\Phi_i^j - \Phi_i^{j-1}\right)^{d_i^j}\right)$, where $\Phi_i^0 = \Phi(-\mathbf{x}_i^0{}'\boldsymbol{\beta}^0)$, $\Phi_i^k = \Phi\left(\mu^k - \mathbf{x}_i'\boldsymbol{\beta}^k\right)$ for *k=1…6* and $\Phi_i^7 = 1$. Indicator variables d_i^j take the value 1 for $y_i = j$ and zero otherwise. The log likelihood function is then

$$\ln L = \sum_{i=1}^{N}\left(d_i^0 \ln \Phi_i^0 + \sum_{j=1}^{7} d_i^j \ln\left(\Phi_i^j - \Phi_i^{j-1}\right)\right) \tag{10}$$

[12] This representation assumes two identification constraints: $\mu_0 = 0$ and the variance of the normal distribution is normalized to one for all *i*. 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).

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 $\mathbf{x}_i$ (the marginal effect of explanatory variables) is

$$\begin{aligned} \frac{\partial \Phi_i^0}{\partial \mathbf{x}_i^0} &= -\boldsymbol{\beta}^0 \varphi_i^0 = -\frac{\partial \Phi_i^1}{\partial \mathbf{x}_i^0} \\ \frac{\partial \left(\Phi_i^j - \Phi_i^{j-1} \right)}{\partial \mathbf{x}_i} &= -\boldsymbol{\beta}^j \left(\varphi_i^j - \varphi_i^{j-1} \right), \text{ for } j > 1. \end{aligned} \tag{11}$$

where φ_i^k is the probability density function value associated with Φ_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 $\mathbf{x}_k$ tends to lead uniformly to higher remittances, then the marginal effect of $\mathbf{x}_k$ on the probabilities of low remittance categories will tend to be negative, and the marginal effect of $\mathbf{x}_k$ on the probabilities of high remittances will be positive.

The unconstrained GOProbit allows the parameters associated with a given explanatory variable to differ for each category.[13] 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

[13] Estimation is performed in Stata IC 11.0 with the GOLOGIT2 routine with the Probit link function, and using the MFX2 routine for calculating marginal effects.

preliminary regression, then the parameters are constrained to be equal for that specific explanatory variable in the final regression.[14]

Some of the variables associated with the first category (zero remittances) are only available if the respondent remits a nonzero amount. 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. We therefore omit the indicator variables related to this question from the vector that applies to the non-remitter category. This is easily done in the GOProbit model by setting the variables to an arbitrary value for the 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 (non-remitters).

Remittance mode and remittance frequency affect remittance transaction costs, which in turn may affect remitted amounts. In principle, if transaction costs are low, income net of transaction costs would be higher, so there may be an income effect associated with choice of remittance frequency and mode. Further, different remittance modes will likely have different marginal costs associated with total remittance (if costs are proportional to total remittance) or remittance frequency (if costs are proportional to a remittance event). We therefore hypothesize

[14] 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*.

that remittance mode and frequency are jointly and endogenously determined along with remittance amount.

Money transfer companies such as Western Union and Moneygram have historically been the largest and among the most costly 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 transfer services such as these (Bernanke, 2004). Due to substantial changes in the market for transfers in the last decade, many of these companies have changed their rate structures substantially (IFAD, 2007). Transmission fees by Western Union now amount to a lump sum fee per transfer payable by the remitter. The other types of remittance methods ("a bank", an "electronic cashier", "a credit union", "a cash card", "a friend, relative, or other person", or "post office mail") generally charge a lower transfer fee although the speed of transmission may be slower.

Beyond the general information above, we do not have data on actual remittance costs. However, in order to capture the effects of transaction costs on remittances, we develop a set of instruments to address endogeneity of these variables that also act as proxies to distinguish between high-cost and low-cost remittance practices. Let us suppose that for a given mode, transaction costs are proportional to the frequency of remittance, and that expected remittance costs are a function of the expected remittance frequency for a given mode as well as the probability of remittance via that mode. Specifically, a proxy for expected remittance costs can be defined as

$$\tilde{T}_i = \sum_{m=1}^{M} \eta_m \hat{F}\left(\mathbf{z}_i'\boldsymbol{\delta}_m \mid m\right)\hat{\pi}_m\left(\mathbf{z}_i'\boldsymbol{\delta}_m\right) \tag{12}$$

Where η_m represents marginal cost of a remittance event for mode *m*, $\hat{F}(\cdot)$ is the predicted frequency of remittance for a given mode, and $\hat{\pi}_m(\cdot)$ is the probability of mode *m* being used for remittance. The index $\mathbf{z}_i'\boldsymbol{\delta}_m$ is comprised of variables $\mathbf{z}_i$ and parameters $\boldsymbol{\delta}_m$. Thus, $\tilde{T}_i$ is a proxy for expected total remittance costs. In practice, $\hat{F}\left(\mathbf{z}_i'\boldsymbol{\delta}_m \mid m\right)$ is estimated via an ordered Probit regression on the categorical *remittance frequency* variable for each of the two mode categories, and $\hat{\pi}_m\left(\mathbf{z}_i'\boldsymbol{\delta}_m\right)$ are estimated via a multinomial Logit with mode categories as the dependent variable.

For our dataset, 73% of our observations correspond to the *Western Union*-type remittance mode, and the other 6 modes each carry relatively small frequencies. We therefore economize in the second stage by using just two instrument categories: the *Western Union*-type mode, and all other modes. Thus, our two instruments become

$$\tilde{T}_i^{wu} = \eta_{wu}\hat{F}\left(\mathbf{z}_i'\boldsymbol{\delta}_{wu} \mid m\right)\hat{\pi}_m\left(\mathbf{z}_i'\boldsymbol{\delta}_{wu}\right); \qquad \tilde{T}_i^{o} = \sum_{m=1}^{M-1}\eta_m\hat{F}\left(\mathbf{z}_i'\boldsymbol{\delta}_m \mid m\right)\hat{\pi}_m\left(\mathbf{z}_i'\boldsymbol{\delta}_m\right); \tag{13}$$

where the superscripts *wu* and *o* represent *Western Union* and *other*, respectively. Finally, the parameters η_{wu} and η_m are unknown, and in principle are represented by the parameter estimate in the second state remittance regression associated with the instrument. Thus, the final (implementable) instruments used in the second stage regression are (with "hats" rather than tildes), represent two categories of expected remittance frequency/modes:

$$\hat{T}_i^{wu} = \hat{F}\left(\mathbf{z}_i'\boldsymbol{\delta}_{wu} \mid m\right)\hat{\pi}_m\left(\mathbf{z}_i'\boldsymbol{\delta}_{wu}\right); \qquad \hat{T}_i^{o} = \sum_{m=1}^{M-1}\hat{F}\left(\mathbf{z}_i'\boldsymbol{\delta}_m \mid m\right)\hat{\pi}_m\left(\mathbf{z}_i'\boldsymbol{\delta}_m\right); \tag{14}$$

where the marginal cost proxy η_{wu} is a parameter estimate in the second stage. The second-stage parameter estimate on $\hat{T}_i^o$ can be interpreted loosely as the mean effect of the "cost" of remittance by the other modes of the category *o*: $\bar{\eta} \approx (1/(M-1))\sum_{m=1}^{M-1}\eta_m$.

In order for these instruments to be identified as components of the second stage regression, $\mathbf{z}_i$ includes variables that are hypothesized to affect remittance modes but do not directly affect total remittance amounts (and therefore do not enter the second stage regression). These variables will be discussed below. As is standard for first-stage instruments, all exogenous variables in the remittance amount regression are also included in the first stage ordered Probit and multinomial Logit regressions.

IV. Results and discussion

Parameter estimates for the remittance regression are reported in Table 4. Because these parameters are harder to interpret than marginal effects for this model, we will not discuss them in detail. However, note that when we fail to reject the null hypothesis that a variable's parameters do not vary across remittance categories, we restrict these parameters to be equal across remittance categories in the final model so that parameter estimates are for the effect of such a variable are identical in that variable's row in Table 4. Based on these tests, this "parallel lines" (or proportional odds) restriction is applied for all but four variables, namely *earnings per week*, *the two remittance mode/frequency instruments* $\hat{\mathbf{T}}^o$ and $\hat{\mathbf{T}}^{wu}$ *the number of children in Mexico* (as well as the constant). The parameters for $\hat{\mathbf{T}}^o$ and $\hat{\mathbf{T}}^{wu}$ are restricted to zero in the *zero remittance* column because no mode is used if no remittance is sent.

Marginal effects of each explanatory variable within each category of remittances are presented in Table 5. 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 of parameters with low statistical significance are consistent with our theory as well. We will discuss these results in the context of the hypotheses developed earlier in the paper.

The variable 'Earnings per week' has two components: The first is an indicator variable that takes the value 1 when *earnings per week* is zero. This variable does not contribute to the predicted probability of being in a category. As Table 5 shows, the effect of *earnings per week =zero* on the probability of remitting nothing is positive, significant, and nearly 1. Such a strong correlation should be no surprise: in order to remit part of one's income, one must have income. The estimated effect on the probability of remitting a positive amount is statistically negative for each category, and progressively smaller for higher remittance categories.

Conditional on having positive income, the probability of being in the two lower categories of remittance declines as income increases, but increases for the four higher categories. The only one of these effects that is not statistically significant at $\alpha=0.01$ is that pertaining to the lowest category of remittance. This result is consistent with the analysis above and in figure 2, which shows that remittances at the level of zero are not responsive over a range of income. Based on our model this is because many of the individuals in this category are constrained by their incomes and are less likely than others to find it worthwhile to incur any lump-sum remittance costs they face unless their income rises.[15] Another interpretation for the insignificant income effect at zero remittances is that income does not play a role in the decision

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to remit or not, even though it plays a part on the amount of remittance given positive remittance. Given our data, our primary interpretation and this interpretation are observationally indistinguishable, but it seems more likely to us that income is one of the factors affecting whether to remit nothing or a small amount, it's just that transaction costs and other cost requirements hinder this transition at the lowest income/remittance levels.

For those remittance categories between zero and $200 a month, a larger income has a significant negative effect on the probability that they remain in either of these categories, leads to a higher probability of remitting in one of the larger remittance categories. It is also interesting to note that the income effect diminishes for the largest two remittance categories: higher income increases the probability of remitting in the two highest categories, but the marginal effect is not as large as the effect pertaining to remittances between $200 and $200. Another variable related to income is *how many relatives work*. The effect of an increase in this number is to increase the probability of being in higher remittance categories, and the effects are statistically very strong (p<0.01). This is both consistent with hypothesis 1 and will be discussed below in terms of income security as well.

Hypotheses 2 and 3 are related to income and substitution effects of differences in total and marginal remittance costs. Remittance frequency and remittance modes are closely tied to relative transaction costs, and in our model they are jointly and endogenously chosen along with remittance amounts. The variables $\hat{T}_i^{wu}$ and $\hat{T}_i^{o}$ as defined in equation (14) are included in the remittance regression as instruments of remittance cost of for Western Union (and similar) remittances, and for other remittance modes, respectively. Because zero remittance implies no remittance mode, the parameters for these two variables are constrained to be zero for the zero remittance category.

Before interpreting the results for the instruments, $\hat{T}_i^{wu}$ and $\hat{T}_i^{o}$, briefly consider the first-stage auxiliary Ordered Probit regression used to generate them (Table 6).[16] First of all, four variables are included in this regression that are not included in the second (remittance levels) regression, in order to ensure parameter identification of the parameters in the second stage regression. These variables (listed at the bottom of table 5) include *how much English do you speak*, *Do you have a US identification card?*, *Has bank account in the US*, and *paid by direct deposit.* We hypothesize they have a direct effect on transaction costs and mode opportunities, but no substantive direct effect on remittance levels. Of these, English speakers and US bank account holders remit more often than others. This is consistent with the hypothesis that both of these factors make it easier and less costly to remit, inducing higher remittance frequency. [17] We have no specific expectation regarding the parameter on *Do you have a US identification card?* The English version of this variable (our short label for it notwithstanding) is *Do you have a photo ID issued by a government agency in the U.S.* This question is sufficiently vague that it might pertain to anything from a state drivers license to an ID card issued at a consulate. We include it, however, because the personal availability of identification is often crucial in determining available modes of remittance. The other regressors listed in Table 6 are included in the second stage remittance level regression as well. The

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[16] Recall that $\hat{T}_i^{wu}$ and $\hat{T}_i^{o}$ were generated using two limited dependent variable regressions: an Ordered Probit on remittance frequency category, and a Multinomial Logit model for mode choice (each with the same set of regressors). We include a discussion only of the more interesting Ordered Probit results. The results of the Multinomial Logit regression are available from the authors on request. Note also that remittance modes indicator variables are not included in the Order Probit model because they are in principle endogenous; and these firsts stage regressions amount to reduced forms of an implicit structural model of remittance level model and frequency.

[17] The variables τ^i in Table 6 are Ordered Probit threshold parameters of no particular interest for our purposes.

statistically significant results include the following: Having a spouse or more children living in Mexico leads to higher remittance frequency, as does having health insurance. Remittance frequency is lower for people who have lived in the U.S. for longer, and for people who have been unemployed for more than a month in the previous year. Finally, higher earnings lead to higher remittance frequency. Each of these results is consistent with our model of the balance between remittance transaction costs and the benefits of remittance frequency including evidence of income effects in both levels and variance in disposable income.

Returning to Table 5 (the remittance levels GOProbit regression), consider again the effects of remittance cost instruments $\hat{T}_i^{wu}$ and $\hat{T}_i^{o}$ on remittance levels. Table 5 shows that parameters associated with these two instruments are only statistically significant at $\alpha \leq 0.1$ for the two highest remittance categories. However, there is a clear and consistent trend for comparison among all categories. For Western Union-type remittances, endogenous remittance frequency is positively correlated with lower remittance categories, but negatively correlated with higher categories. The instrument for other modes shows the opposite trend: negatively correlated with low remittance levels and positively correlated with higher remittance levels.

According to hypothesis 2, more frequent remittances for a given remittance mode implies higher total remittance costs, leading to less total remittance. Further, higher cost modes lead to less total (and perhaps marginal) remittances. We infer from the above results that those remitting larger amounts often have other options (banks, bank cards or credit unions) that also have lower marginal transaction costs and lower foreign exchange transaction fees in Mexico. Further, the more frequent the remittances the lower the probability of remitting small amounts, given a fixed transaction fee. These results are consistent with the apparent fact (based on out-of-sample information) 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. Western Union has pursued the remittances market more aggressively than other market players by conducting campaigns aimed at prospective migrants prior to departure and marketing campaigns in the country of destination (New York Times, 2007). Newly arrived migrants with low incomes are thus more likely to be familiar with Western Union than other financial channels.

Moving on now to other regressors in Table 5, the distribution of family members between Mexico and the U.S. show patterns of marginal effects generally consistent with hypothesis 4. If the migrant has a spouse living with him or her in the U.S., the probability of remitting low amounts is larger and the probability of remitting high amounts is lower, and these results are statistically significant at the 5 percent level. In contrast, if the spouse lives in Mexico, the signs of the parameters are exactly opposite for each remittance category. Although the estimates are statistically not significantly different from zero, the pattern of these effects is compelling especially in comparison to having a spouse in the U.S. As the number of children in the U.S. household increases, the probability of remitting in each category less than $200 increases while the probability of remitting more than this decreases, so more children in the U.S. leads to less remittance to Mexico. All of the marginal effects are statistically significant.[18] If more of the remitter's children live in Mexico, he or she is statistically less likely to remit less

[18] As one might expect, there is correlation between spouses living in the U.S. (Mexico) and children living in the U.S. (Mexico). The correlation coefficients are 0.45 between *spouse lives in the U.S.* and *# children in the U.S.*, and 0.56 between *spouse lives in Mexico* and *# children in Mexico*. The correlations between a spouse living separately from children are negative and smaller in absolute value. These correlations can contribute to the statistical weakness of some of these results. For example, when *spouse lives in the U.S.* is omitted from the regression, the parameters on *# children in the U.S.* become significant at the 10% level or lower.

than $100 per month, and statistically more likely to remit between $400 and $500, meaning that the migrant is more likely to remit more given more children in Mexico.

Marginal effects for the proxies for residence, employment, and financial security in the United States are generally consistent with hypothesis 5. 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). These results are consistent with a setting in which land and real estate require loan or maintenance payments (such as mortgage or repair costs), and businesses provide net income at their respective locations.

Remitters who have been in the United States longer (*# years in U.S.*) tend to remit less. Holding future plans and uncertainty constant, a migrant will have had more time to accumulate savings through remittance, and so has the capacity to remit less for any given goal. Recall also that as the number workers in the respondent's household who work in the U.S. (*# in household who work in U.S.)* tends to increase the probability of remitting more. As noted above, this result can be due to an income effect, but it can also be due to a security effect to the extent that household members rely on each other to pool income risk in the U.S., thereby allowing larger remittances with less subsistence risk.

Remitters who have been unemployed for more than one month in the last year tend to remit more than those who have not. This response is subject to several interpretations, but is consistent with a respondent reporting higher remittance when employed to make up for past and potential future unemployment. Again, however, these effects are both small and weak. A migrant who *has health insurance* is more likely to remit more than those without. Again, none of these parameters are significant at conventional levels, but are qualitatively consistent with a higher propensity to remit under less income/expenditure uncertainty as suggested by hypothesis 5. If the remitter plans on remaining in the U.S. for more than 10 years (*Expects to remain in U.S. >10 years*), the probability of remitting less than $200 increase and the probabilities of remitting more than that decrease. Those who instead indicated that they *will stay in the U.S. as long as possible* are, by their response, indicating relatively strong ties to the U.S., but some uncertainty about their future in the U.S. The results are similar to those associated with *Expects to remain in U.S. >10 years,* but are not statistically significant and are smaller. The interpretation here is that the uncertainty they face reduces their expected stay, and so they account for this in their remittance levels. The relatively higher variance of these estimates associated with *will stay in the U.S. as long as possible* are consistent with the vagaries of this response. Presumably each has some expectation of their likely length of stay, but this expectation is likely to vary significantly among respondents who chose this response.

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. Remittances now make up 20 percent of per capita income in Latin America, and on average, 90 percent of the proceeds go for subsistence needs

(IFAD, 2007), so the impact on poverty alleviation therefore is significant. There is also a secondary balance of payments impact, with remittances averaging 3 percent of exports in 2006 (IMF, 2006). The developmental impact is therefore also dependent on the macroeconomic policies of the recipient country, particularly with respect to exchange rates and financial sector reform.

This paper examines some of the determinants of migrant remittance choices and 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 very broadly consistent with the testable hypotheses developed in this paper. Although some of these results are statistically weak, the general patterns of even these statistically weaker parameter point estimates are substantially consistent with our hypotheses. We find that income has no effect on the probability of remitting nothing, but has statistically significant positive effects on the remittance conditional on remitting a positive amount. Further, high transaction costs implied by high transaction frequency appear to have a negative income effect on remittances. We find also that migrants with more family members in Mexico and fewer family members in the U.S. remit more (especially in the case of spouses); 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 lead to larger remittances compared to those who face lower uncertainty in these measures.

Transaction costs are a major determinant of the process by which remittances are made, and a difficult problem for remitters is commonly a lack of transparency about exchange rates at the receiving end of a transaction. Current law restricts payments in Mexico to be made in

pesos. The lack of transparency and currency restrictions lowers competition by not permitting recipients to "shop around" and in effect establish dual exchange rates that discriminate against remittances. Cross section estimates show that countries with dual exchange rates receive 40 percent less remittances than those with liberalized rates (Lueth and Ruiz-Arranz, 2006). Our estimates show the foreign exchange rate impact indirectly; remitters using money transfer organizations tend to send smaller amounts, probably because of high per-transaction costs at both ends. Liberalizing conversion rules in the recipient country would probably lower implicit transaction costs for remittances by improving remitters and recipients to more effectively shop for low-cost remittance modes, which might increase the probability of remittances of less than $100 most likely to low-income recipients for whom the poverty alleviating impact is greatest.

Lueth and Ruiz-Arranz (2006) find a link between GDP growth rates in the recipient country and remittance flows. Their results on macro-level data suggest that a one percent change in the growth rate is associated with a 2.8 percent increase in remittances. This is loosely consistent with our results, which show a positive relationship between higher remittances and asset ownership in the country of origin. Remittances from individuals with substantial assets in Mexico are likely to have a greater development impact if they are applied toward the domestic savings and capital markets. These results argue for growth promoting policies, not only for their sake, but because they have a 'multiplier effect' through remittance increases.

Our analysis points to possible impacts of US policy measures regarding immigrants as well. A more active process to interdict illegal migrants will have several offsetting effects on remittances. Illegal migrants are likely to be in the lower wage groups, which according to our results would lead to a less than proportionate decline in remittances relative to the number of repatriations. However, remaining illegal migrants would face a greater degree of uncertainty

and a shorter expected stay on average. They are also likely to have a proportionately larger number of dependents in Mexico. Both of these factors would tend to induce more remittance per remaining illegal migrant, so the net effect is ambiguous. Similarly, a legal guest worker program would likely increase the per-migrant remittance per unit time of the participants during their stay, and will allow them more flexibility in remittance modes.

Our results suggest a possible link between host country policies on security and remittances given that most remittances go for subsistence needs. Assume for the moment that funds for illegal purposes move through informal channels. Developing rules that limit the use of such formal channels as banks and other legal channels by illegal migrants would most likely increase volumes through informal means and make monitoring them for illegal funds more difficult. A combination of financial restrictions in the home country and tighter controls in the host country has the effect also of reducing the flows and exacerbating poverty. The impact might very well be the opposite of what both countries intended. These and other issues that relate to the impact of immigration policy in the U.S. can have profound Impacts on remittance flows.

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Table 1: Data descriptions

Variable Name	Description of Variables
Remittance level per month (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.
Earnings (Q39)	Income per week. 1 = $1-$100, 2 =$101-$199, 3 = $200-$299, 4 = $300-$399, 5 = $400-$499, 6 = more than $500.
Remittance frequency	Categorical responses to "How often do you send money to Mexico?" were translated into the number of weeks per year that an individual remits, so that a high number implies a higher frequency. Used to generate instruments $\hat{T}_i^o, \hat{T}_i^{wu}$.
Remittance modes	1=a company like Western Union or Moneygram, 2=a bank, 3=electronic cashier, 4=a credit union, 5=a cash card, 6=friend, relative, 7=post office. Dummy variable counterparts used to generate Used to generate instruments $\hat{T}_i^o, \hat{T}_i^{wu}$.
Transaction cost proxies $\hat{T}_i^o, \hat{T}_i^{wu}$	See equation (14) and surrounding text
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.
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.
Speak English (Q6)	1= a lot, 2= some, 3=a little, 4 = none
Marital status (Q7)	Categorical variable of marital status where 1 indicates married and 0 otherwise.
# 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.
U.S. Photo I.D. (Q 29)	Equals 1 if respondent has a photo ID issued by a U.S. Agency.
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.
# in household who work in the U.S.? (Q26)Unemployed > 1 month last year (Q35)	Equals 1 if the respondent had been unemployed for more than one month last year.
Paid by direct deposit (Q40.1)	Categorical variables equaling 1 if paid by direct deposit.

Bank account in the U.S. (Q46)	Equals 1 if respondent has a bank account in the U.S.
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.?
How much English do you speak? (Q6)	1= a lot, 2= some, 3=a little, 4 = none.
Do you have a U.S. ID card? (Q29)	Do you have a photo ID issued by a government agency in the U.S.? Yes=1, no=0, or missing.
Has bank account in the U.S. (Q46)	Yes=1, no=0, or missing.
Paid by direct deposit (Q40.3)	Are you paid in cash, by check, or through electronic bank deposit? =1 if electronic bank deposit, zero otherwise.

Table 2. Summary statistics of variables used in regressions. Survey question numbers in parentheses. N= 2976.

variable	mean	sd	min	max
Remittance level per month (Q43)	2.39	1.75	0	6
Earnings per week=0 (Q39)	0.15	0.35	0	1
Earnings per week (Q39)	3.15	1.77	0	6
$\hat{T}_i^o$: Transaction cost proxy, other mode	4.31	4.98	0	37.2
$\hat{T}_i^{wu}$: Transaction cost proxy, Western Union mode	3.16	3.71	0	26.8
Gender [male=1] (Q2)	0.65	0.48	0	1
Age (Q3)	3.11	0.97	1.8	7.4
Education level (Q5)	3.05	0.95	1	5
Spouse lives with in the U.S. (Q8.1)	0.44	0.50	0	1
Spouse lives in Mexico (Q8.3)	0.11	0.31	0	1
# children in the U.S. (Q10)	1.24	1.48	0	6
# children in Mexico (Q9-Q10)	0.43	1.02	0	6
Owns land in Mexico (Q19.1)	0.15	0.36	0	1
Owns real estate in Mexico (Q19.2)	0.25	0.44	0	1
Owns business in Mexico (Q19.3)	0.02	0.15	0	1
# years in the U.S. (Q22time)	2.12	1.19	1	4
How many relatives work	2.60	1.80	0	20
Owner/proprietor of business in U.S. (Q34.3)	0.15	0.66	0	3
Unemployed > 1 month last year (Q35)	0.64	0.48	0	1
Has health insurance (Q48)	0.60	0.49	0	1
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)	0.42	0.49	0	1
How much English do you speak? (Q6)	2.53	0.95	1	4
Do you have a U.S. ID card? (Q29)	0.46	0.50	0	1
Has bank account in the U.S. (Q46)	0.68	0.47	0	1
Paid by direct deposit (Q40.3)	0.04	0.20	0	1

Table 3. How much do you send per month on average?

(Q43)	Frequency	Percent	Cumulative
zero	489	16.43	16.43
0<remit/month<$100	422	14.18	30.61
$100<remit/month<$199	875	29.4	60.01
$200<remit/month<$299	504	16.94	76.95
$300<remit/month<$399	257	8.64	85.58
$400<remit/month<$499	165	5.54	91.13
$500<remit/month	264	8.87	100
Total	2,976	100	

Table 4. Parameter estimates, Generalized Type II Ordered Probit regression

Explanatory variables ↓ Remittance ($R) →	R=zero	0<R<100	100<R<199	200<R<299	300<R<399	400<R<499
Earnings per week=0 (Q39)	-4.357***	-4.357***	-4.357***	-4.357***	-4.357***	-4.357***
Earnings per week (Q39)	0.058	0.250***	0.271***	0.291***	0.313***	0.339***
$\hat{T}_i^o$: Transaction cost proxy, other mode	0†	0.007**	0.091**	0.120***	0.190***	0.227***
$\hat{T}_i^{wu}$: Transaction cost proxy, Western Union	0†	-0.071	-0.174***	-0.216***	-0.319***	-0.367***
Gender [male=1] (Q2)	0.268***	0.268***	0.268***	0.268***	0.268***	0.268***
Age (Q3)	0.064**	0.064**	0.064**	0.064**	0.064**	0.064**
Education level (Q5)	0.005	0.005	0.005	0.005	0.005	0.005
Spouse lives with in the U.S. (Q8.1)	-0.134***	-0.134***	-0.134***	-0.134***	-0.134***	-0.134***
Spouse lives in Mexico (Q8.3)	0.120	0.120	0.120	0.120	0.120	0.120
# children in the U.S. (Q10)	-0.046**	-0.046**	-0.046**	-0.046**	-0.046**	-0.046**
# children in Mexico (Q9-Q10)	-0.074	0.143***	0.076**	0.074**	0.071**	0.044
Owns land in Mexico (Q19.1)	0.159***	0.159***	0.159***	0.159***	0.159***	0.159***
Owns real estate in Mexico (Q19.2)	0.104**	0.104**	0.104**	0.104**	0.104**	0.104**
Owns business in Mexico (Q19.3)	-0.234*	-0.234*	-0.234*	-0.234*	-0.234*	-0.234*
# years in the U.S. (Q22time)	-0.066***	-0.066***	-0.066***	-0.066***	-0.066***	-0.066***
How many relatives work	0.040***	0.040***	0.040***	0.040***	0.040***	0.040***
Owner/proprietor of business in U.S. (Q34.3)	0.048	0.048	0.048	0.048	0.048	0.048
Unemployed > 1 month last year (Q35)	0.047	0.047	0.047	0.047	0.047	0.047
Has health insurance (Q48)	0.037	0.037	0.037	0.037	0.037	0.037
Expects to remain in U.S. >10 years (Q23)	-0.190*	-0.190*	-0.190*	-0.190*	-0.190*	-0.190*
Will stay in U.S. as long as possible (Q23)	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054
Constant	1.550***	-0.117	-1.282***	-1.951***	-2.412***	-2.876***

*** p<0.01, ** p<0.05, * p<0.1. N=2976; †parameter constrained to equal zero

Table 5: Marginal Effects from regression in Table 4, calculated at sample means.

Explanatory variables ↓ Remittance ($R) →	zero	0<R<100	100<R<199	200<R<299	300<R<399	400<R<499	500<R
=1 if earnings=0	0.9690***	-0.1650***	-0.3950***	-0.2100***	-0.0955***	-0.0535***	-0.0495***
Earnings per week (Q39)	-0.0089	-0.0884***	0.0229***	0.0357***	0.0182***	0.0106***	0.0099***
$\hat{T}_i^o$: Transaction cost proxy, other mode	0†	-0.0026	-0.0223	0.0089	0.0035	0.0058**	0.0067***
$\hat{T}_i^{wu}$: Transaction cost proxy, Western Union	0†	0.0276	0.0199	-0.0188	-0.0078	-0.0101***	-0.0108***
Gender [male=1] (Q2)	-0.0433***	-0.0618***	0.0341***	0.0372***	0.0173***	0.0092***	0.0073***
Age (Q3)	-0.0097**	-0.0151**	0.0074*	0.0090**	0.0043**	0.0023**	0.0019**
Education level (Q5)	-0.0008	-0.0012	0.0006	0.0007	0.0003	0.0002	0.0001
Spouse lives with in the U.S. (Q8.1)	0.0207**	0.0317***	-0.0158**	-0.0189***	-0.0090***	-0.0048**	-0.0039**
Spouse lives in Mexico (Q8.3)	-0.0171	-0.0291	0.0119	0.0171	0.0085	0.0047	0.0039
# children in the U.S. (Q10)	0.0070**	0.0109**	-0.0053**	-0.0065**	-0.0031**	-0.0017**	-0.0014**
# children in Mexico (Q9-Q10)	0.0113	-0.0669**	0.0348***	0.0109*	0.0053*	0.0034**	0.0013
Owns land in Mexico (Q19.1)	-0.0224***	-0.0386***	0.0154***	0.0227***	0.0114**	0.0063**	0.0053**
Owns real estate in Mexico (Q19.2)	-0.0153**	-0.0249**	0.0111**	0.0148**	0.0072**	0.0039**	0.0032*
Owns business in Mexico (Q19.3)	0.0413	0.0512*	-0.0347	-0.0315*	-0.0139**	-0.0071**	-0.0053**
# years in the U.S. (Q22time)	0.0101***	0.0157***	-0.0076**	-0.0093***	-0.0045***	-0.0024**	-0.0019**
How many relatives work	-0.0061***	-0.0095***	0.0046***	0.0056***	0.0027***	0.0015***	0.0012***
Owner/proprietor of business in U.S. (Q34.3)	-0.0073	-0.0114	0.0055	0.0068	0.0032	0.0017	0.0014
Unemployed > 1 month last year (Q35)	-0.0072	-0.0111	0.0055	0.0066	0.0031	0.0017	0.0014
Has health insurance (Q48)	-0.0056	-0.0087	0.0043	0.0052	0.0025	0.0013	0.0011
Expects to remain in U.S. >10 years (Q23)	0.0326	0.0424*	-0.0269	-0.0259*	-0.0116*	-0.0060*	-0.0046**
Will stay in U.S. as long as possible (Q23)	0.0083	0.0128	-0.0063	-0.0076	-0.0036	-0.0020	-0.0016

*** p<0.01, ** p<0.05, * p<0.1. N=2967; †restricted to zero.

Table 6. Dependent variable: Remittance frequency. Ordered Probit marginal effects. N=2976; Pseudo-R^2=0.126; $\chi^2(22) = 1189.7$, p-value=0.000.

Label	Coef.	Std. Err.	z	P>z
Gender [male=1] (Q2)	-0.200	0.048	-4.19	0.000
Age (Q3)	0.040	0.030	1.36	0.175
Education level (Q5)	-0.068	0.024	-2.83	0.005
Spouse lives with in the U.S. (Q8.1)	-0.068	0.048	-1.42	0.155
Spouse lives in Mexico (Q8.3)	0.166	0.083	2.00	0.046
# children in the U.S. (Q10)	-0.020	0.019	-1.03	0.302
# children in Mexico (Q9-Q10)	0.128	0.026	4.84	0.000
Owns land in Mexico (Q19.1)	-0.103	0.057	-1.82	0.068
Owns real estate in Mexico (Q19.2)	-0.009	0.048	-0.19	0.853
Owns business in Mexico (Q19.3)	0.135	0.132	1.02	0.306
# years in the U.S. (Q22time)	-0.080	0.023	-3.46	0.001
How many relatives work	0.015	0.012	1.26	0.209
Owner/proprietor of business in U.S. (Q...	0.003	0.030	0.11	0.913
Unemployed > 1 month last year (Q35)	-0.172	0.043	-4.03	0.000
Has health insurance (Q48)	0.131	0.042	3.13	0.002
Expects to remain in U.S. >10 years (Q23)	0.118	0.107	1.11	0.268
Will stay in U.S. as long as possible (...	0.018	0.042	0.44	0.659
Earnings per week (Q39)	0.403	0.014	27.91	0.000
How much english do you speak (Q6)	0.110	0.025	4.33	0.000
Do you have a US id card? (Q29)	-0.158	0.048	-3.29	0.001
Has bank account in the U.S. (Q46)	0.190	0.051	3.68	0.000
Paid by direct deposit (Q40.3)	-0.125	0.106	-1.17	0.241
τ^1	-0.064	0.170		
τ^2	0.843	0.171		
τ^3	1.681	0.172		
τ^4	2.336	0.172		

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.

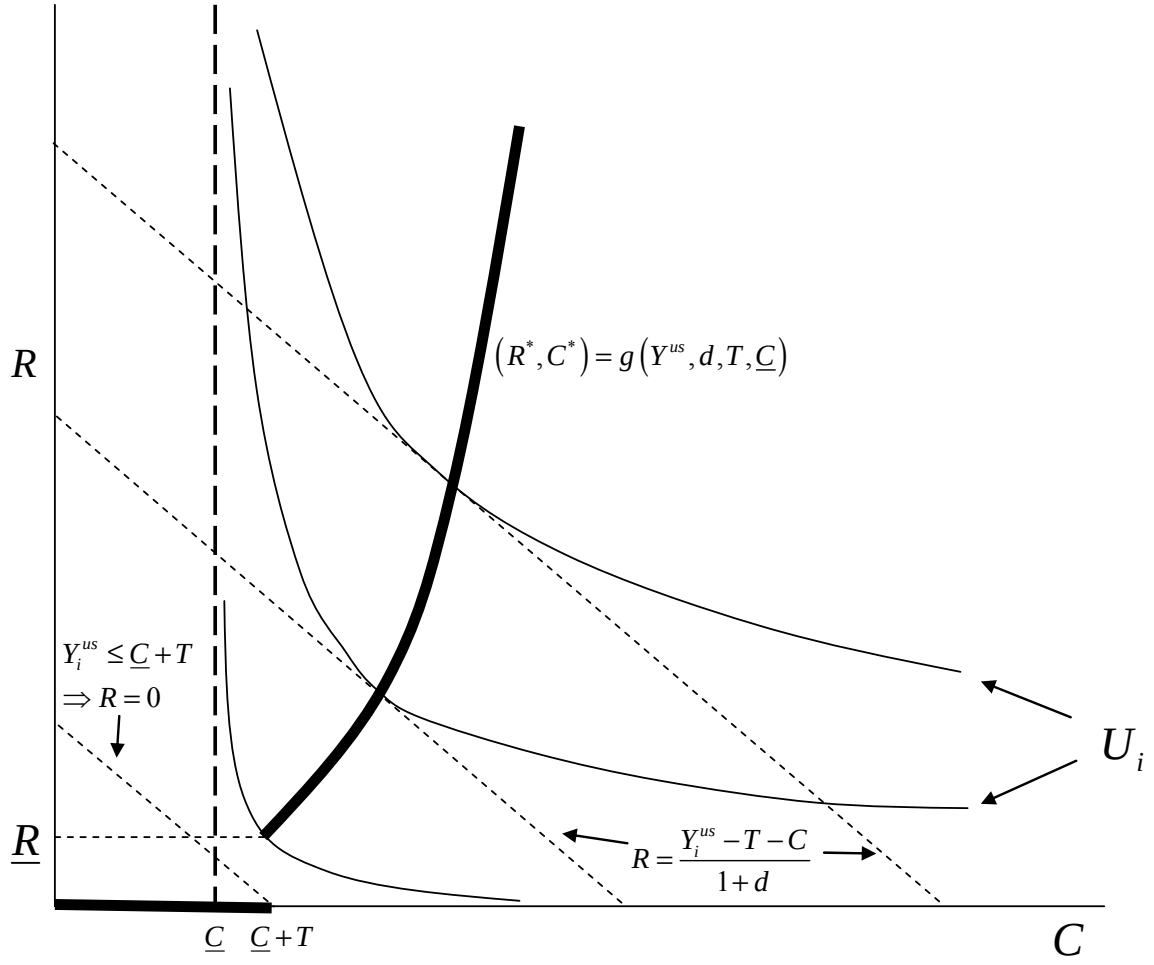

Figure 2: The bold line represents the relationship between income and remittances. An increase in the lump sum cost of remittances T will increase the level of income needed for remittances to be sent, but if the marginal utility of consumption is discontinuous and sufficiently steep at $\underline{C}^{+}$, 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.