

DETERMINANTS OF REMITTANCES: A GENERALIZED
ORDERED PROBIT APPROACH

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A thesis submitted in partial fulfillment of
the requirements for the degree of

MASTER OF ARTS IN APPLIED ECONOMICS

WASHINGTON STATE UNIVERSITY
Department of Economics

MAY 2007

To the Faculty of Washington State University:

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ACKNOWLEDGEMENT

“Many helping hands makes the load lighter” was a saying rehearsed at my home when I was growing up. Many helping hands have been involved to make my thesis possible. I am indeed grateful for those who have offered support, guidance, and suggestions towards the completion of this work. I would like to thank Dr. Mudziviri Nziramasanga, Dr. Jonathan Yoder, and Dr. William Hallagan whom have spent much time and effort guiding me in this journey. I would also like to thank my wonderful wife Lara for supporting and encouraging me when the project seemed like a deep abyss. I would like to thank my little baby Maelie whose sweet smile motivated me to continue on. I am grateful for my fellow students who helped revise and discuss elements of my research. With their helping hands the task and research became more clear and achievable.

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Abstract

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Worldwide remittances have dramatically increased over the past few decades and as a result, many studies have been devoted to determining why one remits. Theoretical models attempting to explain why one remits are often based on altruistic or self-interested motivations. However, while modeling the motivations to remit these theoretical models fail to model net income as a predecessor to remitting. I present a theoretical model where the amount of remittances are determined by the migrant maximizing his/her utility function subject to a subsistence level constraint in addition to a typical budget constraint. From this theoretical format I postulate two testable hypotheses regarding the derivative of remittances with respect to a change in income. The first hypothesis stems from the subsistence level constraint, where the migrant's remittance level will likely remain equal to zero with an increase in earnings. The second hypothesis stems from those migrants who have surpassed a subsistence income level. In this case, the derivative of remittances with respect to a change in income will be positive. I analyze data from Mexican migrants in the United States to test these two hypotheses.

I propose the use of a generalized ordered probit as the appropriate estimation approach for the given data, which approach to my knowledge has not been previously used in this literature. By the use of the generalized ordered probit, I alleviate the problem of distinguishing the different effects of the independent variables on the level of the amount remitted and the likelihood of remitting. Also, with this estimation approach, I am more apt to determine any idiosyncratic effects of the independent variables on the specific levels of remitting. My results support the proposed hypotheses and therefore I conclude that in fact a subsistence level constraint is present among migrants. Following from the theory and empirical analysis it is imperative in modeling the determinants to remit to incorporate the capacity to remit along with the specified motivations.

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Introduction

The term remittance has been defined as the money sent by immigrants to their home country (Congressional Budget Office). Remittances across the world have continued to increase over the past three decades to equal approximately \$230.5 billion in 2004, as shown in figure 1. (World Bank) On a more specific level and one relevant to the empirical analysis, Mexico received about \$9 billion in 2002 from remittances, which was the highest absolute amount among all Latin American countries Bernanke (2004). Furthermore, 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). In 2004 remittances constituted nearly 2.5 percent of Mexico's GDP, where Mexico's total GDP was \$676 billion. (World Development Indicators) 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. Understanding the determinants and motivations to remit are imperative in determining how remittances affect the economic development of certain countries. Also, proper policy implementation can be aided by this knowledge.

The literature on motivations and determinants of remitting can be categorized into two main theories. The first states that remittances are motivated by altruism (Lucas and Stark 1985; Agarwal and Horowitz 2002), which is commonly defined as the utility function of the migrant being a function of other non-migrant's consumption. The second category is motivations to remit based on self-interest which include but are not limited to: risk sharing (Stark 1991; Stark and Levhari 1982), repayment of an informal loan arrangement (Poirine 1997), dissuading the migration of low-skill workers (Stark 1995), and an attempt to secure a bequest upon returning

home (Hoddinott 1994). In addition to these two categories, there are theories interconnected between the two views (Lucas and Stark 1985). However, 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 is a standard approach for modeling migrant remittances. However, these models fail to identify an integral aspect of modeling remittances. This integral aspect of remittances is centered on the idea that a migrant remits from his/her net income.

I define net income in reference to remitting as income less two segments of cost. One segment is the cost for the migrant to live at a self determined appropriate 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. The other cost segment of net income is the cost associated with remitting. Such costs for the migrant to send money may include transaction costs, risks of sending, etc. Therefore, if the cost of sending the remittances exceeds a certain amount, such that net income would be less than or equal to zero upon remitting, the migrant will chose 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.

If a positive net income is a precedent requirement for remittances then including this into a theoretical model is imperative in determining the amount remitted. I therefore suggest as a theoretical approach the use of a utility maximization model where net income becomes an additional constrain to a standard budget constraint. I use a Cobb-Douglas utility function where

the net income constraint allows for a corner solution, such that remittances equal zero due to a binding net income 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 which may not be directly observable.

We would expect that certain observable behaviors would be present if remittances are in fact comprised of a proportion of net income. One such behavior is that if a migrant surpassed the threshold of obtaining a positive net income, then it is plausible that additional income will be remitted at an increasing proportion. Referring back to the illustration of a migrant living in poverty-like conditions to support his/her family, all additional income above a subsistence level may be remitted. Another key behavior is related to those that are not capable of remitting due to the net income constraint. For those constrained by the net income constraint, a small incremental change in income will unlikely be remitted. These behaviors consistent with the net income constraint will be the bases for my testable hypotheses and focus of my empirical work.

I apply a generalized ordered probit model to test the hypotheses. The attempt to test the net income theory is facilitated by obtaining a more complete understanding of the effects of the factors of remittances. John Hoddinott (Hoddinott 1992) stated that prior empirical work on remittances did not address the distinction between the explanatory variables effects on the likelihood of remitting and the level of remittances. He tried to correct for this factor effect distinction by use of a Tobit model and a Heckman approach. I suggest the use of a generalized ordered probit model as an alternative technique to distinguish the different effects on the likelihood and level of remitting. This alternative approach is beneficial in that it allows estimation when the dependent variable is of an ordered categorical nature in which case a Heckman approach would not be appropriate. Also, the generalized ordered probit estimation

procedure allows the effects of the individual parameters to be unique for all different dependent variable categories, which facilitates observing behavior consistent with the positive net income theory.

The paper is organized in the following manner. Section II will provide a detailed literature review of the prominent and pertinent literature on micro-economic motivations and determinants of remittances. Section III consists of a theoretical presentation of determinants of remittances based on the consideration of a net income constraint. An empirical analysis of Mexican migrants in the United States will comprise Section IV. A discussion of the results will be in Section V and Section VI will be the conclusion.

II. Literature Review

Lucas and Stark (1985) provide the seminal paper on theoretical models of motivations and determinants of remittances. The authors state that prior to their paper there did not exist a formal theoretical model on motivations to remit, and thus they proceed by delineating a formal theoretical model of remittances based on altruistic motives. The authors also provide non-formal theoretical models (reasons) of remittances based on self-interest and a contractual agreement between the migrant and the remaining family members. The altruistic model suggests that the migrant's utility function is a function of the migrant's consumption and the consumption of those that remain in the home country. In this case a type of net income has been included into the model but in a rather inappropriate manner. The migrant's consumption is a function of net income after the amount remitted has been determined, and the amount remitted is a function of the migrant's wage, income of family members at home, and the number of

family members in the home country. This model assumes away the two key elements of net income: first there is no consumption level requirement for the migrant, such as a subsistence income level and second there are no costs to remit.

With regards to self-interested reasons to remit, the authors posit three main motivations: aspiration to inherit, investing in the home country, and preparing to return home. A discussion is warranted regarding investing in the home country as a motivation for remitting. The authors state investing in the home country as investing in physical assets such as land and cattle and do not mention investment in human capital. Investment in the home country is much more extensive than investment solely in physical assets. Many studies have been done connecting remittances to investment in human capital such as, children's schooling.(Cox Edwards and Ureta 2003; Acosta 2006) The third reason, preparing to return home, is defined by the authors as public and social assets, which are used to promote the migrant's prestige in the public's view or bolster family relationships. The authors state the self-interested motivations without any indication that a positive net income is considered prior to remitting. The contractual agreement theory presented in this paper is based on the attempt to diversify family income to spread financial risk, specifically between a parent and child. The mutually beneficial contract aspect of the theory also implicitly suggests that the different parties of the contract are solving individual utility functions and not a joint utility function. Similar to the self-interested theory there is no consideration of net income influencing the amount remitted.

In Stark (1991) and Stark and Levhari (1982), remittances are implied or stated as a transfer of income in order for the family to spread risk. In these papers the focus is on determining motivations to migrate and not necessarily modeling remittances themselves. The authors refer to or state remittances as an integral aspect in the process of diversifying risk. Both

papers fail to derive a formal theoretical model as well as mention remittances as a proportion of net income.

Theoretically related to the contractual agreement theory is the theory of remittances as an attempt to acquire future bequests from parents (Hoddinott 1994). This theory uses a joint utility function, only in determining whether to migrate or not, where the family's utility is a linear combination of the son's utility and the parent's utility in the two different states of migration and non-migration. The amount of remittances is determined solely by the migrant whose remittances are a function of future bequest by the parents. The author discusses the case where the migrant may be in need of financial assistance, such as when unemployed, from those at home. While the article considers the situation where the migrant does not remit and receives assistance from his/her family, the theoretical model does not implement a positive net income requirement in order for the migrant to remit.

It has also been posited that remittances are a repayment of an informal loan that migrants used to facilitate the migration process (Poirine 1997). The author describes this theory in a conceptual manner where a positive net income requirement is not discussed in the layout of the theory. One may argue that a positive net income is implied because it would be calculated into the decision to lend and borrow the money. For example, the lender of funds for education, travel expenses, and other possible needs to facilitate migration would not be given unless it was expected that the income would be sufficient to repay the loan. However, this gross simplification of an implication of a positive net income requirement is flawed in that expectations may deviate from reality and that the remittance amount is determined after migration. Similar to repayment of other loan arrangements, if the migrant does not have sufficient funds after migration to repay the loan he/she would default on the loan and

remittances would not occur. Remittances based on the loan repayment theory is still subject to a sufficient amount of income for the migrant to cover at least a subsistence level of life and enough to cover the transaction costs of remitting.

A unique theory of self-interest is the theory that migrants send remittances to low-skill potential migrants to maintain a higher wage (Stark 1995). This theory is based on the notion that migrants receive a wage equal to the average product of labor for all migrant workers. Thus if low-skill workers migrate and work in the host country, the average product of labor for all migrants will decrease, and thus cause the wage level to decrease. In this case a migrant may then see remitting as a way to protect his/her wage.

Yang (2006) observed that remittance receipts in the Philippines increased due to the Asian financial crisis. Yang presents how the Philippine peso depreciated in exchange rate value for many countries during this time period. As a result of the depreciation of the Philippine peso the migrant's income increased in terms of the Philippine currency and thus may be considered an increase in income for the migrant. A general net income model, as the one presented in the following section, would expect remittances to increase as the migrants income increased. This expectation is based on the associated cost not increasing equal in value to the increase in income, so that the increase in income is an increased net income. Yet Yang, similar to prior literature, does not discuss an increase in net income as a probable cause for the increased remittances.

It is reasonable to suspect that motivations to remit differ among migrants and even motivations may change for a single migrant over time. It has been suggested that motivations to remit differ in a systematic way such as by gender Vanwey (2004) and De la Briere, et al. (2002). Prior theoretical models attempting to determine remittances seem to be overly

concerned with modeling the motivations to remit and not with the capacity to remit. While theoretical applications attempt to control for non-remitters as a sample selection¹ problem, no theoretical model incorporates net income in the formal theoretical model. My goal is to then provide a general theoretical model for remittances that can accommodate prior theory but includes a net income constraint.

II. Theoretical Model

I begin with the assumption that the migrant has already migrated and is in the host country. Migration and remittances are related in the sense that remittances cannot occur until the migrant has migrated. In this manner motivations to remit may in fact be the same as the motivation to migrate. However, the migrant still determines the amount remitted by maximizing his/her utility function either before or after migration has occurred. And thus relaxing the assumption that the migrant has already migrated does not change the implications of the theory but only changes aspects of the model to expectations. However, if expectations are not fully realized, then the capacity to remit may deviate from the expected capacity to remit and therefore remittances would be different than the expected amount of remittances. In addition to the post migration assumption, I assume that the migrant solves a Cobb-Douglas utility function. The Cobb-Douglas utility function assumption is for illustrative and simplification purposes. I also assume that the Cobb-Douglas utility function satisfies all traditional assumptions of a well behaved agent. The utility function is defined as follows:

¹ Sample Selection has been recognized as an issue but I have the same information for both remitters and non-remitters, and therefore do not have a Sample Selection problem.

$$U(C, R) = C^\alpha R^\beta \quad (\text{Equation 1})$$

Where C is the total expenditure for consumption of the migrant and R is the amount of money or cash equivalent that is remitted. I will refer to C as consumption and not as total expenditure on consumption for simplicity. The utility function is positively related to both C and R . This form of utility function is general in the sense that it may support an altruistic motive, a self-interested motive, or a combination of the two. For example, the migrant may take into consideration the consumption of others since R directly affects the consumption of non-migrants. Also, R may be defined as the migrant being self-interested where R is: an insurance payment, a loan payment, etc. With this utility function I am not stating why remittances increase utility and as a result, the theoretical model is general enough for nearly any theoretical concept of motivations to remit.

The migrant then solves his utility maximization problem given two constraints. The first is a typical budget constraint which in this case may be defined as:

$$I \geq C + R + TC \quad (2)$$

Where I is the income of the migrant and TC represents transaction costs associated with remitting. This budget constraint indicates that the migrant cannot consume and remit more than he/she makes. The second constraint is the subsistence constraint:

$$I \geq \underline{C} + R + TC \quad (3)$$

Where \underline{C} is the subsistence level for total expenditure on consumption by the migrant and the other variables remain as previously defined. This subsistence level of consumption may be a

subsistence level of consumption in which consumption below this threshold would not sustain life. However, \underline{C} is not restricted to be a subsistence level, it may be a certain level chosen by the migrant before he/she is willing remit. Thus, if I is above \underline{C} and the excess amount will not cover the cost to remit, then the migrant will not remit.

Combining Equations 1, 2, and 3 we can formulate the Lagrangian as follows:

$$\mathcal{L} = C^\alpha R^\beta + \lambda_1 (I - C - R) + \lambda_2 (I - \underline{C} - R - TC) \quad (4)$$

Where the Kuhn-Tucker conditions equal:

$$\mathcal{L}_C = \alpha C^{\alpha-1} R^\beta - \lambda_1 = 0$$

$$\mathcal{L}_R = \beta C^\alpha R^{\beta-1} - \lambda_1 - \lambda_2 \leq 0$$

$$\mathcal{L}_{\lambda_1} = I - C - R = 0$$

$$\mathcal{L}_{\lambda_2} = I - \underline{C} - R - TC \geq 0$$

where,

$$R \geq 0 \text{ and } R\mathcal{L}_R = 0$$

$$\lambda_1 \geq 0 \text{ and } \lambda_1 (I - C - R - TC) = 0$$

$$\lambda_2 \geq 0 \text{ and } \lambda_2 (I - \underline{C} - R - TC) = 0$$

The main focus of this model is the second constraint which I term the net income constraint. The result then indicates a possible corner solution (remittances equal to zero) if the net income constraint is binding, $\lambda_2 = 0$. Here λ_2 is the shadow price of the net income constraint

and indicates the value of relaxing the net income constraint. From the theory the following general conditions hold for remittances:

$$R \geq 0, \text{ if } \lambda_2 \geq 0 \text{ and } \beta > 0$$

And

$$R = 0, \text{ if } \lambda_2 = 0 \text{ and/or } \beta = 0$$

A brief discussion is necessary here regarding cases where remittances equal zero. I suggest three central explanations for remittances equaling zero. The first is that which has been extensively argued, the net income constraint is binding and therefore all income is used for the migrant's personal consumption. The second reason is that β , the weight of remittances on the utility function, is small enough or equal to zero such that a corner solution exists given the migrant's budget constraint and preferences. For example, a migrant's income may exceed the net income constraint but the migrant does not sufficiently value remittances. The third explanation is that the migrant faces social, cultural, and political barriers to remitting, which are unobserved and are therefore missing variables in the model. As missing variables these factors affect the level of remittances through the error term. An illustration of such is a study by Edward Funkerhouse (1995), where he compares two similar countries and determines that differences in the amount remitted are at least partially affected by political and familial issues. It is intuitive that migrants with the capacity and motivations to remit may be limited by unobserved social, cultural, and/or political deterrents. While these factors may limit remitters from remitting, I am primarily concerned with illuminating net income as a key limiting factor on potential remitters and therefore set aside other limiting factors.

If the constraint is non-binding, $\lambda_2 \geq 0$, then the amount of remittances is determined by the migrant's preferences, the budget constraint, and the transaction costs of remitting. From the Lagrangian, demand equations (Equations 5 and 6) for the optimal level of R and C may be derived such that:

$$R^*(I, Z, X, TC) \quad (5)$$

$$C^*(I, Z, X, TC) \quad (6)$$

X represents an array of socioeconomic independent variables which include: *gender, age, education, number of years in U.S., expected stay, having a bank account, and earnings*. Z is an array representing familial and investment independent variables which include; marital status, spouse in Mexico, number of children in Mexico (CIM), and ownership of land, real estate, and/or a business. These familial explanatory variables are imperative in determining motivations to remit given that remittances may be a necessary financial provision for immediate family members remaining in the home country. A note is warranted about the variable indicating ownership of a bank account. This is a relevant explanatory variable given that having a bank account may facilitate remitting as a formal method of remitting. Similar to Dorantes and Bansak (2006) I find that the variable indicating having a bank account is an endogenous variable and therefore I use instrumental variables to accommodate for this. A more complete discussion of the test for endogeneity and the instrumental variables is provided in the Empirical Analysis section. While X and Z are not directly stated in the Lagrangian function, they can be seen as part of the structure of the utility function through the β weight of R in the utility function.

Logic from the theoretical model and comparative statics, which can be derived from the R^* equation, allow for the following testable hypotheses:

Hypothesis 1: The amount remitted will remain zero with a small increase in earnings for those migrants with a binding net income constraint.

Hypothesis 2: The amount remitted will increase as a migrant's earnings increase given a non-binding income constraint.

The logical reasoning bolstering hypothesis 1 is based on how a small change in income affects the remitting behavior of those constrained by the net income constraint. For these migrants, the difference between current income and the subsistence consumption level is a negative amount. As a result any additional income will be used for additional consumption or to cover the cost of remitting as to satisfy the net income constraint. Since, the concept of a derivative here is the effect on the amount remitted by an infinitesimal change in income. I expect that this small increase in income will not be remitted.

Hypothesis 2 stems from model and behavioral patterns of those that have already surpassed the net income constraint. Consider a hypothetical illustration, where a migrant's income is sufficient for his/her consumption level requirement and cost of remitting. Since, the migrant has already then reached at least a subsistence income level it is plausible that a greater proportion of additional income will be remitted. The relative proportion of remittances compared to income is derived from the utility function where the marginal rate of substitution, in my case, equals 1. However, the migrant's capacity to remit can be deduced given that the migrant has determined a sufficient level of consumption \underline{C} before any amount is remitted. The migrant is able to remit all additional income above the amount of \underline{C} . Despite the necessity of a functional form of the utility function to determine remittances; there is a general aspect of a

utility function that is consistent with this remitting behavior. This aspect is the relative weight (α and β) of C and R on the utility function. R must be equal to or greater in weight than C . When R has a greater weight on the utility function than C and once the net income constraint is satisfied, the migrant will remit all additional income until the marginal rate of substitution equals 1. For example, assume a migrant's income equals \$1,000 per month and this migrant's C equals \$900 per month. Also assume that this migrant values the consumption that his family receives from R greater than his own consumption conditioned upon the net income requirement being met. In this case, the migrant will remit \$100 per month or 10% of his income. Now assume that the migrant earns an additional \$100 in the following month and thus his income is \$1100. The migrant is able to remit up to \$200 in the second month or approximately 18% of his income and therefore in this fashion remittances may increase in proportion to income as income increases.

There are several ways to evince that a positive net income is a requirement for remitting and thus test the stated hypotheses. Perhaps the most thorough and complete confirmation would come from a time series data set with observations of numerous migrant's remittance amounts upon arrival and over several years. Also, the data set would need to contain several socio-economic variables such as income, consumption, age, education, number and type of family members in the home country, etc. From this type of data set one could observe if remittances occurred after some income level was achieved. For example, this could be observed if a migrant remitted nothing until his income increased to a certain level and then remittances continued when the migrant's income was above that level. However, I am not aware of such an extensive data set and thus am limited.

III. Empirical Analysis

The data come from survey questionnaires that were administered by the Pew Hispanic Center.² (PEW) The surveys were conducted at Mexican Consulates in the following U.S. cities: Los Angeles, New York, Chicago, Atlanta, Dallas, Raleigh, and Fresno. The data from the surveys consists of people that were applying for a Matricula Consular. According to the National Conference of State Legislatures website (NCSL), a Matricula Consular card is an identification card issued by the Mexican government to Mexican citizens residing abroad. One is obtained by applying in person and providing certain forms of identification such as a: birth certificate, government-issued photo identification, etc. to prove Mexican nationality (NCSL).

The dependent and explanatory variables are listed and explained in Table 1. Table 2 provides summary statistics for the data used in the statistical analysis. I have also provided summary statistics for all the variables in their separate remittance group level in Tables 3 through 9. The total number of respondents equals 4,836; of these 1,693 observations were sufficiently complete to use in the analysis. Also eliminated were certain observations based upon their marital status response. The responses for marital status were divided into various categories which included single, married, divorced, separated, widowed, and common law marriage. I chose to use only those who responded as single, married, or married by common law. The two responses of “married” and “married by common law” were combined and considered to be married. The reason for not including the other observations of marital responses was due to the nature of the dummy variable for marriage. Divorced and widowed were not included in the not married category because they may have financial obligations similar to those that are married.

² “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.”

There are numerous reasons as to why many respondents only partially completed the survey, such as: time limitations, apathy, privacy concerns, etc. Therefore I acknowledge that this imposes limitations on the findings of the empirical analysis. I do attempt, however, to identify those respondents that appeared to deliberately avoid questions regarding remittances. A total of 36 respondents did not provided information for the amount remitted while providing information for all other variables of interest, excluding the instrumental variables. Because this number is so small I did not further pursue the issue. Table 10 provides summary statistics for the previously mentioned respondents.

The dependent variable in the estimation equation is the amount remitted (R) by the respondent and is an ordinal categorical variable. The following is a more formal description of relationship between R , used in the estimation, and R^* , the latent optimal amount remitted from Equation 5.

R equals...

$$\begin{aligned}
 & 0 \text{ if } R^* = 0 \\
 & 1 \text{ if } 0 < R^* < 100 \\
 & 2 \text{ if } 100 \leq R^* < 200 \\
 & \cdot \\
 & \cdot \\
 & 6 \text{ if } R^* > 500
 \end{aligned}$$

I estimate the parameters using a generalized ordered probit model, which maximizes the likelihood function in equation 7. I use the GOLOGIT2 command in STATA using the P link,

which specifies a probit probability distribution (Williams 2006). The probabilities indicated below follow the pattern described by William Greene (2003).

$$L = \prod \Phi \left(x_i \beta_j \right)^{d_j} \quad (7)$$

Where, i distinguishes the specific observation, j indicates the associated group of the dependent variable and the probabilities equal:

$$\begin{aligned} \text{Prob.}(y = 0 | x_i) &= \Phi(-x_i' \beta_0) \\ \text{Prob.}(y = 1 | x_i) &= \Phi(\mu_1 - x_i' \beta_0) - \Phi(-x_i' \beta_1) \\ &\vdots \\ \text{Prob.}(y = 6 | x_i) &= 1 - \Phi(\mu_5 - x_i' \beta_6) \end{aligned}$$

Where Φ indicates the Standard Normal Cumulative Density.

The benefit of this model over a standard ordered probit model is that one can use the information contained in the ordinal dependent variable without the restriction of parallel regressions for the different categories of the dependent variable. The parallel regression assumption, sometimes referred to as the proportional odds assumption, of an ordered probit model is where all the β_j 's are restricted to be equal across the different categories of the dependent variable. Relaxing this restriction is warranted due to the fact that the explanatory variables may not affect all groups equally. For example, the effect of increasing a migrants income on the amount remitted may not be the same for someone who does not remit at all (group 0) and for someone that remits approximately \$250 per month (group 3). This behavior is consistent with both Hypothesis 1 and 2 from the net income theory, since an increase in

earnings is less likely to change the amount remitted for the migrant with a binding net income constraint.

Another empirical issue is that of the endogeneity of the bank account variable. I use a Wu-Hausman test to test for endogeneity and receive a P-value of .0005 in favor of endogeneity. I predict a variable for having a bank account, *Bank Account (hat)*, using variables indicating the migrant's ability to speak English and if the migrant has a photo identification form from a U.S. government agency. Therefore *Bank Account (hat)* is used in the generalized ordered probit estimation.

IV. Results

I test the individual parameters to identify where the proportional odds assumption is not valid. Wald tests are conducted for the proportional odds assumption for each explanatory variable as well as for the model as a whole. When using the phrase, model as a whole, I am indicating the case where the $\beta_j = \beta_k$ across all the groups for the various dependent variable categories for all independent variables. The test of the proportional odds assumption for the model as a whole is testing if an ordered probit model may be used to estimate the parameters. If the proportional odds assumption holds for all independent variables, then an ordered probit model is sufficient for the estimation procedure. The P-values listed in Table 11 are the results of the Wald tests for each individual explanatory variable such that $\beta_i \neq \beta_j$. The results for the model as a whole have a chi square value of 40.28 and a P-value of .6719. The null hypothesis is that the proportional odds assumption holds. From the results in Table 4, I fail to reject the null for all individual explanatory variables except: *Education, Marital Status, Bank Account (hat)*,

and *Earnings*. Also, I fail to reject the null in the model as a whole. The model as a whole may then be estimated with the restriction of parallel regression lines for all variables.

However, despite the failure to reject the null in the model as a whole, relaxing the proportional odds assumption and allowing the parameters estimates for the variables: *Education*, *Marital status*, *Bank Account (hat)*, and *Earnings* to be unique across the different dependent variable categories will provide a more accurate measurement of the effects of these specific variables. Also, allowing the specific parameter estimates to vary provides insightful economic results and allows me to more fully test my hypotheses about the net income constraint. The model is then estimated using the generalized ordered probit procedure where the proportional odds assumption is relaxed for the previously identified variables. The complete results are presented in Table 12. For comparison, I also estimate the model using ordinary least squares and a standard probit model. The dependent variable in the probit model is 0 if the migrant does not remit and 1 if the migrant remits. The results of these two estimations are in Tables 13 and 14 respectively. It is interesting to note that the signs of all the variables where the proportional odds assumption held and *Education* are the same in the generalized ordered probit estimation and in the regression. For the variables *Marital Status*, *Bank Account (hat)*, and *Earnings*, the signs of the regression estimation where the same as the majority of the signs in the generalized ordered probit estimation.

Hypothesis 1 states that the amount remitted will remain zero with a small increase in earnings for those migrants with a binding net income constraint. In mathematical terms, this equals the derivative of remittances with respect to a change in income being equal to zero. To test this hypothesis I calculate the marginal effects from the generalized ordered probit, which are listed in Table 15. Because I use a probit estimation procedure, the derivative in my case is

defined as the change in the probability of moving to the next category of the amount remitted due to a change in earnings. This marginal effect has a value of -0.0022 and a P-value of .685. This value is not equal to zero according to my hypothesis, however it is smaller in relative magnitude to the marginal effects of earnings in the other dependent variable categories. Also, this marginal effect is not statistically significant and the marginal effects for earnings in all other categories are statistically significant. This difference in statistical significance supports hypothesis 1 that a change in income will not cause non-remitting migrants to remit.

The second hypothesis posits that as a migrant's earnings increase the amount remitted will also increase, given that the migrant is already remitting. As shown in Table 12, those that do not remit (group 0), earnings has the smallest impact on the likelihood of remitting for all categories of the dependent variable. For migrants that remit, earnings have a positive effect and the positive effect is increasing as the amount of remittances increase. Similar empirical results have been found in Stark and Lucas's (Lucas and Stark 1985) results, where four groups of migrant's log wages are presented. In their case, as the migrant's wage group increases the impact of additional income has a larger impact on the amount remitted. The impacts of the log of wage for the three groups of wages are 0.251, 0.472, and 0.732 for the respected three groups. These findings support the stated hypothesis. However, in my case, the coefficients from the ordered probit estimation are not equal to the derivative of the probability of increasing the amount remitted due to a change in income. Therefore, I calculate the marginal effects for those that have a positive amount of remittances as shown in Table 15. The increasing effect of earnings on remittances, seen in the *Earnings* coefficient estimates from the generalized ordered probit estimation, is not as lucid from observation of the marginal effect estimates. Groups 1 and 2 have negative estimates indicating that as earnings increase it is more likely that migrants will

move into categories 1 and 2 than move out of those categories. However, groups 3 through 6 have positive estimates that have a relatively increasing pattern with values equal to 0.0161, 0.0180, 0.0119, and 0.0350 respectively. These results indicate that for groups 3-6, it is more likely that migrants will move in to these groups with an increase in income. This relatively high level of positive net inflow of migrants into group 6 is expected since it is the highest possible level and migrants would not move out of this group to a higher remittance level. Overall the results are not conclusive but strongly indicate that hypothesis 2 is accurate. A note is warranted about the increasing effect of earnings on remittances given this data set. Because the dependent variable is measured in groups of hundreds, so that an increase in remittances will not be recorded in the data until the threshold of the sequential hundred dollar amount is met, it is difficult to actually determine of the amount of increase in remittances due to a change in income. This should not bias the overall results though given the size of the data set.

Although my primary focus in the empirical analysis is testing the hypotheses, other aspects of the results provide insights on motivations to remit. These may support theories based upon altruism and/or self-interest, but I leave this to those interested parties. The parameter estimates *Spouse in Mexico* and *Children in Mexico (CIM)* are positive and statistically significant indicating a positive effect on the likelihood of increasing remittances. These results are consistent with my prior example of a Mexican migrant working in the U.S. and living in poverty-like conditions while supporting those members that remain at home.

The results of the parameter estimates also suggest that owning land and/or real estate increases the probability of those to remit more. This implicitly corroborates that a proportion of the total amount of remittances is used for investment purposes in Mexico, if migrants are purchasing real estate (homes) with the intent of returning. With respect to migration these

results indicate that wage differentials may not be the sole determinant in migration. For example, if it is true that a migrant's remittances are used as investment for a home or real estate then it is logical that a migrant may return home after ample investment to reside in the home. The migrant's decision to return home after ample investment would be determined by other factors and not solely based on the wage differential between the two countries.

As for the other results from the marginal effects, the first three groups seem to be counter intuitive for the variables: *Cim*, *Own land*, *Own real estate*, *Spouse in Mexico*, *Marital status*, and *Gender*. It is not intuitively clear why at group 2 many of the marginal effects change signs. However, the latter groups are more consistent with economic intuition.

V. Conclusion

Modeling the determinants of migrant's remittances must include the motivations to remit along with the capacity to remit. The net income constraint is an essential aspect of properly modeling a migrant's capacity to remit and is supported by economic intuition and the results of my empirical analysis. The statistical strength supported by the economic intuition of the results seems to suggest that the above variables are in fact determinants of remittances, at least for the case of Mexican Migrants. The results also illustrate the usefulness of the generalized ordered probit approach. In this case, the application of the generalized ordered probit model illuminated the different effects of migrant earnings on the level of remitting.

The lack of statistical significance on the marginal effect of earnings in group 0 bolstered the first hypothesis of the derivative of the amount remitted due to a change in earnings being equal to zero. The increasing effect of earnings on the amount remitted, given a migrant remits, supports the theoretical concept of remittances being a portion of net income. Both hypotheses

indicated that indeed a net income constraint for remitting migrants is a reality among migrants. Thus while migrants may be motivated to remit by altruism, self-interest, or some combination of the two, a key determinant of remitting is the capacity to remit.

Figure 1: Graph of World Remittance Amounts since 1970-2004.

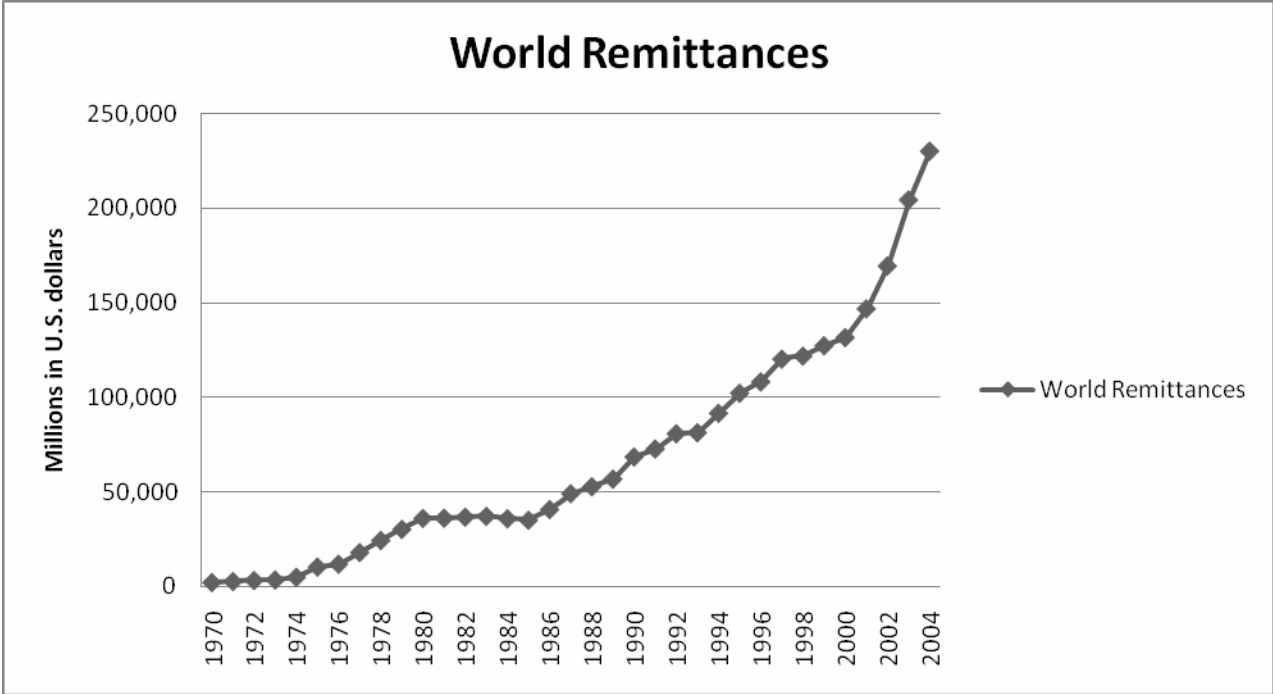


Table 1: List and explanation of all variables.

Variable Name	Description of Variables
Amount remitted (Dependent Variable)	Ordinal categorical dependent variable of monthly amount remitted where 0 indicates no remittances sent, 1 indicates less than \$100, 2 indicates \$100-\$199, 3 indicates \$200-\$299, 4 indicates \$300-\$399, 5 indicates \$400-\$499, and 6 indicates more than \$500.
Gender	Categorical variable of gender where 1 indicates male and 0 otherwise
Marital Status	Categorical variable of marital status where 1 indicates married and 0 otherwise
Spouse in Mexico	Categorical variable of spouses location where 1 indicates living in Mexico and 0 otherwise
Own land, Own real estate, Own business	Categorical variable where 1 indicates ownership of land, real estate, or a business in Mexico respectively and 0 otherwise
Years in U.S.	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.
Education	Indicates the last level of education that was achieved by the respondent. Here 1 indicates not attending or complete school. 2 indicates completion of K-11 but not finishing High School. 3 indicates completion of a secondary education at a Technical School. 4 indicates High School or equivalent graduation. 5 indicates college or more.
Expected Stay	Categorical variable stating intended length of stay in U.S. This variable has several categories where 1 indicates 1-6 months, 2 indicates 6-11 months, 3 indicates 1-2 years, 4 indicates 3-4 years, 5 indicates 6-10 years, 6 indicates more than 10 years, 7 indicates as long as one can or able, 8 indicates all ones life
Earnings	Categorical variable stating the amount the migrant makes per week. This variable has several categories where 1 indicates \$1-\$100 per week, 2 indicates \$101-\$199 per week, 3 indicates \$200-\$299 per week, 4 indicates \$300-\$399 per week, 5 indicates \$400-\$499 per week, 6 indicates more than \$500 per week
Bank Account (hat)	This is the predicted value of having a bank account from the instrumental variables. The variable equals a value between 0 and 1 that indicates the likelihood of having a bank account.
CIM	Variable stating the number of the migrant's children that remain in Mexico. This variable was constructed by subtracting the number of children in the U.S. from the total number of children.

Table 2: Summary statistics of all variables (N = 1693)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	2.4991	1.6601	0	6
<i>Gender</i>	0.6533	0.4761	0	1
<i>Age</i>	33.8972	8.9524	18	73
<i>Education</i>	2.9380	0.9143	1	5
<i>Marital Status</i>	0.8411	0.3657	0	1
<i>Spouse in Mexico</i>	0.1778	0.3824	0	1
<i>Own land</i>	0.1630	0.3695	0	1
<i>Own real estate</i>	0.3148	0.4646	0	1
<i>Own Business</i>	0.0219	0.1463	0	1
<i>Yrs. In U.S.</i>	2.3095	1.2106	1	4
<i>Expected stay</i>	5.9817	2.0204	1	8
<i>Earnings</i>	3.7366	1.3043	0	6
<i>Bank Account (hat)</i>	0.3629	.2387	.0513	.9596
<i>Cim</i>	0.6923	1.2634	0	6

Table 3: Summary statistics for Remittance Amount Group 0 (N = 177)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	0	0	0	0
<i>Gender</i>	0.4746	0.5008	0	1
<i>Age</i>	33.2316	10.1527	18	65
<i>Education</i>	3.2486	1.0087	1	5
<i>Marital Status</i>	0.7627	0.4266	0	1
<i>Spouse in Mexico</i>	0.0282	0.1662	0	1
<i>Own land</i>	0.0847	0.2793	0	1
<i>Own real estate</i>	0.1921	0.3951	0	1
<i>Own Business</i>	0	0	0	0
<i>Yrs. In U.S.</i>	2.7740	1.1205	1	4
<i>Expected stay</i>	6.9379	1.3987	1	8
<i>Earnings</i>	3.8079	1.4838	0	6
<i>Bank Account (hat)</i>	0.4581	0.2457	0.0513	0.9596
<i>Cim</i>	0.1864	0.7025	0	6

Table 4: Summary statistics for Remittance Amount Group 1 (N = 266)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	1	0	1	1
<i>Gender</i>	0.5000	0.5009	0	1
<i>Age</i>	33.4098	8.8544	18	73
<i>Education</i>	2.7632	0.8334	1	5
<i>Marital Status</i>	0.8045	0.3973	0	1
<i>Spouse in Mexico</i>	0.1015	0.3026	0	1
<i>Own land</i>	0.0902	0.2870	0	1
<i>Own real estate</i>	0.1992	0.4002	0	1
<i>Own Business</i>	.0301	.1711	0	1
<i>Yrs. In U.S.</i>	2.2331	1.2217	1	4
<i>Expected stay</i>	6.1090	1.8912	1	8
<i>Earnings</i>	3.2105	1.2442	1	6
<i>Bank Account (hat)</i>	0.3124	0.2297	0.0513	0.9526
<i>Cim</i>	0.4135	.9991	0	6

Table 5: Summary statistics for Remittance Amount Group 2 (N = 566)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	2	0	2	2
<i>Gender</i>	0.6184	0.4862	0	1
<i>Age</i>	33.0318	8.4388	18	62
<i>Education</i>	2.9417	0.9150	1	5
<i>Marital Status</i>	0.8587	0.3487	0	1
<i>Spouse in Mexico</i>	0.1555	0.3627	0	1
<i>Own land</i>	0.1396	0.3469	0	1
<i>Own real estate</i>	0.3057	0.4611	0	1
<i>Own Business</i>	0.0177	.1319	0	1
<i>Yrs. In U.S.</i>	2.2014	1.1667	1	4
<i>Expected stay</i>	6.0035	1.9251	1	8
<i>Earnings</i>	3.4965	1.1925	1	6
<i>Bank Account (hat)</i>	0.3276	0.2321	0.0513	0.9526
<i>Cim</i>	0.6572	1.1999	0	6

Table 6: Summary statistics for Remittance Amount Group 3 (N = 295)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	3	0	3	3
<i>Gender</i>	0.7322	0.4436	0	1
<i>Age</i>	34.2712	8.8387	20	63
<i>Education</i>	2.9220	0.8982	1	5
<i>Marital Status</i>	0.8203	0.3846	0	1
<i>Spouse in Mexico</i>	0.2237	0.4175	0	1
<i>Own land</i>	0.1763	0.3817	0	1
<i>Own real estate</i>	0.3559	0.4796	0	1
<i>Own Business</i>	0.0271	.1627	0	1
<i>Yrs. In U.S.</i>	2.2441	1.2184	1	4
<i>Expected stay</i>	5.8441	2.1212	1	8
<i>Earnings</i>	3.8644	1.2214	1	6
<i>Bank Account (hat)</i>	0.3662	0.2313	0.0513	0.9596
<i>Cim</i>	0.8949	1.4330	0	6

Table 7: Summary statistics for Remittance Amount Group 4 (N = 147)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	4	0	4	4
<i>Gender</i>	0.7823	0.4141	0	1
<i>Age</i>	34.2449	8.5276	18	57
<i>Education</i>	2.9048	0.9015	1	5
<i>Marital Status</i>	0.9048	0.2945	0	1
<i>Spouse in Mexico</i>	0.2925	0.4565	0	1
<i>Own land</i>	0.1973	0.3993	0	1
<i>Own real estate</i>	0.4014	0.4918	0	1
<i>Own Business</i>	0.0272	.1633	0	1
<i>Yrs. In U.S.</i>	2.3129	1.2264	1	4
<i>Expected stay</i>	5.5986	2.1823	1	8
<i>Earnings</i>	4.0816	1.1792	1	6
<i>Bank Account (hat)</i>	0.3945	0.2321	0.0513	0.9526
<i>Cim</i>	1.0340	1.5368	0	6

Table 8: Summary statistics for Remittance Amount Group 5 (N = 92)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	5	0	5	5
<i>Gender</i>	0.8152	0.3902	0	1
<i>Age</i>	35.2391	9.4594	19	60
<i>Education</i>	3.0435	0.9007	2	5
<i>Marital Status</i>	0.8478	0.3612	0	1
<i>Spouse in Mexico</i>	0.2717	0.4473	0	1
<i>Own land</i>	0.2935	0.4579	0	1
<i>Own real estate</i>	0.4239	0.4969	0	1
<i>Own Business</i>	0.0217	.1466	0	1
<i>Yrs. In U.S.</i>	2.2500	1.2807	1	4
<i>Expected stay</i>	5.2826	2.3409	1	8
<i>Earnings</i>	4.0761	1.1974	1	6
<i>Bank Account (hat)</i>	0.3814	0.2446	0.0513	0.9526
<i>Cim</i>	1.0109	1.4411	0	6

Table 9: Summary statistics for Remittance Amount Group 6 (N = 150)

Variable	Mean	Std. Dev.	Min.	Max
<i>Amt remitted</i>	6	0	6	6
<i>Gender</i>	0.8867	0.3181	0	1
<i>Age</i>	36.9133	9.1849	19	60
<i>Education</i>	2.8667	0.9024	1	5
<i>Marital Status</i>	0.9067	0.2919	0	1
<i>Spouse in Mexico</i>	0.3133	0.4654	0	1
<i>Own land</i>	0.3333	0.4730	0	1
<i>Own real estate</i>	0.4667	0.5006	0	1
<i>Own Business</i>	0.0333	.1801	0	1
<i>Yrs. In U.S.</i>	2.4667	1.2621	1	4
<i>Expected stay</i>	5.6200	2.2366	1	8
<i>Earnings</i>	4.6933	1.2367	1	6
<i>Bank Account (hat)</i>	0.4249	0.2399	0.0513	0.9177
<i>Cim</i>	0.9867	1.3708	0	6

Table 10: **Summary Statistics of those who failed to report the amount remitted**
(N = 36)

Variable	Mean	Std. Dev.	Min.	Max
<i>Gender</i>	0.5556	0.5040	0	1
<i>Age</i>	34.8056	10.0735	21	57
<i>Education</i>	2.7500	0.8409	1	4
<i>Marital Status</i>	0.8611	0.3507	0	1
<i>Spouse in Mexico</i>	0.3333	0.9562	0	1
<i>Own land</i>	0.1944	0.4014	0	1
<i>Own real estate</i>	0.4444	0.8433	0	1
<i>Own Business</i>	0.0000	0.0000	0	0
<i>Yrs. In U.S.</i>	2.4722	1.1335	1	4
<i>Expected stay</i>	6.0556	2.1104	1	8
<i>Earnings</i>	3.3889	1.2254	1	6
<i>Cim</i>	0.5556	1.0809	0	3

Table 11: **Test if $\beta_i \neq \beta_j$ or test of proportional odds assumption**

Variable	P-value
Years in US	0.8910
Gender	0.8521
Owens a Business	0.7130
Spouse in Mexico	0.6686
Expected length of stay	0.4424
Owens land	0.3277
Owens real estate	0.2549
Age	0.2645
Children in Mexico	0.1962
Education	0.0468
Marital status	0.0162
Bank Account(hat)	0.0003
Earnings	0.0000

Table 12: **Results of partial parallel lines ordered probit**

Dependent Variable: Amount remitted

Variables with parallel lines restriction is imposed		
Variable	Coefficient	Standard Error
Gender	.2391***	.0627
Age	.0070**	.0034
Spouse in Mexico	.2712***	.0922
Own land	.3489***	.0711
Own real estate	.1648***	.0578
Own business	-.0177	.1765
Years in U.S.	-.0498*	.0280
Expected Stay	-.0476***	.0156
Children in Mexico	.0630**	.0275
Variables without parallel lines restriction imposed		
Note: listed are coefficients for each dependent variable group		
Education		
0 group	-.1177**	0.0463
1 group	-0.0255	0.0382
2 group	-.0740**	0.0364
3 group	-.0710*	0.0407
4 group	-0.0575	0.0463
5 group	-.1342**	0.0539
Marital Status		
0 group	.2692**	0.1096
1 group	.1496*	0.0902
2 group	-0.0852	0.0904
3 group	0.0724	0.1064
4 group	-0.0403	0.1195
5 group	0.0608	0.147
Bank Account (hat)		
0 group	-0.4911**	0.1945
1 group	-0.0992	0.164
2 group	0.4187***	0.1588
3 group	0.4674***	0.1727
4 group	.4171**	0.1907
5 group	0.486**	0.2144
Earnings		
0 group	0.0146	0.036
1 group	.1108***	0.0302
2 group	.2105***	0.0293
3 group	.2314***	0.032
4 group	.2458***	0.036
5 group	.3072***	0.0407

Cont. from table 12

Constants for individual groups		
0 group constant	1.4414***	0.2125
1 group constant	0.0753	0.1963
2 group constant	-1.1139***	0.1974
3 group constant	-1.9212***	0.2159
4 group constant	-2.2760***	0.2343
5 group constant	-2.7581***	0.2715

* indicates significant at the 10 % significance level
 * * indicates significant at the 5 % significance level
 *** indicates significant at the 1% significance level

Table 13: Results of Ordinary Least Squares Regression.

Variable	Coefficient	Standard Error
Constant	1.3730***	0.2523
Spouse in Mexico	0.4069***	0.1334
Owens a Business	-0.0775	0.2571
Gender	0.3040***	0.0909
Years in US	-0.0734*	0.0406
Owens real estate	0.2553***	0.084
Expected length of stay	-0.0705***	0.0226
Owens land	0.5795***	0.103
Children in Mexico	0.0734*	0.0399
Age	0.0119**	0.005
Education	-0.1012**	0.0428
Marital status	0.0801	0.1043
Bank Account (hat)	0.2639	0.1926
Earnings	0.2553***	0.0341

* indicates significant at the 10 % significance level
 * * indicates significant at the 5 % significance level
 *** indicates significant at the 1% significance level

Table 14: **Results of Probit Regression.**

Variable	Coefficient	Standard Error
Constant	2.0662***	0.3212
Spouse in Mexico	0.4046*	0.2301
Owens a Business	-----	-----
Gender	.2717***	0.1027
Years in US	-.1022**	0.0496
Owens real estate	.2234**	0.1086
Expected length of stay	-.0742**	0.0327
Owens land	.2735*	0.1429
Children in Mexico	0.0652	0.0629
Age	0.0059	0.0059
Education	-.1831***	0.0502
Marital status	0.244**	0.1126
Bank Account (hat)	-.4565**	0.224
Earnings	-0.0194	0.0392

* indicates significant at the 10 % significance level

* * indicates significant at the 5 % significance level

*** indicates significant at the 1% significance level

Table 15: Marginal Effects for each of the dependent variable category groups and independent variables.

Variable	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Gender	-0.0382***	-0.0384***	-0.0142***	0.0259***	0.0212***	0.0178***	0.0258***
Age	-0.0011**	-0.0011**	-0.0005**	0.0007**	0.0006**	0.0005**	0.0008**
Education	0.0178**	-0.0099	0.0205	-0.0086	-0.0089	0.0043	-0.0153**
Marital Status	-0.0463**	-0.0022	0.0814**	-0.0529*	0.0277	-0.0145	0.0067
Spouse in Mexico	-0.0364***	-0.0430***	-0.0266**	0.0247***	0.0240***	0.0218***	0.0354**
Own land	-0.0449***	-0.0548***	-0.0372***	0.0300***	0.0306***	0.0285***	0.0478***
Own real estate	-0.0239***	-0.0265***	-0.0134**	0.0165***	0.0147***	0.0129***	0.0197***
Own Business	0.0027	0.0029	0.0012	-0.0019	-0.0016	-0.0014	-0.0020
Yrs. In U.S.	0.0075*	0.0080*	0.0036*	-0.0052*	-0.0045*	-0.0038*	-0.0057*
Expected stay	0.0072***	0.0077***	0.0034***	-0.0050***	-0.0043***	-0.0036***	-0.0054***
Earnings	-0.0022	-0.0325***	-0.0463***	0.0161*	0.0180***	0.0119***	0.0350***
Bank Account (hat)	0.0744**	-0.0434	-0.1920***	0.0301	0.0514	0.0242	0.0553**
Children in Mexico	-0.0095**	-0.0102**	-0.0045**	0.0066**	0.0056**	0.0048**	0.0072**

* indicates significant at the 10 % significance level

** indicates significant at the 5 % significance level

*** indicates significant at the 1% significance level

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