Remittance Frequency, Transactions Fees and Household Impacts

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Remittance Regularity and Household Impacts

Abstract

The usage and impact of remittances on rural development is a key research topic in the migration literature. A rather peculiar observation is that many migrants send money frequently, a method which can be very costly since the majority of transactions involve fixed costs. Most studies revolving around this topic focus on the volume of money that migrants send in a given timeframe, paying less attention to the frequency which the funds are actually sent and the role played by transactions costs. This research proposes a more nuanced approach of examining the impacts of remittances on household behavior by incorporating information on the frequency at which funds are received. It is hypothesized that frequent, regular remittances help households smooth their consumption over time and impact the savings, investment and consumption behavior differently compared to alternative methods. Additionally, remittance patterns driven by specific needs of the household are also likely to respond in heterogeneous ways when faced with changes in transactions costs.

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Motivation and Objectives

i. General Introduction& Motivation

At an estimated 436 billion dollars in 2014 (World Bank, 2015), remittances represent a stream of funds over twice the size of annual aid flows to developing countries. The sheer volume of income transfers is made all the more impressive considering how stable it is relative other forms of trans-regional financial flows such as foreign direct investments (Ratha, 2003). These income flows often perform vital functions for migrant sending households, with the potential for spillover impacts at the local level through remittance sharing and gift giving (Yang &Choi, 2007).

Unfortunately, global remittances are not without costs,on average intermediaries take up 9% of the total amount sent, and transaction costs may run as high as 12.4% for African countries, a region likely most in need of these transfers (A. Aga et al. 2013, World bank 2012). One peculiarity of remittances compared to other forms of financial transfers is their relatively high frequency and small amounts each time, a pattern that may seem puzzling considering that transfer fees tend to be structured as fixed costs, rendering such behavior costly.In an experiment concerning El Salvadorian migrants working in Washington D.C, Yang (2011) finds the frequency of transactions is around 17 times annually, and for a significant portion of migrants, money is sent back home almost bi-weekly. Most money transfer organizations (MTO's) and banks charge a nontrivial fixed fee per each transaction, which is usually held constant over a range of transfer sizes.

Perhaps more interesting then, is that when the said El Salvadorian migrants received a $1 reduction in transaction fees, they opted to increase the frequency of remittances whilst holding amount sent each time constant, resulting in an average increase of $25 in total volume sent. An overwhelming response in terms of number of transactions indicates that the frequency at which money is sent back home has meaning. A better understanding of why migrants remit money in such a frequent (and costly) fashion, along with how they may respond to rising service fees due to recent anti-terrorism/money-laundering policies would help us better understand the role that remittances play in the daily lives of migrant households, and how this resource could better be leveraged for global development.

Broadly speaking most of the current research within the remittance literature has focused on understanding the motivations to remit and subsequent impacts on the households of origin in terms of investment and development. Channels through which migrants send funds, the nature of the remittance flow and how transaction costs may influence their choices of magnitude & frequency have seen less attention. In other words, previous research treated money sent by migrants as a discrete annual event, largely due to data limitations, taking into account only the amount sent over a period of time. This leaves an unfilled gap in the literature, which this paper aims to address, concerning how the nature of the flow is determined and what impacts do different remittance policies have on household welfare & behavior.

It has often been argued that remittances levels are quite steady (Ratha, 2003) lending itself naturally to a consumption smoothing function, as funds intended for consumption are often less volatile (Salomone, 2006). If we were to take the perspective of minimizing costs associated with transferring money, a lumpier approach involving a smaller number of transactions seems optimal; though intuitively, if the recipient household members have trouble/find it costly to smooth their consumption over time due to irregular income flows there exists room for the migrant to shoulder a portion of the burden by providing a steadier stream of funds. The nature of how remittances are sent (hereafter referred to as the remittance policy), can also have differentialimpacts on household members' consumption, savings and investment decisions. Several theories have been proposed to explain high remittance frequencies such as self-control & temptation issues from the migrant side. Though it is almost certain that behavioral mechanisms partially explain this observed phenomenon, this paper seeks to explore the possibility of economic concerns also being part of the story. Deviating from the behavioral aspects, this paper proposes to examine exclusively the economic rationales that may be driving different forms of remittance patterns with implications for development in mind.

This research aims to contribute to a broader understanding of the functions performed by remittances in migrant sending households by carefully examining the channelsandfrequency which money is sent and how transactions costs can have different influences on various modes of remittance.Motivations to better understand why some migrants adopt a costly high frequency policy and subsequent impacts it can have on household behavior can have important implications from both an academic understanding on migration and global policy. Aside from the direct contribution of knowledge regarding remittance flows from a previously unexplored angle; secondary contributions includea better assessment of how migrants help households cope with both unexpected and deterministic/natural changes in income flows over time. Insights into how remittance policies can influence investment, consumption and savings patterns will also help provide a clearer picture as to why migrants remit; and what factors govern their decision across both the intensive and extensive remittance margins,guiding more informed policy in global transfers.

From the policy angle, financial regulations, of which the anti-money laundering & combating the financing of terrorism policies (AML/CFT) being the most important, have created large disparities in access to reliable/cheap remittance tools for certain groups of migrants. Reports have surfaced concerning how increased regulation of transfer operators threaten the existence of certain remittance flows. For instance, US to Somalia remittance transfers were severely hampered following the closing of *al barakat*, a key money transfer firm in 2001 (Vlcek, 2006). For a desperately poor country where transfersaccount for 60% of the average income in migrant families (Orozco &Yansura, 2013), this is no doubt a massive blow to their living standards and may well have long term implications for poverty reduction. While official methods of sending funds still exist, transactions costs are relatively high, especially for migrants who need to send money very often.An increase in the transaction costs of formal remittance channels (money wire services & banks) not only erodes beneficial flows of income to those who need it most, but may drive migrants to utilize informal channels of sending money which are often unreliable and fairly costly themselves.

For many migrant sending households in poor regions of the world, monetary transfers can act as an important lifeline to support daily activities. Empirically, it has been found that remittances are spent mostly on basic subsistence needs ahead of more investment oriented goods (Itzigsohn, 1995), though more recent papers have found investment promoting effects at least under certain conditions (Yang 2008, Dorantes&Pozo 2014). Regardless of how the money is spent, its impacts on poverty alleviation are unquestionable, cross-country studies have found that remittances have reduced the share of poor in their destination significantly (Page & Adams, 2003).Thus careful consideration of how future policies such as the AML/CFTmentioned above can adversely impact a flow of funds three times the size of global aid becomes of first order importance.

ii. Why might the remittance policy matter?

A higher frequency remittance policy could perform valuable consumption smoothing services, as it reduces the need for household members to adopt costly strategies to smooth their own income flows. This function becomes especially important if the migrant sending household is constrained by imperfect credit markets, has inherently uneven income flows, lacks access to a good savings mechanism, or is vulnerable and lives close to a subsistence level of consumption. Within this setting, money received on a steady basis helps provide assistance in smoothing out resources temporally, and could also directlysupport a minimum level of living standard.

In response, members of the household may augment their consumption, savings and investment choices if they anticipate obtaining funds in the future, changing the optimal allocation of their own resources over time. If the stream of funds is perceived as “safe” by the household, it can have the added benefit of encouraging more risk taking, improving the household’s welfare over the longer run.

However, if the main goal is to induce investment by the household, under most scenarios the migrant’s best choice would likely be to adopt a lumpier remittance path, or formulate remittances as an *ex post* insurance policy. An agreement that migrants will compensate rural households if they suffer a loss induces households to take on more risky investments by reducing the downside risk they are exposed to, augmenting the risk and return relationship that the household faces and promoting investment by the household. Empirical evidence has shown that somemigrants do indeed insure household members.Leveraging rainfall shocks, Yang & Choi (2005) show that remittance levels are responsive to shocks experienced by the household, with the authors unable to reject the null of full insurance. It should be noted that formulation of remittances as insurance potentially creates moral hazard problems for the insuring party (the migrant), especially since geographic distance may weaken any form of enforcement/monitoring ability. Additionally, for migrant sending households that are exceedingly poor, providing insurance may also be a sub-optimal choice as such households tend to have low levels of investment and are unwilling to take excessive risk,for them a steadier flow of funds may be more beneficial.

In certain cases investment enhancing effects can be obtained via a large lumpy payment which can help overcome any upfront fixed costs of investments and relieve short term liquidity constraints. Migrant sending households receiving lumpy payments can also utilize the funds for *ex ante* risk reduction by investing in better infrastructure to help mitigate damages fromfutureshocks (Mohapatra et al., 2012). However,in a scenario where access to savings mechanisms are lacking, a lumpier policy fails to address the fundamental issue of costly income smoothing. On a more behavioral level, it can also be argued that a lumpy form of transfer is subject to commitment issues on the side of the household once the funds are sent, as the migrant has little control over the allocation. Experimental research altering levels of control over remittance usage for migrants have revealed that some migrants do desire more say in how their money is being spent (Ashraf, 2011).

Assuming then, that migrant household as a whole is able to overcome the commitment and moral hazard issue, which policy is better suited for improving the welfare of the household members will depend heavily on their current wealth level, degree of risk aversion and the nature of their own income flows amongst other things.

iii. How Transactions Costs Factor Into the Story

Currently in the El Salvadorian setting, the cost to transfer under $300 through MTOs is $8.90 flat, and to send under $500 the cost is $9.85 (World Bank, *Remittance Prices Worldwide*). Though seemingly small, these numbers can be misleading as there is wide variation in the size and frequency at which migrants utilize MTO/bank services, those who send smaller amounts more often can incur much heavier total fees.

In spite of recent developmentsinvolving financial organizationswhich facilitating income transfers, both formal and informal channels of income transfers still come with substantial costs. Despite the overall decline in service fees, partly due to increased competition (World Bank, 2012), implementation of the AML/CFT policies since the events of 9/11 have reduces the number and accessibility of banking services crucial to global remittance flows for roughly half of all emerging countries, some to prohibitive levels. Though alternative channels through formal banking institutions sometimes exist, such methods are often much more costly.

A large number of methods are deployed in transferring funds between migrants and their family members. Common channels chosen are money transfer operators (MTO's) such as Western Union, bank/ATM wire transfers, corridor specific transfer firms (as in the case of *al barakat*), informal channels (sometimes in person transfers) and more recently, mobile transfers such as M-Pesa in Africa, or Xoom, a Silicon Valley based online money transfer firm. An overview of how migrants remit show that the composition of remittance channels for different migrant populations varies widely, likely due to large discrepancies in corridor specific costsand availability/compatibility of financial institutions between the two regions. Papers examining the choice of remittance agencies by migrants seem to indicate that there is some evidence of personal payment behavior and habits having an influence, but the stronger impacts come from the remittance amount, personal characteristics of the migrant, costs and convenience (Kosse&Vermuelen, 2014). Of the available corridors, almost all MTO's charge a fixed transactions cost over a range of remittance sizes, with the average proportion charged decreasing in the size of each remittance transaction.

The limited research on transaction fees indicate that any changes in cost play an enormous role in terms of the total amount sent. Utilizing data from the Tongan migration experiment, Gibson et al (2005) estimate the cost-elasticities of remittances and find that it is negative with respect to the fixed cost component. Their results suggest that a unit decrease in remittance costs can translate into a more thanproportional increase in funds transferred.

Changes in transactions costs affect heterogeneous migrant households in different ways. For a given increase in the fixed cost of sending funds, migrants adopting a higher frequency method of sending funds would experience larger increases in transactions costs; prompting them to reduce the number of times they would remit more easily than those who send less often, or stop remitting altogether. Unfortunately as discussed earlier, migrants who send more often could also have households which are heavily reliant on remittances for daily activities. Thus, changes in transactions costs potentially have equity impacts on households of origin. If higher frequency forms of remittances are truly driven by a consumption smoothing, the concern is that upswings in transactions costs cut off the flow of funds for those who arepoor and vulnerable the quickest, leaving them without an important source of income.

Theoretical Model and Simulations

This section develops a stylized 2 period savings, investment and consumption model of an interlinked migrant and his/her migrant sending household (hereafter referred to as the household), with the goal of highlighting the various tradeoffs between remittance policies (high frequency, lumpy and insurance) along with developing testable hypotheses on how household investment, consumption and savings are affected. Migrants, who may or may not be risk averse, obtain a fixed income Y^M in both periods and can continuously allocate some portion of their money each period to the household in order to augment their budget constraint. It is assumed that migrants have access to three forms of remittances: *1.)* a high frequency policy involving sending fixed portions of money each period *2.)*a lumpy policy where money is only sent in a single period and *3.)*formulation of remittances as an *ex post* response to shocks experienced by the household, or the insurance policy.

Migrants can perfectly observe their household members preferences, thus anticipates how their remittance policy will impact decisions made back home. It is initially assumed that the migrant acts out of altruism with no reciprocation in mind. Migrantsthen utilizes information on household responses to choose the option which maximizes theiroverall welfare, or value function.Households have access to a risky investment prospect (start a small business, purchase farm capital etc.) but are characterized by risk aversion and lack access to a good savings mechanism and/or prefect credit markets. At the end of this section, the inferred results are extrapolated to a longer time horizon to help draw inference on remittance patterns and how transactions costs can have differential impacts based on the remittance policy and household needs.

i.The Household

Since solving the model requires the migrant to know how household members respond, it is necessary to first solve the household's maximization problem. In the first period household members obtain a fixed incomeW_0, a portion of which they can use as contemporaneous consumption $C_1$and havethe remainder allocated between a risky investment$I$and a safe savings option S for the second period. To reflect the fact that smoothing consumption is costly in this simple 2 period model, we impose the condition that household savings experience a discount in the second period, (i.e. if a household saves Sin the first period, their total savings in the second period is$\hat{S} \equiv \delta \cdot S$, where $0 < \delta < 1$). Note that this does not necessarily mean a negative rate of returns on savings (but it could be the case); instead this is a general reflection on the fact that the rural household experiences some costs to smooth their own consumption temporally, a fact often observed in studies of households in poor areas of the world.

In the interest of keeping things simple,the risky investment Ihas only two outcomes: *1.)* High payoff with probabilityρ, yielding $\tilde{\theta}^H > 1$ per each dollar allocated in the good outcome and*2.)*alow payoff with probability $1 - \rho$, yielding $0 \leq \tilde{\theta}^L < \delta < 1$ per each dollar allocated into the risky investment if the state of the world is bad in period 2. The safe asset is imperfectly transferred to the next period where they receive only the inter-temporal discount δ. Payoffs materialize in the second period to fund consumption.

Migrants can choose to augment the constraints of the rural household via remittances. Conditional on the specific policies chosen, money sent in the two periods "R_1"& "$R_2, \tilde{R}_2$" can either be predetermined (R_1&R_2) or an *ex post* insurance response to compensate the household for their loss ($\tilde{R}_2(\tilde{\theta})$), depending on the remittance policy the migrant adopts. Here we are assuming that the migrant can effectively follow through with his/her policy regardless of what happens to the state of the world experienced by the rural household. Assuming rural households maximize a Von Neumann-Morgenstern Bernoulli utility function with standard Constant Relative Risk Aversion (CRRA) properties and discount rate "β", we solve the problem below to ascertain their response to remittances.

$MAX_{S,I}\ \ u(C_1) + \beta[\rho \cdot u(C_2^H) + (1-\rho) \cdot u(C_2^L)]$Subject to:

$$\rightarrow C_1 \leq W_0 - S - I + R_1$$

$$\rightarrow C_2^H \leq \delta \cdot S + \tilde{\theta}^H \cdot I + R_2$$

$$\rightarrow C_2^L \leq \delta \cdot S + \tilde{\theta}^L \cdot I + R_2 + \tilde{R}_2(\tilde{\theta})$$

By substituting in and simplifying, we obtain the following first order conditions:

$$\partial L/_{\partial S}:\ -u_1' + \beta \cdot [\rho \cdot u_H' + (1-\rho) \cdot u_L'] \cdot \delta = 0 \qquad \text{(E1)}$$

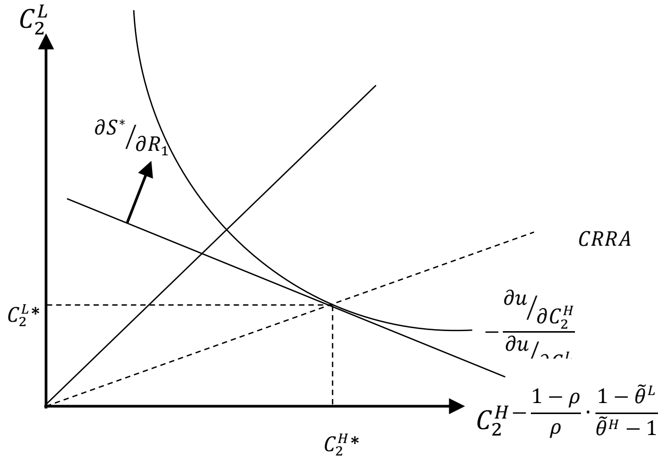
$$\partial L/_{\partial I}:\ -u_1' + \beta \cdot \left[\rho \cdot u_H' \cdot \tilde{\theta}^H + (1-\rho) \cdot u_L' \cdot \tilde{\theta}^L\right] = 0 \text{(E2)}$$

Condition (E1) states that households will choose a savings level that equates the marginal benefits of extra expected consumption in period 2 with the marginal cost of forgone consumption in period 1, taking into account the fact that a cost is leveraged on total savings. As such, their overall savings rate if lower than what it should be had the household been able to smooth their income (consumption) over the two periods without cost (i.e had $\delta = 1$). The optimal savings rate is denoted$S^*(R_1, R_2, W_0, \tilde{R}_2(\tilde{\theta}))$.

First order condition (E2) states that the household will choose to allocate their savings into the risky asset until the marginal risk profile is balanced as if choosing a portfolio scheme. To see this more clearly, we can leverage CRRA preferences and rewrite (E2) to obtain the expression$\frac{u_H'}{u_L'} = \frac{1-\rho}{\rho} \cdot \frac{1-\tilde{\theta}^L}{\tilde{\theta}^H - 1}$yielding the standard portfolio choice results.

Graphically, this is shown in **figure 1**. The amount of savings a household puts into the risky asset$I$ will depend on the properties of the expected utility functions, with higher risk aversion reducing investment levels. With constant relative risk aversion (CRRA) the ray of expansion is a straight line emanating from the origin. It is theoretically possible, under some situations, for a corner solution where the household holds no safe assets $S = 0$ if remittances are formulated as a full insurance policy with the payoff in the bad state of the world still yielding better than certainty savings. To avoid this uninteresting result, we impose the condition that households are not fully insured (i.e. the payoff in the bad state of the world can be improved by holding some of the safe asset). Furthermore, we denote the optimal investment rate as$I^*(R_1, R_2, W_0, \tilde{R}_2(\tilde{\theta}))$.

Figure 1



Migrants seeking to better the welfare of their household will utilize knowledge of the household problem by taking into account their responses to remittances in various periods and forms. It can be shown that the signs on the response functions are as follows (proof in **Appendix A1**):

$$\partial S^* / \partial R_1 > 0$$

$$\partial I^* / \partial R_1 > 0$$

Providing an inflow of cash in the first period induces households to increase both their savings rates and investment. Consumption smoothing preferences lead to spreading out of budgets temporally, it is important to note that as savings increase, the implicit cost of savings goes up as well as $\delta < 1$. This generates the potential for a higher frequency remittance policy to improve upon the situation if the cost to smooth income temporally is high.

$$\partial S^* / \partial R_2 < 0$$

$$\partial I^* / \partial R_2 > 0$$

Intuitively, anticipation of receiving funds later on reduces the need to save but promotes investmentsince savings come with a cost and a steady flow of funds encourages risk taking. Interestingly, the magnitude at which optimal investment rates improve by a dollar increase in R_2 depends heavily on δ, or the inter-temporal discount. The heavier the discount (or smaller the δ), the larger the magnitude of increase in investment since a worse savings alternative encourages households to take on a bit more risk (proof in **Appendix A2**). Mathematically, the condition governing investment response is $\partial E2 / \partial R_2 \cdot \delta - \partial E1 / \partial R_2 \cdot \frac{1}{\delta}$ where *E1* and *E2* are the marginal returns to savings ($E1 \equiv \partial V / \partial S$) and investment ($E2 \equiv \partial V / \partial I$) at the optimum. This expression states that fixed payments in the second period induce households to rebalance the present value of savings with the future value of investment since remittances are considered safe by the household and is combined with savings when making decisions over the two periods.

$$\partial S^* / \partial \tilde{R}_2(\tilde{\theta}) < 0$$

$$\partial I^* / \partial \tilde{R}_2(\tilde{\theta}) > 0$$

Remittances sent as insurance (or at least anticipated insurance) leads household members to reduce savings rates, but increase investment. The savings effect is straightforward as an improved expectation of future resources allows households to consume more in the present through reduction of savings. Investment increases with insuranceas the expected return on the risky asset is effectively elevated, with a reduction in losses should the bad state of the world occur.

The value function of the household problem is the target of interest for the migrant; we express the welfare of the household as a two period maximization problem with the optimal response functions inserted.

$$V^{HH}\left(R_1, R_2, \tilde{R}_2\right)$$

$$= u(W_0 - S^* - I^* + R_1) + \beta[\rho u\left(\delta S^* + \tilde{\theta}^H I^* + R_2\right) + (1-\rho) u(\delta S^* + \tilde{\theta}^L I^* + R_2 + \tilde{R}_2\left(\tilde{\theta}\right))$$

ii. The Migrant Problem

Once the household response functions have been signed we turn our attention to the full problem involving the migrant's decision regarding which remittance policy to adopt. It's assumed that the migrant also exists in two periods, but unlike their household has a relatively stable income (wage income$\overline{Y}$) each period which they can draw upon to fund their own consumption $c_1^m \& c_2^m$, as well as transfer some as remittances to improve the welfare of their household ($R_1, R_2 \& \tilde{R}_2$). Furthermore, the migrant has the capacity to transfer his/her own funds from period 1 to period 2 with no discount. This is aimed to be a stylized reflection of the fact that they may find it easier to save money but still lack access to perfect credit markets and are constrained from borrowing. Assuming that the migrant's utility function incorporates the value function of the household linearly for tractability, their maximization problem can be expressed as:

$$m(c_1^m) + \beta^m m(c_2^m) + \vartheta \cdot V^{HH}(R_1, R_2, \tilde{R}_2)$$

Subject to:

$$c_1^m + S^m + R_1 \leq \overline{Y}$$

$$c_2^m + R_2 + \tilde{R}_2 \leq \overline{Y} + S^m$$

Solving the migrant's problem yields the unsurprising condition:

$${\partial V^{HH}}/{\partial R_1} = {\partial V^{HH}}/{\partial R_2} = {\partial V^{HH}}/{\partial \tilde{R}_2} = m'_{1,2} \text{(E3)}$$

E3 states that at the maximum, the marginal benefit of all three remittances levels needs to be equal; else there is room for improvement. The full expression for the three marginal benefit functions can be found by applying the envelope theorem to the value function with respect to remittance parameters:

$$\partial V^{HH} / \partial R_1 = \ u_1'(W_0 - S^* - I^* + R_1)(1)$$

$$\partial V^{HH} / \partial R_2 = \rho \cdot u_H'\big(\delta S^* + \tilde{\theta}^H I^* + R_2\big) + (1-\rho) \cdot u_L'(\delta S^* + \tilde{\theta}^L I^* + R_2 + \tilde{R}_2)(2)$$

$$\partial V^{HH} / \partial \tilde{R}_2 = (1-\rho) \cdot u_L'(\delta S^* + \tilde{\theta}^L I^* + R_2 + \tilde{R}_2(\tilde{\theta})) \quad (3)$$

The marginal benefit functions are simply the optimized benefit of adding one more unit of wealth through each remittance type. As the response functions themselves ($S^* \& I^*$) are non-linear the marginal benefit equations are as well, it is extremely difficult to derive any useful results without explicit functional forms and restrictive assumptions.

We thus turn to simulation methods to obtain a numerical answer for analysis. In the following subsection, the model is simulated to derive both comparative statics and the full iterative solution (i.e., the solution obtained once the migrant takes household responses into account)

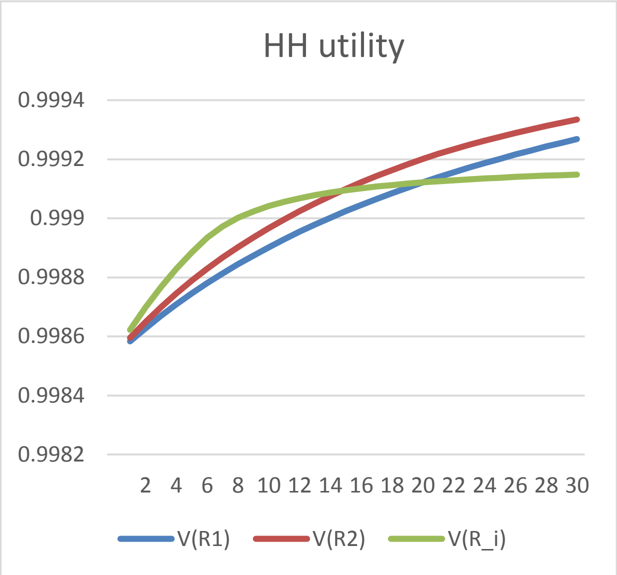
i. Simulating Comparative Statics for the Household Model.

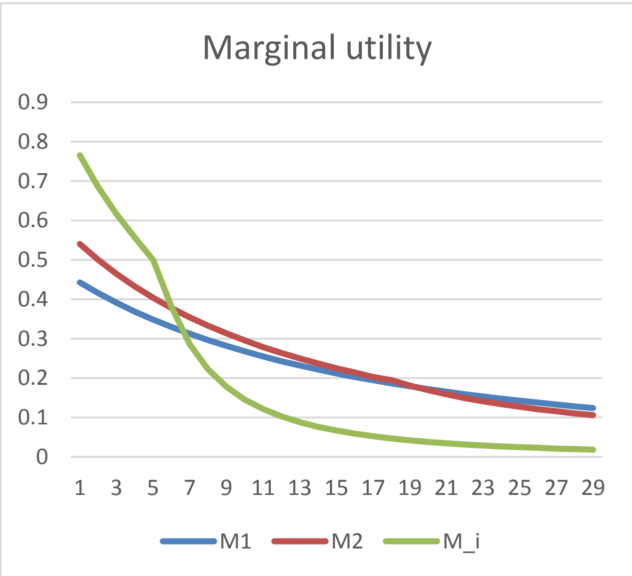
It should be noted that for this sub-section, all results are comparative statics and not the result of migrants choosing an optimal combination of remittance policies. A standard CRRA utility function is utilized for the household to maintain consistency with the theoretical section.

Comparisons between the three remittance policies are conducted via simulating increasing levels for each type of remittance, while holding the other two at 0 to obtain the simulated comparative static results. The resulting recipient household utility, savings and investment levels are graphed to illustrate the static impacts of the three remittance flows. To start with, baseline levels of parameters are as follows:

Baseline parameter levels	
$\tilde{\theta}^H$	2
$\tilde{\theta}^L$	0
ρ	0.6
Risk Aversion	2
δ	0.8
W_0	3000

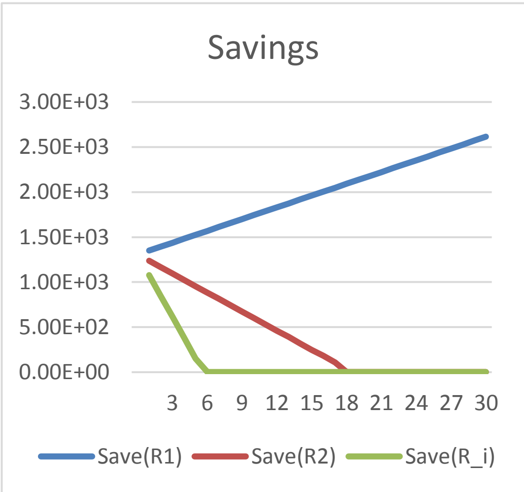
The model is first simulated 30 times for each form of remittance in intervals of 100 dollars, giving us a range between 0% to 100% of the households own wealth in each type of remittance. It should be noted that since the payoff in the insurance policy only triggers in the bad state of the world, for comparison purposes, a compensated model where the same amount is given in expectation (implying the migrant is risk neutral) is computed.

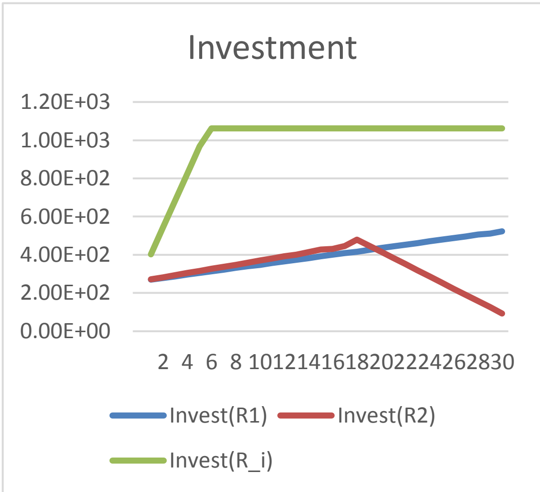




At low levels of transfer, formulating remittances as an insurance policy provides, on the margin, the highest improvement in welfare while the marginal returns to utility for fixed remittances in either period are fairly similar. Intuitively, a promise to send money to the household in response to a shock has an immediate effect of promoting household investment and thereby (expected) welfare. However, the insurance policy doesn't directly alleviate liquidity constraints. At larger higher of transfers, insurance becomes less effective once liquidity constraints start to bind. It's interesting to note that these results are consistent with Amuedo-Dorantes&Pozo's (2006) empirical finding that poorer migrants who have limited funds to send home tend to adopt an *ex post* insurance policy.

While the initial marginal improvements to welfare $MU(\widetilde{R_2})$ are large, without simultaneously alleviating liquidity constraints, the benefits accrued diminishes rapidly. Interestingly enough, if remittance income is very high relative to the income of the household $MU(R_1)$ eventually becomes larger than $MU(R_2)$ due to the recipient household needing funds in the first period to help relax liquidity constraints. This indicates that for a (risk neutral) migrant seeking to improve the welfare of his/her household, the optimal remittance policy depends on how much remittances they would be willing to send relative to the household's income level, as well as how constrained the household is in terms of liquidity. To help illustrate the tradeoff between remittance policies, the savings and investment rates of the three remittance policies are graphed below.

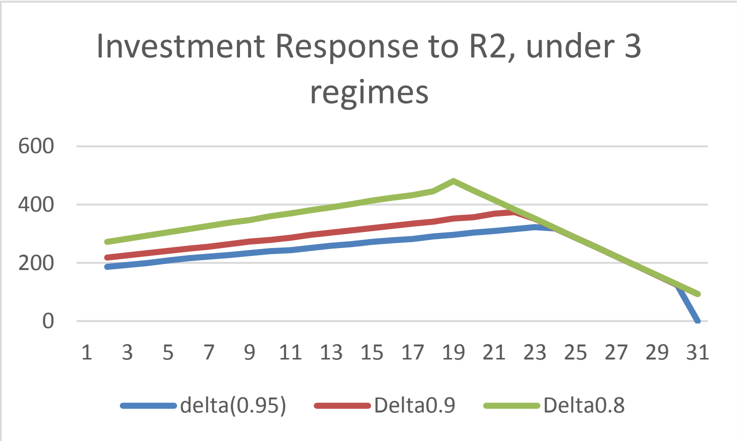




The impact of the three forms of remittances on savings and investment decisions by the household conform to the theoretical comparative statics results up to the point where the simulated households receive enough remittances to forgo savings all together (a situation corresponding to a binding liquidity constraint in the first period). Though the comparison is not exact, a situation when remittances hit the lower bound would correspond to the scenario in condition (4).

Focusing our attention on the domain where savings are still strictly positive, we can see that savings is increasing inR_1, but decreasing in bothR_2&$\widetilde{R_2}$, all three remittance policies encourage more investment, albeit at different rates.

While the investment promoting effects of R_1 vs R_2 are initially comparable, remittances in the second period actually serve to decrease total investment if liquidity constraints are already binding in the first period. Lacking access to credit, households cannot directly alleviate liquidity constraints in the first period once savings levels are zero. The decrease in investment as a response to R_2 happens when the household members begin to draw down investment levels to fund consumption in the initial period. Unsurprisingly, the remittances acting as *ex post* insurance (*R_i*) does the most to increase investment, but also induces the household to quickly drop savings, leading to a lack of liquidity in the first period even faster than promising fixed paymentsR_2.



The rate at which investment responses to R_2 is influenced by δ, or the inter-temporal cost parameter as shown above. A higher discount (Delta=0.8) increases the marginal propensity to invest when given a fixed payment in the second period.

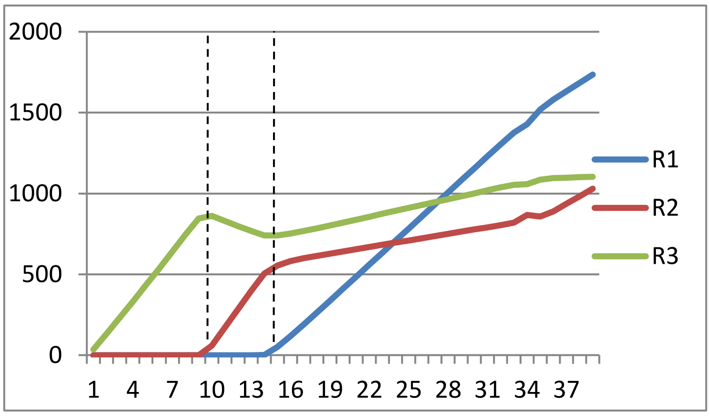
Having illustrated the static results from the household side, we now turn to a fully simulated model in which the migrant is aims to improve the welfare level of the household by considering the household's response when choosing the optimal bundle of remittances.

ii. **Simulating full migrant problem**

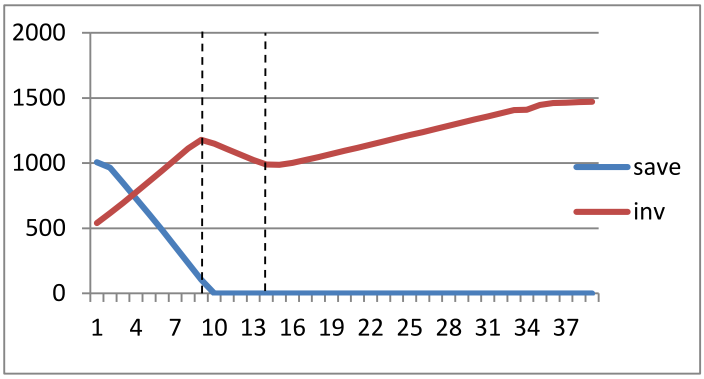
Results from the previous section do not take into account the endogeneity of remittance choices, the optimal remittance policy choice would require the migrant to account for adjustments in behavior at the household level. To obtain a more accurate picture of how household responses to *ex ante* promises of remittance flows in the future would impact the migrant's optimal remittance policy we simulate the full intra-household model (detailed in theoretical section) and provide a range of income levels for the migrant. This method generates the total (migrant + household) welfare maximizing choices for the three remittance policies over a range of income levels of the migrant.

As a baseline case, the standard parameters detailed in the previous section are used for the household, while the migrant is modeled as a CRRA agent whose utility function has the household's value function as an additively separable component. The migrant obtains income in both periods with certainty; the total value of his/her income is simulated over the range $\overline{Y}^m \in [500, 4500]$ in hundred dollar intervals. The intra-household model is iterated until the levels of choice variables converge and the resulting combination of different remittance policies solved.Theinvestment/savings rates of the householdaredisplayed below.

REMITTANCE POLICIES



SAVINGS & INVESTMENT



The above two charts are stacked together to facilitate interpretation, the horizontal axis measures migrant income in hundreds of dollars from 500 to 4500. The optimal composition changes over the relevant range in accordance with the marginal utilities computed in the first simulation section. Initially, the insurance based remittance flow is the only non-zero policy, indicating that for the first few dollars being sent home the largest gains come from providing a degree of insurance. As the migrant's income rises, total remittance levels increase correspondingly (at a fixed ratio due to the additive-separability assumption) and the migrant diversifies the remittance portfolio to first include fixed payments in the second period, followed by fixed payments in the first period.

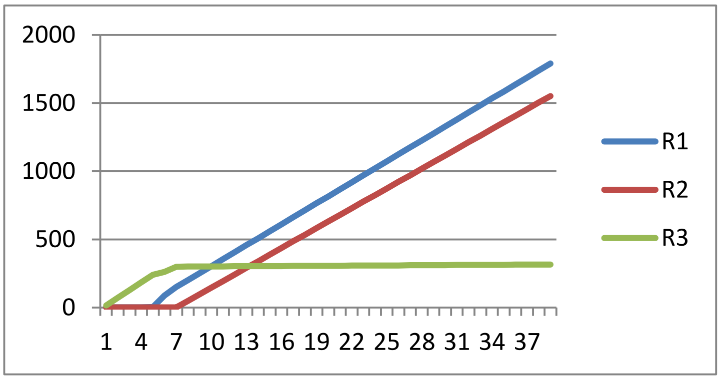
Three distinct regimes are readily visible in the simulated model. In the initial phase, migrants recognize that since they are sending limited funds, it's optimal to provide *ex ante* insurance in case of shocks as this induces the risk averse household to decrease its holdings in the expensive safe asset in favor of the riskier asset which provides a higher expected payout. During this period, full insurance hasyet to be achieved. In the second phase, the household becomes liquidity strapped and unable to further take advantage of any insurance improvements, in response to this challenge migrants provide a fixed payment in the second period (R_2) which effectively acts as external savings. Over this range, investment falls slightly as the household rebalances it's consumption over the time horizon and states of the world, resulting in a small decrease in the amount of remittances allocated to the insurance policy. Finally, as total remittances rise above a certain threshold (corresponding to condition 4 in the theoretical section), it becomes necessary to provide funds in the present (R_1) where remittance flows have the added function of helping balance household consumption in both periods since fixed payments in the first period relax liquidity constraints.

iii. Risk and the optimal policy

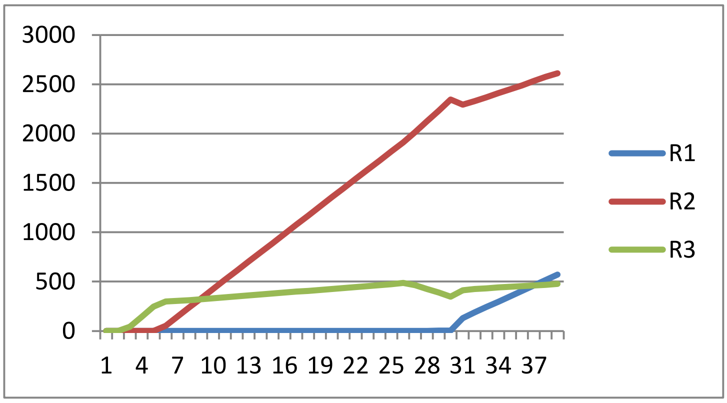
One major implication of the theoretical model was that choices of the optimal policy are sensitive to the degree of risk and inter-temporal smoothing costs faced by the household. To explore this dimension more, we augment the degree of riskiness faced by the household and re-solve the intra household model to obtain optimal remittance patterns under two distinct risk profiles. The two profiles are a mean preserving spread.

Low risk profile		**High Risk profile**	
$\tilde{\theta}^H$	1.2	$\tilde{\theta}^H$	3
$\tilde{\theta}^L$	0.8	$\tilde{\theta}^L$	0
ρ	0.8	ρ	0.373
δ	0.9		

Low Risk Profile



High Risk Profile



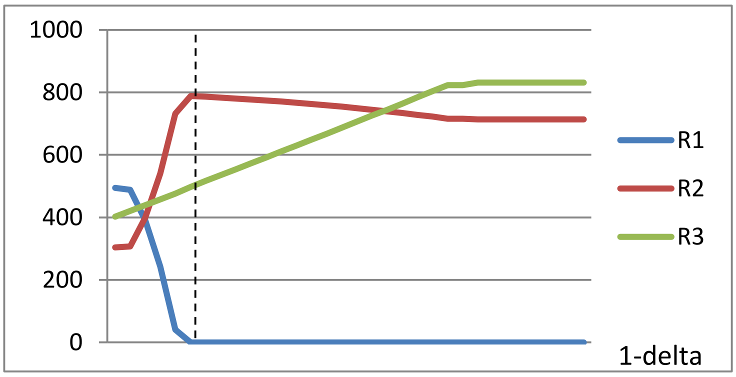
Both models are iterated over the same range ofmigrants' wealth, while holding the households' initial assets at three thousand dollars.

So long as some levels of risk are taken, the optimal policy initially is to allocate remittances to the insurance policy. However, if the household faces a more favorable risk return scenario, fixed payments in the first period become relatively more favorable as this form of payment allows the household to tack on more of the risky asset, while the opposite holds for households faced with more risk. Eventually however, the same liquidity issues discussed earlier materialize and forces the migrant to expand their portfolio to all three forms of remittance flows.

iv. Temporal Smoothing Costs and the Optimal Policy

Another parameter in the model which influences how remittances should be sent is the inter-temporal smoothing cost. To see how costlier consumption smoothing (smaller δ) affects the remittance policy, we again iterate the model, this time over a range of different smoothing costs from zero to twenty percent, with the leftmost point of the horizontal axis starting at zero. Household and Migrant wealth are held constant at three thousand and five thousand respectively.

SMOOTHING COSTS & REMITTANCES



As the cost of transferring income over time increases, the optimal remittance pattern is altered drastically. Initially, without smoothing costs fixed payments in the first period dominate fixed payments later, but rather quickly the pattern is reversed as the marginal benefits of providing funds in the first period are lowered due to increasing costs to transfer them to the future. At a high enough cost ($\delta \approx 0.94$) the first period remittances are shutdown altogether in favor of future funds.

Surprisingly, at higher levels of smoothing costs, the insurance policy actually is favored over the fixed payment as well. This is not due to any direct effects, but rather a secondary wealth effect where high levels of consumption smoothing costs effectively make the household feel poorer.

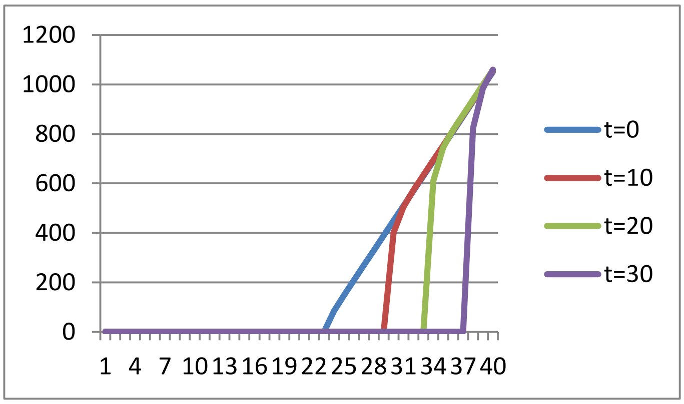
v. Transactions costs and the impact on remittance flows

The last portion of the simulation model is designed to address how changes in transaction costs influence different forms of remittance policies. To do this, wesimulate the model across various levels of migrant income, but perform this simulation over a range of (fixed) transactions costs values.

From the theoretical section, we obtain the result that households who depend heavily on remittances for consumption smoothing are more heavily affected by increases in transactions costs. In the simulation model this would translate to a shutdown of remittances in specific periods (with R_1being one most heavily associated with consumption smoothing) and reductions in the amount sent/probability of sending.

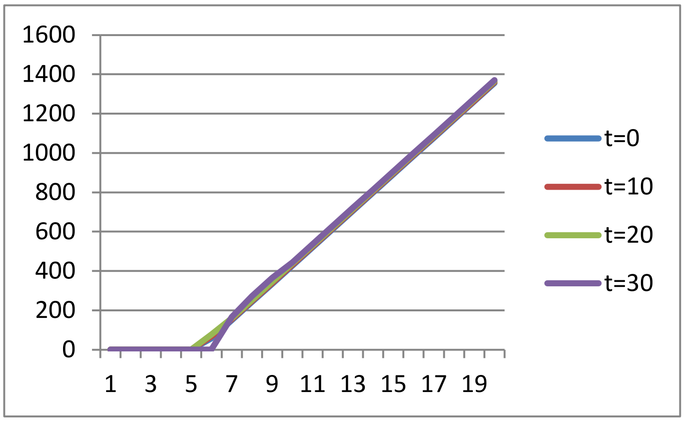
Transactions costs are simulated in for 0, 10, 20&30 dollars per transaction and the resulting optimized policies are displayed below. (Note: it is assumed $R_2 \& \tilde{R}_2$ are sent together, i.e. only one instance of the transactions costs is applied.)

R1 & TRANSACTIONS COSTS 1

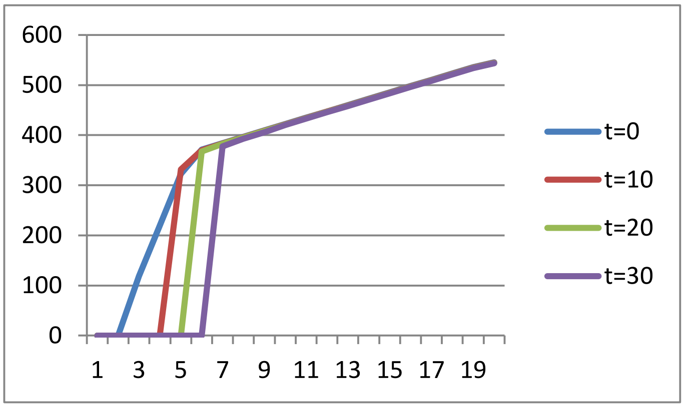


A clear pattern emerges in terms of impacts of transactions costs as remittances in the first period quickly stopping with increasing costs, intuitively more frequent transfers incur a heavier cost leading migrants to abandon the costlier policy.

R2 & TRANSACTIONS COSTS 1



R3 & TRANSACTIONS COSTS 1



While fixed payments in the second period and insurance based remittances are affected less, there is still a sizeable shift in the threshold in which migrants are willing to send money back home. The implications are that relatively small increases in remittance costs have a big impact on a portion of households which lose access to funds altogether.

Having simulated the model to examine the relevant mechanisms at play, we turn to some econometric evidence of consumption smoothing costs and a smoother remittance policy in the empirical section.

Empirical Section

The data set utilized for the purpose of this study comes from the World Bank LSMS panel surveys in Nicaragua in the years 2001 and 2005. The two waves of surveyscontain modules in household characteristics, assets holdings, consumption, income and a detailed section for migration and remittances. Individual data is aggregated to the household level to construct household income and assets measures by summing across individuals.

Since the population of interest for this particular studyis migrant sending households, the empirical analysis will focus solely on those households who reported receiving international remittances in both rounds of the survey. This leaves us with a balanced panel of 180 households over the two waves, representing roughly 15% of the total sample.

Suggestive evidence supporting several hypotheses presented in the theoretical section are presented and discussed below.

i. Frequency and Income Smoothing

One of the implications of the theoretical section was that smooth, high frequency remittance policies can act as a form of income/consumption smoothing strategy if there is some cost to transferring funds temporally. Taking into account the amount of remittances received, the frequency at which migrants are sent money should be determined by the characteristics of the household’s income flow, while the total amount sent depends on the relative wealth between the migrant and his/her family. As such, we would likely expect to see households with a larger proportion of their income from irregular sources receive a higher frequency of remittances as they stand to benefit more from such a policy. Alternatively, household’s whose main source of income pays regularly would like likely see lower frequencies of remittances flows, as it is costly to send money too often. In the context of our dataset, one important determinant of a household’s income flow would be the composition of income sources for households. Namely, families which derive a larger proportion of their income from agricultural sources as opposed to non-agricultural wage work would likely stand to benefit more from a costlier, but smoother remittance path due to agricultural income being inherently more lumpy.

One empirical challenge is that the remittance policy is dictated by the frequency, the amount and also timing of transactions. Unfortunately, the dataset does not contain any information of when remittances were received, but rather just the frequency.

Given this limitation, results from the model should be interpreted carefully as there is no convincing way to identify a remittance transaction as *ex post* insurance or a pre-determined fix payment. Nonetheless, we can employ fixed effects and control for a set of characteristics which may be correlated with the amount of risk households are exposed to.

Another issue preventing us from simply running a naïve OLS regression is the fact that the amount sent is most certainly correlated with the frequency of remittances. In other words, migrant and household characteristics likely determine the amount and frequency of remittances sent simultaneously, with year-on-year changes affecting both. Under such a setting, we choose to jointly estimate a pair of simultaneous models governing both amount and frequency, while also allowing the error term to be correlated for each equation pair with seemingly unrelated regression. Identification of the coefficients relies on two sets of exclusion restrictions extrapolated from the theoretical portion.

The first exclusion restriction pertains to a set of instruments aimed at capturing economic circumstances of the migrant's destination location, which are hypothesized to influence the migrants decision on how much to send, but not necessarily the frequency. Another restriction imposed on the estimation is that the nature of a households income flow (or source of their income, rather) influences the frequency at which remittances are sent back, controlling for the amount sent in each year. Though both can be considered to be somewhat strong assumptions, the exclusion restrictions can be tested by systematically adding each excluded variable into the other equation to test for significance.

The baseline pair of models are as follows:

$$remitamount_{it} = \beta_0 + \beta_1 HH_{it} + \beta_2 Migrant_{it} + \varphi Inst_{it} + \omega Remitfreq_{it} + \gamma_i + \varepsilon_{it} \quad \text{(S1)}$$

$$remitfreq_{it} = \alpha_0 + \alpha_1 HH_{it} + \alpha_2 Migrant_{it} + \emptyset Remitamount_{it} + \mu Incflow_{it} + \omega_i + \epsilon_{it} \text{(S2)}$$

Where S1 is the remittance amount equation, HH_{it} is a vector of household characteristics containing the household size, dependent ratio, income, assets levels and the age & gender of the head of household. The object $Migrant_{it}$ indexes a set of variables controlling for migrant characteristics, as we do not observe migrant income, the variables here aim to control (at least partially) for migrant earnings and welfare, which may influence their adoption of the remittance policy. A set of instruments measuring economic conditions at the migrant destination are included in $Inst_{it}$, where it is posited that these conditions do not directly affect remittance frequency except through decisions in the amount to be sent. As mentioned previously, each instrument was systematically added to the frequency equation (S2) as a test of the exclusion restriction, none of the proposed instruments were significant and as such we proceed to only include them in the amount equation (S1).

The frequency equation S2 contains the same set of controls for household and migrants, but also includes $Incflow_{it}$, a vector of the proportion of incomes from 2 main sources (agriculture, non-agriculture wage work). We would expect a higher proportion of agricultural income to increase the frequency at which remittances are received and vice versa for wage work as a percentage of income. Both models are estimated with household level fixed effects ($\gamma_i \& \omega_i$) through a first difference, and taking into consideration the relatively long span of time across the two survey waves, municipality dummies interacted with survey waves are included to soak up any regional changes over the period (such as banking developments facilitating transfers). The results are presented in **Table1**.

Results from the remittance amount equation S1 indicate that larger households receive more money, households with larger asset holdings and living in rural regions receive less and there is an inverted U relationship between household income and remittance amount. The relationship between household income and remittances is interesting as it may be pointing towards mixed incentives towards remitting money, or it could be the case that the migrant controls are imperfect and fail to fully capture the income of the migrant.

The remittance frequency equation (S2) generally corroborates the theoretical results where a larger proportion in non-agriculture wage income decreases the frequency of which money is received and a larger proportion of agricultural income increases frequency. The dummy for agricultural households however is negative, which could be reflecting the fact that there is less access to remittance operators (western union, moneygram etc.) in locations which are primarily based on agriculture. Since the data is first differenced, the only identification on the dummy variable comes from households switch in/out of agricultural production altogether.

Table1

VARIABLES	Frequency	Amount
HH Size	-0.2	0.1**
	(0.4)	(0.0)
Male Head	-5.4***	0.1
	(2.1)	(0.2)
Age of Head	-0.0	0.0
	(0.1)	(0.0)
Dependent Ratio	-2.0	-0.5
	(4.8)	(0.5)
HH income	-0.0	0.0***
	(0.0)	(0.0)
HH income^2	0.0	-0.0***
	(0.0)	(0.0)
Asset Index	-0.7	-0.1**
	(0.7)	(0.1)
Mig. Education	0.0	-0.0
	(0.2)	(0.0)
Mig. Experience	0.2*	-0.0
	(0.1)	(0.0)
Wage Income Proportion	-16.4**	
	(7.9)	
Agricultural Household	-20.1***	
	(5.9)	
Ag Income Proportion	17.3**	
	(7.3)	
Rural Region	2.7	-0.6**
	(2.7)	(0.3)
Remittance Amount	1.7*	

	(0.9)	
Remittance Frequency		0.0*
		(0.0)
Exchange Rate		0.0
		(0.0)
Var. Exchange Rate		0.1*
		(0.0)
Municipality Trends	Yes	Yes
Household FE	Yes	Yes
Observations	142	142
R-squared	0.5	0.6

Both equations estimated simultaneously through seemingly unrelated regression.
All standard errors are clustered at the municipality level.

Although the results are cursory, there seems to be evidence that household conditions such as income, asset levels and size strongly influence the migrants' decision on how much to send, while the frequency at which funds are sent are driven by factors such as the nature of the household's income. Lumpier forms of income (agricultural income) tends to drive up the frequency, while having a larger proportion of income in non-agricultural wages decreases frequency.

Conclusion

The purpose of sending remittances can be multifaceted. The amount remitted and how it is sent matters when a migrant is considering the best way to support his/her family. In lieu of well performing credit markets or savings mechanisms, high frequency remittances can act as a consumption smoothing income flow for those households that need it. Migrant households that are poor or lack access to cheap methods of consumption smoothing derive larger benefits if the migrant adopts a policy of sending money frequently, even though this remittance path is relatively costly. Fundamentally, there exists a tradeoff between smoother, more frequent remittances and increased transactions costs which may not work in the favor of poorer households. For migrant households requiring help smoothing income, increases in transactions costs can have overwhelming negative welfare impacts, as they are unable/unwilling to change the way remittances are sent, thus paying more in service fees relative to migrant households adopting a "lumpier" policy. Policy makers would do well to carefully consider the impacts of directly or indirectly making remittances more costly, as the negative impacts disproportionately affect the poorer households which receive money more often.

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Appendix

A0. Signing the determinant for the implicit function theorem (note the utility discount rate β is dropped in derivations for the sake of simplicity).

The Hessian matrix is negative definite, with a positive determinant. Using the notation *E1*&*E2* for the two first order conditions, the matrix is as follows:

$$\begin{bmatrix} \partial E1/_{\partial S} & \partial E1/_{\partial I} \\ \partial E2/_{\partial S} & \partial E2/_{\partial I} \end{bmatrix} \text{with:}$$

$$\partial E1/_{\partial S} = u_1'' + [\rho \cdot u_H'' + (1-\rho) \cdot u_L''] \cdot \delta^2$$

$$\partial E1/_{\partial I} = \partial E2/_{\partial S} = u_1'' + [\rho \cdot u_H'' \cdot \tilde{\theta}^H + (1-\rho) \cdot u_L'' \cdot \tilde{\theta}^L] \cdot \delta$$

$$\partial E2/_{\partial I} = u_1'' + [\rho \cdot u_H'' \cdot \tilde{\theta}^{H^2} + (1-\rho) \cdot u_L'' \cdot \tilde{\theta}^{L^2}]$$

Inverting the hessian yields:

$$\frac{1}{|\det|} \begin{bmatrix} \partial E1/_{\partial I} & -\partial E1/_{\partial I} \\ -\partial E2/_{\partial S} & \partial E2/_{\partial S} \end{bmatrix}$$

Where the determinant can be simplified and expressed as:

$$\rho(1-\rho) u_L'' u_H'' \delta^2 (\tilde{\theta}^H - \tilde{\theta}^L)^2 + \rho u_1'' u_H'' (\delta - \tilde{\theta}^H)^2 + (1-\rho) u_1'' u_L'' (\delta - \tilde{\theta}^L)^2 > 0$$

A1-1. Showing $\partial S^*/_{\partial R_1} > 0 \& \partial I^*/_{\partial R_1} > 0$

Applying the implicit function theorem in conjecture with the inverted hessian matrix above provides the expressions:

$$\partial I^*/_{\partial R_1} = \left(-1/_{Det}\right) \cdot [\rho u_H''(\delta - \tilde{\theta}^H) + (1-\rho)u_L''(\delta - \tilde{\theta}^L)] \cdot \delta$$

With the term inside the bracket being less than zero once the optimal portfolio choice $(\frac{u_H'}{u_L'} = \frac{1-\rho}{\rho} \cdot \frac{1-\tilde{\theta}^L}{\tilde{\theta}^H - 1})$ & CRRA preference conditions $(\frac{u_j''}{u_j'} = -\bar{k}/_{c_j}, j \in H, L \quad \& \bar{k} \in constant)$ are applied through proof by contradiction. More generally, any form of risk aversion that induces the household to invest more in the risky asset as wealth increases creates the same qualitative results (to be proven), though the magnitude may not be exact. Similarly, savings effects are:

$$\partial S^*/_{\partial R_1} = \left(-1/_{Det}\right) \cdot [\rho u_H''(\delta - \tilde{\theta}^H)\tilde{\theta}^H + (1-\rho)u_L''(\delta - \tilde{\theta}^L)\tilde{\theta}^L]$$

With the term in square brackets being less than zero once the above two conditions are applied.

A1-2. Showing $\partial S^*/_{\partial R_2} < 0 \& \partial I^*/_{\partial R_2} > 0$

The implicit function theorem gives:

$$\partial S^*/_{\partial R_1} = \left(-1/_{Det}\right) \cdot \left[\rho u_H''(\delta - \tilde{\theta}^H) + (1-\rho)u_L''(\delta - \tilde{\theta}^L)\right] \cdot u_1''$$

Which directly is <0 as the determinant is positive. The expression for investment response is:

$$\partial I^*/_{\partial R_1} = \left(-1/_{Det}\right) \cdot [\rho u_H''(\delta\tilde{\theta}^H - 1) + (1-\rho)u_L''(\delta\tilde{\theta}^L - 1)] \cdot \delta \cdot u_1''$$

The term inside the square brackets can be decomposed as:

${\partial E2}/{\partial R_2} \cdot \delta - {\partial E1}/{\partial R_2} \cdot \frac{1}{\delta}$ Where E1 and E2 are the first order conditions respectively.

Under our assumption of $0 \le \tilde{\theta}^L < \delta < 1$, or the risky investment does not outperform the safe asset in the bad state of the world, the term in square brackets can be expressed as:

$\frac{C_L}{C_H} > \left(\frac{1-\delta\tilde{\theta}^L}{\delta-\tilde{\theta}^L}\right) \cdot \left(\frac{\delta-\tilde{\theta}^H}{\delta\tilde{\theta}^H-1}\right)$Which has the inequality holding in the correct direction if the sign of the term in square brackets is larger than zero.

A1-3. Showing ${\partial S^*}/{\partial \tilde{R}_2(\tilde{\theta})} < 0 \& {\partial I^*}/{\partial \tilde{R}_2(\tilde{\theta})} > 0$

The implicit function theorem gives:

${\partial S^*}/{\partial \tilde{R}_2(\tilde{\theta})} = \left({-1}/{Det}\right) \cdot [(1-\rho) \cdot u_1'' u_L'' \left(\delta - \tilde{\theta}^L\right) + \rho \cdot (1-\rho) \cdot u_H'' u_L'' \tilde{\theta}^H \delta (\tilde{\theta}^H - \tilde{\theta}^L)]$ A term which is less than zero. The investment response function is:

${\partial I^*}/{\partial \tilde{R}_2(\tilde{\theta})} = \left({-1}/{Det}\right) \cdot [(1-\rho) u_1'' u_L'' \left(\tilde{\theta}^L - \delta\right) + \rho(1-\rho) u_H'' u_L'' \left(\tilde{\theta}^L - \tilde{\theta}^H\right)\delta^2]$Which is strictly larger than zero under the assumption $0 \le \tilde{\theta}^L < \delta < 1$.

B0. Full differentiation of marginal benefits

$${\partial V^{HH}}/{\partial R_1} = u_1'\left(1 - {\partial S}/{\partial R_1} - {\partial I}/{\partial R_1}\right) + \beta[\rho u_H'\left(\delta \cdot {\partial S}/{\partial R_1} + \tilde{\theta}^H \cdot {\partial I}/{\partial R_1}\right) + (1-\rho) u_L'\left(\delta \cdot {\partial S}/{\partial R_1} + \tilde{\theta}^L \cdot {\partial I}/{\partial R_1}\right)]$$

(1)

$${\partial V^{HH}}/{\partial R_2} = u_1'\left(-{\partial S}/{\partial R_2} - {\partial I}/{\partial R_2}\right) + \beta[\rho u_H'\left(\delta \cdot {\partial S}/{\partial R_2} + \tilde{\theta}^H \cdot {\partial I}/{\partial R_2} + 1\right) + (1-\rho) u_L'\left(\delta \cdot {\partial S}/{\partial R_2} + \tilde{\theta}^L \cdot {\partial I}/{\partial R_2} + 1\right)]$$

(2)

$$\partial V^{HH} \big/ \partial \tilde{R}_2 = u_1' \left(-\partial S \big/ \partial \tilde{R}_2 - \partial I \big/ \partial \tilde{R}_2\right) + \beta[\rho u_H' \left(\delta \cdot \partial S \big/ \partial \tilde{R}_2 + \tilde{\theta}^H \cdot \partial I \big/ \partial \tilde{R}_2\right)$$
$$+ (1-\rho) u_L' \left(\delta \cdot \partial S \big/ \partial \tilde{R}_2 + \tilde{\theta}^L \cdot \partial I \big/ \partial \tilde{R}_2\right)]$$

B1. Comparing Insurance versus Fixed payments in the second period.

By applying the envelope theorem together with young's theorem over $\partial V^{HH} \big/ \partial R_2$ & $\partial V^{HH} \big/ \partial \tilde{R}_2$, we find that (dropping the star notation for clarity):

$$\frac{\partial (\partial V^{HH} \big/ \partial \tilde{R}_2)}{\partial \delta} = [\rho u_H' + (1-\rho) u_L'] \cdot \ \partial S \big/ \partial \tilde{R}_2$$
$$\frac{\partial \left(\partial V^{HH} \big/ \partial R_2\right)}{\partial \delta} = [\rho u_H' + (1-\rho) u_L'] \cdot \ \partial S \big/ \partial R_2$$

Or the optimized marginal benefits change in proportion to the optimal savings rate response. Thus $\frac{\partial (\partial V^{HH} \big/ \partial \tilde{R}_2)}{\partial \delta} - \frac{\partial \left(\partial V^{HH} \big/ \partial \tilde{R}_2\right)}{\partial \delta} \quad \propto \quad [\partial S \big/ \partial \tilde{R}_2(\tilde{\theta}) - \partial S \big/ \partial R_2]$.

Where $\partial S \big/ \partial \tilde{R}_2(\tilde{\theta}) - \partial S \big/ \partial R_2 = \frac{-1}{|\mathrm{DET}|} \cdot \{\rho u_1'' u_H'' \left(\delta - \tilde{\theta}^H\right) + \rho(1-\rho) u_H'' u_L'' \delta\left[\tilde{\theta}^L\left(\tilde{\theta}^H - 1\right)\right]\}$

The first term in the curly brackets $\rho u_1'' u_H'' \left(\delta - \tilde{\theta}^H\right)$ is less than zero and increasing in δ, the second term $\rho(1-\rho) u_H'' u_L'' \delta\left[\tilde{\theta}^L\left(\tilde{\theta}^H - 1\right)\right]$ is larger than zero and also increasing in δ. Thus as $\delta \downarrow$, or it becomes more costly to transfer income across time periods, the sum of the two parts becomes negative, rendering $\frac{\partial (\partial V^{HH} \big/ \partial \tilde{R}_2)}{\partial \delta} - \frac{\partial \left(\partial V^{HH} \big/ \partial \tilde{R}_2\right)}{\partial \delta} > 0$, or that a fixed transfer payment stands to generate a higher level of welfare on the margin.