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ABSTRACT

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Due to inadequate savings and binding borrowing constraints, income volatility can make households in developing countries particularly susceptible to economic hardship. We examine the role of remittances in either alleviating or increasing household income volatility using Mexican household level data over the 2000 through 2008 period. We correct for reverse causality and endogeneity and find that while income smoothing does not appear to be the main motive for sending remittances in a non-negligible share of households, remittances do indeed smooth household income on average. Other variables surrounding income volatility are also considered and evaluated.

JEL Classification: F22, O15, O54

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I. Introduction

Income volatility is of paramount concern in many developing countries. Lack of reliable social insurance programs, inadequate liquid savings and binding borrowing constraints, particularly among poorer households, often translate into low living standards and poor prospects for escaping poverty. In that context, remittances could prove rather helpful given their potential to stabilize household income. After all, some researchers have noted that remittances appear to respond to and replace income shortfalls for families remaining back home (*e.g.* George R. C. Clarke and Scott Wallsten 2003, Dean Yang and HwaJung Choi 2007). In those instances, in addition to responding to a one-time shock, remittances could help stabilize household income over time. Yet, a review of the literature suggests that income smoothing is not always the motive for sending money home. Remitting takes place for myriad reasons: to contribute toward family businesses, to take advantage of differential expected returns to investments in the home and host communities or to build good-will with the family back home (*e.g.* Catalina Amuedo-Dorantes and Susan Pozo 2006). Furthermore, many migrants simply remit a set fraction of their earnings, regardless of income variation back home. In those instances, remittances could result in more volatile, as opposed to smoother, household income streams in the home country. Such a pattern could increase the exposure to economic hardship of households with inadequate savings and with borrowing constraints –often the case of remittance-receiving households.

In this paper, we seek to learn about the determinants of household income volatility in a developing country, such as Mexico, placing special emphasis on the potential role of remittances in either alleviating or increasing household income volatility.

II. Data

We use data from the 2000 through 2008 harmonized waves of the Mexican *Encuesta Nacional de Ingresos y Gastos de los Hogares* (ENIGH), developed with the purpose of providing information on the size, structure, and distribution of Mexican households' income and expenditures. Unique to the ENIGH, and crucial to the study at hand, is the six-month history of all categories of income receipts required to construct measures of household income volatility.[1] To gauge household income volatility, we compute the standard deviation of the stream of month-to-month percentage changes in income flows.[2] The latter provides us with a summary measure of household income volatility that is scale invariant or unit-less, thus allowing for the comparison of the level of volatility endured by all households regardless of their income levels.[3]

Approximately 6 percent of our sample of 123,233 households reports receiving remittances from abroad during the past six months. Remittances for those households (See Table 1) averaged 10,657 pesos (US$ 178 per month), with 57 percent reporting receiving remittances every month. Income for non-remittance receiving households averaged 43,439 pesos (US$ 724 per month). The corresponding figure (excluding remittances) for remittance-receiving households was 21,581 pesos (US$ 360 per month). Therefore, remittances constitute a significant source of income. Of particular interest to us is the higher volatility of household income (including remittances) of remittance-receiving households in comparison to non-remittance receiv-

[1] Because the ENIGH is implemented during a short two-month period, the six months of reference range from mid March to mid November, excluding Christmas when remittances tend to be higher.

[2] Ideally, one would want to follow these households over extended periods of time to gauge the impact of remittances on household income volatility over the years. Unfortunately, longitudinal data with a detailed month-to-month history of income flows are not available.

[3] Results proved robust to various measures of income volatility, including the coefficient of variation.

ing households (0.46 versus 0.29),[4] which raises the question of whether remittances contribute to greater household income volatility.

To properly answer this question, we would need to compare household income volatility in the presence of remittances Vol(I_t+R_t) to household income volatility *in the absence of* remittance income Vol(I_t^u). Of course, we do not observe I_t^u. Furthermore, we cannot use the observable I_t series from remittance receiving households in place of the unobservable I_t^u because, in the absence of remittances, households may have behaved differently. For example, without the remittance inflows, family members in Mexico may have worked longer hours. Similarly, we cannot use the I_t series of non-remittance receiving households due to differences in the characteristics of remittance-receiving and non-receiving households. Hence, we employ an out-of-sample prediction methodology to predict the volatility of I_t^u.[5] Subsequently, we examine the frequency distribution of the series: [Vol(I_t+R_t) – predicted Vol(I_t^u)] for remittance-receiving households in Figure 1. Households to the right of zero are estimated to experience higher income volatility following the receipt of remittances, whereas households to the left of zero display lower income volatility. The histogram reveals the great diversity in the impact of remittances on household income volatility. Unlike the summary volatility statistics reported earlier, the predicted and actual income volatility figures *pre* and *post* remittance receipt now uncover the suggestion that slightly more than half (54 percent) of remittance-receiving households enjoy lower income volatility following the receipt of these money flows.

[4] The difference is statistically different from zero.

[5] The out-of-sample prediction methodology predicts the volatility of I_t^u using: (a) the estimated coefficients from an equation explaining the volatility of the I_t series for the 115,846 non-recipient households, along with (b) the mean values for the remaining 7,387 remittance-receiving households in our sample of the household level characteristics (shown in Table 2), state and year fixed effects, and state-time trends included in the estimated equation for part (a).

III. Methodology

While informative, the descriptive evidence from above only helps establish correlations between remittances and household income volatility. But it does not inform on the impact of remittances on household income volatility. To that end, we estimate the following model

(1) $$Y_{i=}\ \alpha_0 + \alpha_1 R_i\ + \boldsymbol{X_i \beta} + \boldsymbol{\gamma_s} + \boldsymbol{\delta_t} + \boldsymbol{\gamma_s t} + \boldsymbol{\alpha_2 P_s} + \varepsilon_i \text{ where } \varepsilon_i \sim N(\mu, \sigma^2)$$

where i=1, …, n households. The variable, Y, measures the volatility of total household income, R captures household remittances and the vector $\boldsymbol{X}$ includes various household-level characteristics (mean values reported in Table 1) thought to impact income volatility. A battery of state fixed-effects, year fixed-effects and state-level time trends capture regional and macroeconomic factors affecting household income volatility (such as well-established migration networks in poorer states or economy-wide shocks or business cycles), as well as time-varying economic conditions at the state level ($\mathbf{P_s}$).

Several econometric issues arise in the estimation of equation (1). First, remittances may be endogenous to household income volatility due to reverse causality and omitted variable biases. (The ENIGH lacks information on household level characteristics, such as wealth and migration.) Second, remittance income may be subject to the classical errors-in-variables problem due to the six-month period for which we have information on remittance receipts. To address these concerns, we estimate equation (1) using instrumental variable methods. We instrument for remittance income using information on the unemployment rate and unemployment rate volatility in U.S. states that are the likely destinations of Mexican emigrants. The rationale for our choice of instruments lays on the expectation that unemployment rates and their volatility in U.S. destinations for Mexican emigrants are likely to be highly correlated to their employment prospects and remittance outflows. Common U.S. state destinations for Mexican emigrants are obtained

for each Mexican area in our sample from the Mexican Migration Project database. Weighted U.S. unemployment rates and their volatility series are constructed and used as instruments for the remittance flows received by households in the various Mexican states and survey years included in the analysis. (Details concerning the construction of these instruments are provided in the appendix.) While the two instruments are highly correlated to remittance income, in order to constitute valid instruments, they also need to be uncorrelated to the error term in the main regression. Our identifying assumption is that U.S. labor market conditions over the past six-months do not affect household income volatility experienced by Mexican households over the same time period other than via their remittance inflows. Over-identification tests suggest that the instruments are exogenous. Nevertheless, we foresee some shortcomings in our choice of instruments that we address in our analysis.

First, the instruments may be correlated to unobserved household characteristics possibly impacting income volatility, such as household wealth, a variable that is lacking in the ENIGH. Better-to-do households may have been historically more likely to place migrants in U.S. states with lower unemployment rates and volatility. To address this concern, we include information on the educational attainment and employment of household members (both highly correlated to household wealth) in our least parsimonious model specification.

A second possible threat to the validity of our instruments is that, owing to close ties between the Mexican and U.S. economies, unemployment in destination states in the U.S. may be correlated to Mexican economic conditions impacting Mexican households' income volatility. To address this, we include Mexican state and year fixed-effects, along with Mexican state-level time trends, to account for state-specific characteristics, as well as economy-wide and state-

specific business cycles. In our final specification we include information on the state's manufacturing production to further account for time-varying economic conditions at the state level.

A third concern with our instruments is that they could be related to Mexican migration and, in particular, to return migration at the household level.[6] Specifically, better employment prospects in the U.S. may induce emigration by some household members in Mexico which, in turn, can impact household income volatility. While it is true that employment conditions in the U.S. during the past six-months can induce future emigration of some of our respondents, their *future migration* will not contaminate the *retrospective information* on income flows used to construct our measures of household income volatility. Nevertheless, one may still worry about the possibility of poor employment conditions in the U.S. inducing return migration. The latter could result in incomplete information on retrospective income inflows that, in turn, would affect our income volatility measure. Our data reveal that those events are rare.[7] This is not surprising since our sample ends in 2008 –at the onset of the economic downturn. Furthermore, even during the downturn, the responsiveness of Mexican return migration to economic conditions in the U.S. has been shown to be quite limited, at least in the short-run as would be captured by our data. Poor economic prospects in Mexico, increasing border enforcement and difficulties in re-entering the U.S. seem to be the main causes for that pattern (Jeffrey Passel and D'Vera Cohn 2009).

Summing up, the unemployment rate and unemployment rate volatility in U.S. states that are the likely destinations of Mexican emigrants perform well and can also be considered reasonable instruments for the remittance inflows received by Mexican households.

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[6] Aggregate (return) migration trends are otherwise captured by the state and year fixed-effects and by the state-level time trends.

[7] The ENIGH records the reason for lacking information on income entry, allowing us to identify incomplete income profiles due to return migration –a very small fraction in our dataset.

IV. Results

Estimation results are displayed in Table 2. Because of the arguably endogeneity of some regressors, we estimate three different specifications that sequentially add household level and state level characteristics to better gauge how they impact our estimates. In particular, our first specification only includes information on remittances, state and year fixed-effects, and state-level time trends. We subsequently add household characteristics in specification (2), and information on aggregate state-level manufacturing production in specification (3). An endogeneity test of remittance inflows reveals that, regardless of the specification being used, remittances are endogenous to household income volatility; hence, we instrument for remittances using the monthly weighted U.S state unemployment rate series and its volatility. First-stage regression results are reported at the bottom of Table 2. The joint F-tests reveal that the instruments are highly correlated to remittances.[8] Additionally, over-identification tests indicate that the instruments can be considered exogenous.

What are our key findings? First, remittances seem to reduce household income volatility by a similar amount regardless of the model specification being used. A 5,000 peso increment in remittances over the past six months (an additional USS 83 per month) reduces household income volatility anywhere between 0.32 of a standard deviation in specification (1) and 0.34 of a standard deviation in specification (3). Stronger results are found when we restrict our sample to households more likely to be at risk in the midst of higher income volatility, as would be the case

[8] Higher unemployment rates in the U.S. reduce remittance flows to Mexico, probably because emigrants have less disposable income to share with their kin. Likewise, greater employment uncertainty in the U.S. reduces the flow of remittances to Mexico as migrants find it necessary to instead, build up a stock of saving as a cushion in the event of unemployment spells.

of households who consume all their incomes over the past quarter.[9] Second, the estimates reveal some of the circumstances surrounding higher levels of household income volatility. In particular, female-headed households and larger households appear more prone to experiencing greater income volatility. The same is true of households located in rural areas, typically more exposed to seasonal variations in agriculture production. In contrast, the presence of young children, as well as the educational attainment and employment of household members, are inversely related to household income volatility. This may be due to the extended government programs targeting the well-being of young children (e.g. *Oportunidades*) and the ability of households with more educated or working individuals to weather economic shocks.

V. Summary and Conclusions

Due to inadequate savings and binding borrowing constraints, household income volatility can make households in developing countries particularly susceptible to economic hardship. We uncover some of the circumstances leading to higher household income volatility, such as being a female-headed or larger-sized household, having fewer educated or employed household members, or residing in a rural locality. Households with such characteristics seem to be most vulnerable to income volatility. Yet, remittances appear to have the potential to partially address that problem by stabilizing income flows. Indeed, while income smoothing does not appear to be the main motive for sending remittances in a non-negligible share of households, remittances are found to generally smooth household income. In fact, this is especially true among households unable to save and thus expected to be at greater risk in the midst of higher income volatility. Overall, the findings can prove helpful in anticipating higher income volatility and in design-

[9] For such households, a 5,000 peso increment in remittances over the past six months reduces household income volatility anywhere between 0.6 of a standard deviation in specification (1) to 0.7 of a standard deviation in specification (3).

ing remittance-related policies that may help stabilize the income streams of households at risk in developing economies.

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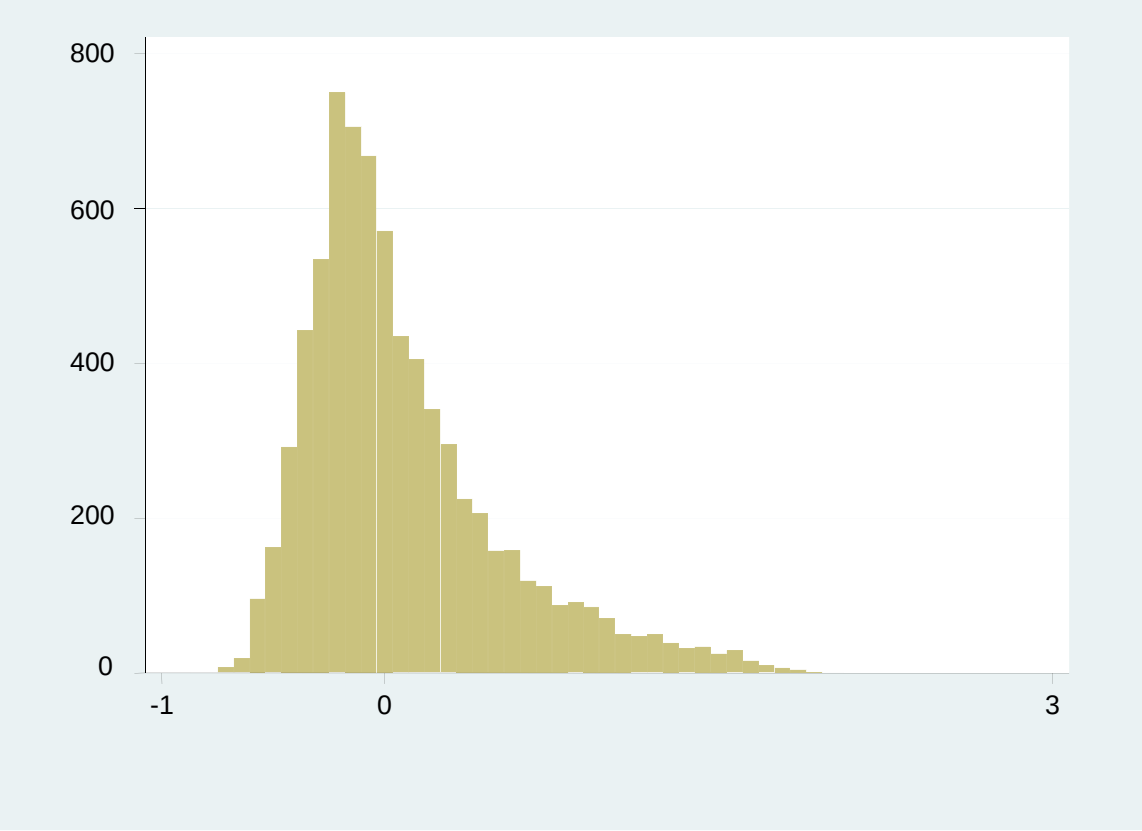
Figure 1

Histogram of Differences in Household Income Volatility Pre and Post Remittance Receipt (Vol[I_t+ R_t] – predicted Vol[I_t^u])



Notes: About 46 percent of remittance-receiving households fall to the right of zero. For them, remittances appear to increase household income volatility. The remaining 54 percent of remittance-receiving households fall to the left of zero, experiencing decreased income volatility following the receipt of remittances.

Table 1
Descriptive Statistics for Remittance-receiving and Non-receiving Households

Variables	HH receives remittances		HH does not receive remittances	
	Mean	**S.D.**	**Mean**	**S.D.**
Volatility in Household Income	0.458	0.465	0.288	0.374
Remittance Income (in 1,000 pesos)	10.657	10.757	0.000	0.000
Non-Remittance Income (in 1000 pesos)	21.581	32.871	43.439	73.449
Female Headed Household	0.421	0.494	0.217	0.412
Number of Young Children (6 and less) in HH	0.628	0.919	0.567	0.840
Number of Elderly Members (65 and up) in HH	0.395	0.664	0.242	0.547
Number in HH with High School and above	0.216	0.585	0.494	0.870
Number of HH Members with Middle School	1.061	1.200	1.270	1.246
Number of Employed HH Members	1.386	1.265	1.725	1.123
Household Size	4.089	2.234	4.068	2.022
Rural Household	0.484	0.500	0.246	0.431
Number of Observations	7387		115846	

Table 2
Two-Stage Least Squares Estimates of the Determinants of Household Income Volatility

Independent Variables	Specification (1)		Specification (2)		Specification (3)	
	Coefficient	**Robust S.E.**	**Coefficient**	**Robust S.E.**	**Coefficient**	**Robust S.E.**
Remittance Income (1000 pesos)	**-0.064****	**0.031**	**-0.067****	**0.029**	**-0.067****	**0.029**
Household Level Variables						
Female Headed Household	-	-	0.067**	0.029	0.062**	0.029
Number of Young Children	-	-	-0.018***	0.002	-0.018***	0.002
Number of Elderly Members	-	-	0.005	0.005	0.005	0.005
Number with HS and Above	-	-	-0.021***	0.001	-0.021***	0.001
Number with Middle School	-	-	-0.013***	0.002	-0.013***	0.002
Number of Employed Members	-	-	-0.044***	0.011	-0.044***	0.011
Household Size	-	-	0.024***	0.004	0.024***	0.004
Rural Household	-	-	0.261***	0.018	0.260***	0.018
State Level Production	-	-	-	-	-1.96e-08	6.35e-08
Observations	123,233		123,233		123,233	
Wald Chi-sq statistic	7,034.99		11,525.41		11,561.93	
Prob > Chi-square	0.000		0.000		0.000	
Endogeneity Test of Remittance Income:						
Durbin-Wu-Hausman Chi-sq (1) st	5.83		6.77		6.75	
P-val	0.016		0.009		0.009	
Over-identification test of all IVs:						
Hansen J-statistic	0.151		0.388		0.339	
Chi-sq (1) P-val	0.697		0.533		0.561	
Independent Variables	**First-stage Results**					
U.S. Unemployment Rate	-8.7	5.6	-9.7*	5.5	-9.9*	5.7
U.S. Unemployment Rate Vol.	-38.1***	11.1	-37.2***	11.0	-37.0***	11.1
Household Level Variables	No		Yes		Yes	
State Level Production	No		No		Yes	
Observations	123,233		123,233		123,233	
Joint Significance of the IVs:						
F-statistic	9.04		9.34		9.35	
Prob > F	0.000		0.000		0.000	

Notes: ***Significant at the 1 percent level or better, **significant at 5 percent level or better and *significant at the 10 percent level or better. The regressions also include a constant, Mexican state dummies, year dummies and Mexican state time trends.

Appendix

To construct the instruments used in our analysis, we obtain information on emigration patterns for each Mexican state in our sample from the Mexican Migration Project (MMP118) database. The MMP118 reveals the U.S. state of residency of interviewed return migrants in various Mexican states. Using that information, we derive weights for the likely U.S. destinations of current Mexican emigrants from each Mexican state. These are used to construct weighted averages of U.S. unemployment for emigrants from each of the Mexican states in the ENIGH during each survey period. For example, about 31 percent of return migrants in the state of Durango resided in California, 28 percent resided in Texas, 26 percent in Illinois and 15 percent elsewhere in the United States. Using this information about emigration patterns, we compute average U.S. unemployment rate for emigrants from Durango in 2000 as follows: $(0.31*\bar{u}_{CA}+0.28*\bar{u}_{TX}+0.26*\bar{u}_{IL}+0.15*\bar{u}_{US})$, where, for instance, $\bar{u}_{CA}$ ($\bar{u}_{US}$) denotes average unemployment rates in California (overall US) from the 2000 CPS Merged Outgoing Rotation Groups (commonly known as the MORG extracts).

To obtain a measure of uncertainty in U.S. unemployment rates in the year 2000, we compute the standard deviation of percentage changes in month-to-month unemployment rates in each U.S. state during 2000. The information on migration networks derived from the MMP118 is then applied to compute a weighted average of the standard deviation of percentage changes in month-to-month U.S. unemployment rates during the year 2000. For example, using the pattern of emigration from the State of Durango to the U.S. we compute the following weighted average of U.S. unemployment uncertainty for emigrants from Durango: $(0.31*S_{CA} + 0.28*S_{TX} + 0.26*S_{IL} + 0.15*S_{US})$ where, for instance, S_{CA} represents the variability of monthly unemployment rates in California during 2000 according to the MORG extracts of the CPS. The weighted average of the volatility series proxies the unemployment uncertainty experienced by emigrants from the state of Durango in 2000.

The described weighted U.S. unemployment and unemployment volatility series are used as instruments for the remittance flows received by households in various Mexican states and survey years.