

The Impact of Remittances on Infant Mortality in Mexico: A Research Design*

Bodin Civilize[†] and Sinaia Urrusti Frenk[‡]

May 2009

1 Introduction

Amongst the many channels through which migration affects sending countries, remittances stand as the most prevalent potential source of development opportunities. Remittance flows are of critical importance for many developing countries' economies. Mexico is no exception: in 2007, remittances accounted for almost 3 percent of Mexico's GDP, surpassing inflows from foreign direct investment and tourism (Reyes, 2008). According to World Bank's estimates (Mohapatra *et al.*, 2008), Mexico is likely to have kept its position as the third largest recipient of remittance flows in 2008 among developing countries.

Remittances can enhance development through numerous mechanisms, some of which are parallel to the effect of any additional income source, such as government transfers. However, international remittances are in many ways different to other income sources. Most importantly, remittance transfers are likely to be less procyclical¹ to Mexico's economy. Moreover, their flows could be assigned to specific uses, such as long-term household investments, health, or education (Conway and Cohen, 1998; López-Cordova and Olmedo, 2007). For these reasons, the study of remittance income deserves attention as a topic in its own right within the development economics literature.

One important mechanism through which remittances can promote economic development is through their effect on health, the main topic of this research.

*This research design was supported by a grant from the Hewlett Foundation and Professor Gustav Ranis. It was prepared to be presented at Yale University's Global Citizenship Workshop in May 2009. We would like to thank Michael Boozer, the Mexican Remittances group formed by Professor Gustav Ranis, and Vidur Chopra for their invaluable contributions to the project's design.

[†]bodin.civilize@yale.edu

[‡]luzmaria.urrustifrenk@yale.edu

¹The literature's findings on this topic are mixed. Some authors have found that remittances are countercyclical (Happe *et al.*, 2003; Ratha, 2003), others that they are acyclical (Kumar and Teele, 2009; Sayan, 2006).

Health improvements might come from many different channels which are difficult to disentangle. The most obvious of such channels is the direct effect of higher health expenditures and improved nutrition. Some other channels such as a reduction in female labor participation, household improvements, better sanitary infrastructure, or higher access to credit, are less direct. We have reasons to believe that remittances are very significant in terms of their impact on health in Mexico. Amuedo-Dorantes and Pozo (2004) find that almost half of remittance senders report health investments as the most important reason for sending remittances. If we include living expenses and food as indirect health-enhancing uses of remittance income, 76 percent of reported remittance-sending motives would be related to health improvements.

The positive effect of remittances could be reduced if households' available income is hurt as a result of high migration costs or a smaller labor force² (see, for instance, Airola, 2008). Dorantes and Pozo (2006) find that remittances might "defray migration related expenses" (Amuedo-Dorantes and Pozo, 2006: 222) and, at the same time, alter households' labor supply. Moreover, the household head's absence can have ripple effects on household dynamics (Acosta, Fajnzylber and López, 2007; Borraz, 2005; Calero *et al.*, 2008; Cox and Ureta, 2003; Hildebrandt and McKenzie, 2007; López, 2004). Migration could cause women to have less support in children's upbringing (see, for instance, Frank, 2005), and household head's migration could induce older children in the household to extend their labor services, leading to lower rates of school enrollment (Acosta *et al.*, 2007; Borraz, 2005; Calero *et al.*, 2008; López-Córdova, 2004).

Hildebrandt and McKenzie (2005), Kanaiupuni and Donato (1999), and López-Córdova (2004) have analyzed the impact of remittances and migration on infant mortality as an indicator of health outcomes in Mexican communities. Other studies, such as Acosta *et al.* (2007), attempt to use anthropometric measures of health for children such as height-for-age and weight-for-age. Regardless of the measure used, most studies have found better health outcomes for children from remittance-receiving households. For instance, Hildebrandt and McKenzie (2005) find that children in migrant households³ have higher birth weights and are more likely to survive their first year of life⁴.

Kanaiupuni and Donato (1999) observed that the effect of migration on health, as on other development outcomes, might be time-dependent and varying at different stages of the migration process. Health might worsen in the

²The labor surplus model (Lewis, 1956; Fei and Ranis, 1975) predicts that a smaller labor force will have no effect on household's income as a result of a smaller labor force because migrant-sending households adjust their work input to compensate for the loss of household workers, maintaining household income constant.

³We refer to migrant households as those that have had a member migrate to a foreign country.

⁴It should be noted, however, that Hildebrandt and McKenzie (2005) also find that migrant households are less likely to adopt preventive health care measures such as breastfeeding and vaccinations.

short-term as a result of migration, but subsequently increase as remittance flows become larger and more stable. In their analysis, they find that infant mortality increases during early stages of the migration process, but gradually decreases as the volume of remittances grows and migration becomes "institutionalized". Their finding of a non-linear relationship between migration and health outcomes highlights the potential impact that remittances have on migrant-sending households. In a macroeconomic-level analysis, Guillaumont, Korachais, and Subervie (2008) provide a similar insight: income (and, with it, remittance) growth has a different impact depending on whether it is stable or not.

2 The Model

Several issues arise when investigating the impact of migration and remittances on development outcomes, including health. Firstly, opportunities in the use of remittance income are not randomly distributed across households (Yang, 2005), causing their effect to vary depending on elements that are difficult to observe. Similarly, exogenous income shocks such as crop failure may induce the decision to migrate which in turn might affect health outcomes (Calero *et al.*, 2008; Hilderbrandt and McKenzie, 2007). In addition to the endogeneity problem and a possible omitted variable bias, estimations could suffer from a reverse causality problem where lower levels of development might influence the motivation to remit (Calero *et al.*, 2008; Dorantes and Pozo, 2006; Hilderbrandt and McKenzie, 2007; López, 2004).

To address these issues, we must instrument for the volume of remittances received. Some studies have exploited historic migration rates and distance from the U.S.-Mexico border as potential instruments of migration and remittance flows, respectively (Acosta, 2006; Acosta *et al.*, 2007; Borraz, 2005; Hanson and Woodruff, 2002; Hilderbrandt and McKenzie, 2005; López-Córdova, 2004; Mansuri, 2006; McKenzie and Rapoport, 2006 (a) and 2006 (b)). Indeed, historical migration rates and distances from the U.S.-Mexico border are correlated with the strength of migrant and social networks, rendering them an arguably appropriate instrument for migration. Nevertheless, they are not an accurate proxy of the volume of remittances because, even if migration prevalence and intensity follow historical patterns, they are not necessarily correlated to the size of remittances.

Amuedo-Dorantes and Pozo (2006) construct an instrument based on an alternative measure - the per capita count of Western Union offices in the state during the previous year - interacted with household members' education levels. Along similar lines, Ponce, Olivie and Onofa (2008) attempt to analyze the

impact of remittances on human development in Ecuador. Their research finds that the probability of receiving remittances varies with the ease with which banks and/or money-transferring agencies can be accessed. Estimates suggest that the presence of an institution which enables the transfer of remittances in the local community, increases the amount of remittances received by U.S. \$ 8 per month. These two studies are important as they set a precedent for the instrument we propose for this study.

The goal of the study is to draw upon and complement previous studies on the impact of remittances on one of many potential development outcomes: infant survival. The model we propose is the following:

$$IM_i = \alpha_i + \beta R_i + X_i' \gamma + \varepsilon_i \quad (1)$$

where IM is a dummy of whether household i had an infant die during the specified year, R is the amount of external remittances received by household i in that year, and X' is a vector of household i 's characteristics that includes household size, floor material, head's educational level, and whether other children are living in the household.

As explained above, the problem with equation (1) is that remittances are not exogenous. In order to infer causality, we must use an instrumental variable approach. We hope to contribute to the literature by incorporating a new instrument for remittances: distance from the household's community to the closest Western Union franchise interacted with household income. The main idea behind this instrument is that the further away a household is to a Western Union franchise, the smaller its remittance inflows will be because the costs associated with the receipt of remittances are higher. Our proposed instrument must satisfy two requirements. First, it must have no partial effect on infant mortality, our dependent variable. Second, it must be correlated with remittance flows but not with the error term in equation (1). Below, we address some potential critiques of our instrument.

One possible criticism is that the community-level distance measure might be correlated with general infrastructure development which in turn is correlated with infant mortality. This omitted variable criticism can be addressed by including health and general infrastructure variables in the exogenous regressor set of the first and second stages. A second potential criticism concerns the identification condition. Given that the distance to the closest Western Union franchise is likely to represent a higher cost to poorer households, we can include the main effects of such distance and income level variables and use their interaction as the excluded instrument. By doing so, the distance to the closest Western Union franchise can be included in the first and second stages as a control variable. This will allow us to test the overidentifying restrictions since we

no longer have to assume that distance to the closest Western Union franchise is excludable.

The regression will be estimated using a 2SLS approach - we are not only interested in empirically describing the correlates of infant mortality, but also the causes of such outcome. The decision to use a linear probability model and not a logit model is that empirically, once we convert logit coefficients into effects on probabilities, they look very similar to the coefficients found with an OLS regression. The advantage of the LPM is that the coefficients are much easier to interpret.

3 Data and Variables

Our approach will be tested using Oportunidades' ENCEL 1998, 1999 and 2000 rural datasets. The sample is not representative at the national level - it pertains to rural households in marginalized communities eligible to receive benefits from the Oportunidades program in seven Mexican states (Guerrero, Hidalgo, Michoacán, Puebla, Querétaro, San Luís Potosí, and Veracruz). In ENCEL 2000 the survey asks whether an infant in the household has died in the last five years. We will use this information to reconstruct infant mortality for each year since 1995. Using ENCEL 1998 and 1999, we will do a cross-section analysis explaining infant mortality in 1999. Our analysis will focus on those households surveyed that have had a member migrate anytime between 1992 and 1999. We do this sample selection because we are interested in comparing migrant households that receive remittances with migrant households that do not.

Table 1 presents the main summary statistics of the variables that will be included in the analysis. We have found several inconsistencies in the data, so our results should only be seen as preliminary. Our sample includes households that have had a member migrate (temporarily or permanently) since 1992. Only 1% of households had an infant die between the first⁵ month and the first year of age. Clearly, the low number of observations do not allow us to estimate the regression presented in section 2 - with 7 out of 700 observations, estimates would not be able to tell us much. Further cleaning of the data must be performed before reaching the regression stage.

⁵We excluded deaths that occurred within the first month of birth.

TABLE 1. SUMMARY STATISTICS

Variable	Mean	Std. Dev.	N
Dummy of infant mortality	0.011	0.103	747
Annual household income	24821.335	64898.756	747
External remittances	3839.059	15774.341	747
Household size	5.534	2.923	646
Dummy for no education	0.357	0.479	703
Dummy for 1-8 years of schooling	0.606	0.489	703
Dummy for 9-14 years of schooling	0.031	0.174	703
Dummy for another child in the household	0.946	0.226	703
Distance to closest Western Union	8.710	6.869	747

However, Table 1 does provide some useful information about our sample. As expected, the annual income of the average household in our sample is much lower than that of the average Mexican household (approximately MXP 24,821 or USD\$1,911 at current exchange rates vs. USD\$9,000 income per capita according to World Bank estimates). Average remittances are recorded in monthly values and they are approximately USD\$296. Educational attainment of individuals in our sample is low relative to the entire population, with about 95% of household heads having completed only their primary education or below. Thus, although these limited data are somewhat informative, to test our hypothesis using the model described above, we need to use the full sample.

We will also include variables of household sanitary conditions, such as whether the household has a paved floor. Moreover, our robustness checks will include municipality level health infrastructure in order to control for the fact that Western Union franchises' proximity might be correlated with general locality infrastructure development and, therefore, with infant mortality outcomes.⁶ This should reduce the omitted variable problem.

Our instrument measures the distance between each household (each locality where the household resides) and its closest Western Union agent. This immediately raises two major methodological issues, namely: (1) how to specify geographical coordinates of each household and Western Union agent, and (2) how to calculate distances between a pair of points on the surface of the Earth. The first problem arises because precise geographical coordinates are not available at such detailed level. For the second issue, a number of geodesic formulas, algorithms, and heuristics exist to deal with the distance calculation, and we need to choose one with an appropriate trade-off between accuracy and computational costs.

⁶The municipality level health infrastructure variables we have available include the number of per capita doctors, nurses, and health centers.

To deal with the first, we take coordinates of each household and Western Union agent at the levels of locality and zip code, respectively. We obtain representative coordinates for each localidad directly from INEGI. Specifically, we rely primarily on two authorities: the Servicio Postal Mexicano (Sepomex) and the U.S. National Geospatial-Intelligence Agency (NGA). The former's data set provides geographical names at various levels associated with each zip code; the latter's allows us to "geocode" those geographical names into latitudes and longitudes. Note that zip codes, and not localities, are used in identifying locations of Western Union agents. The geostatic distances are calculated using Vincenty's formula⁷.

We will also test our results using data from the latest National Demographic Dynamics Survey of 2006 (ENADID 2006) carried out by the National Institute of Statistics, Geography, and Informatics (INEGI), the National Population Council (CONAPO), the Ministry of Health, and the National Institute of Public Health. The ENADID 2006 is representative at the national level and includes rural and urban households from all Mexican states. The advantage of the ENADID 2006 dataset is that it allows us to include mother's health in the regressors set.

4 Hypothesis

The effect of remittances on infant mortality will depend on how households employ remittance income. Using the instrument for remittances presented in this research design, we expect our results to confirm previous findings in the literature: infant mortality will be less prevalent in remittance-receiving migrant households.

⁷We calculate geodesic distances between a given pair of points on the surface of the Earth using Vincenty's formula, as developed in Vincenty (1975) and implemented by Nichols (2007). The Haversine formula, which deals with two points on a sphere, is commonly used in practice due to its computational efficiency. In contrast, Vincenty bases his derivation on a more accurate, ellipsoidal model of the Earth; and by taking into account the Earth's ellipticity, his complicated formula gives a remarkable accuracy of 0.5 mm. One caveat is that the theoretical ellipsoid used in the calculation might differ from the actual shape of the Earth. Also, the calculation assumes "zero elevation" above the ellipsoid, which might make a difference when two points of interest are very close but vary greatly in height. These two caveats, however, are negligible for our purpose. Vincenty's formula has also proven a track record against more advanced, computationally expensive formulas (see, for instance, Thomas and Featherstone, 2005).

References

- [1] Acosta, P. (2006). *Labor supply, school attendance, and remittances from international migration: The case of El Salvador*. World Bank Policy Research Working Paper 3903. Washington, DC.
- [2] Acosta, P., Fajnzylber, P., and López, H. (2007). *The Impact of Remittances on Poverty and Human Capital: Evidence from Latin American Household Surveys*. World Bank Policy Research Working Paper 4247
- [3] Airola, J. (2008). *Labor Supply in Response to Remittance Income: The Case of Mexico*. Journal of Developing Areas, 41(2), 69-78.
- [4] Borraz, F. (2005). *Assessing the Impact of Remittances on Schooling: the Mexican Experience*. Global Economy Journal, 5(1), Art. 9, 1-30.
- [5] Brockerhoff, M. (1994). *The Impact of Rural-Urban Migration on Child Survival*. Health Transition Review, 4, 172-49.
- [6] _____ . (1995). *Child Survival in Big Cities - The Disadvantages of Migrants*. Social Science & Medicine, 40(10), 1371-83.
- [7] Calero, C., Bedi, S. A., and Sparrow, R. (2008). *Remittances, Liquidity Constraints and Human Capital Investments in Ecuador*. Discussion Paper No. 3358. Institute for Social Studies, Netherlands (currently under print in World Development)
- [8] Conway, D. and Cohen, J. (1998). *Consequences of Migration for Mexican Transnational Communities*, Economic Geography, 74(1), 26-44.
- [9] Cox, E. and Ureta, A. (2003). *International migration, remittances and schooling: evidence from El Salvador*. Journal of Development Economics, 72(2), 429-446.
- [10] Donato, K. M., Kanaiaupuni, S. M., Stainback, M. (2001). *The Effects of Migration, Household Income, and Gender on Mexican Child Health*. Madison: University of Wisconsin-Madison, CDE Working Paper No. 2001-10.
- [11] Dorantes, A.C. and Pozo, S. (2006). *Migration, Remittances and Male and Female Employment Patterns*. American Economic Review, 96 (2), 222-226.
- [12] Frank, R. (2005). *International migration and infant health in Mexico*. Journal of Immigrant Health, 7(1), 11-22.
- [13] Guillaumont, P., Korachais, C., and Subervie, J. (2008). *How Macroeconomic Instability Lowers Child Survival*. UNU-WIDER Research Paper 2008/51.
- [14] Hanson, G. and Woodruff, C. (2002). *Emigration and educational attainment in Mexico*. Mimeo, University of California San Diego.

- [15] Happe, N., Hussain, M., Redifer, L. (2003). *Absorbing Shocks*. Finance and Development, 40(4), 24-27.
- [16] Hildebrandt, N. and McKenzie, D. (2005). *The effects of migration on child health in Mexico*. Washington, World Bank Policy Working Paper No. 3573.
- [17] Kanaiaupuni, S. M. and Donato, K. M. (1999). *Migradollars and mortality: The effects of migration on infant survival in Mexico*. Demography, 36(3), 339-353.
- [18] Kumar, A., Teele, D.L. (2009). *A View from Above: Macroeconomic Determinants of Mexican Remittances*. A paper presented at the Global Citizenship Workshop, Yale University.
- [19] Landale, N. S., Gorman, B. K., and Oropesa, R. S. (2006). *Selective migration and infant mortality among Puerto Ricans*. Maternal and Child Health Journal, 10(4), 351-360.
- [20] Lindstrom, D. P. and Muñoz-Franco, E. (2006). *Migration and maternal health services utilization in rural Guatemala*. Social Science & Medicine, 63(3), 706-721.
- [21] Lindtjorn, B., Alemu, T., and Bjorvatn, B. (1993). *Population-Growth, Fertility, Mortality and Migration in Drought Prone Areas in Ethiopia*. Transactions of the Royal Society of Tropical Medicine and Hygiene, 87(1), 24-28.
- [22] López-Córdova, E. (2004). *Globalization, Migration and Development: The Role of Mexican Migrant Remittances*. Working Paper 20. Buenos Aires: Institute for the Integration of Latin America and the Caribbean / Integration, Trade and Hemispheric Issues Division (INTAL/ITD), Inter-American Development Bank.
- [23] López-Córdova, E. and Olmedo, A. (2006). *International Remittances and Development: Existing Evidence, Policies and Recommendations*. Occasional Paper 41. Buenos Aires: Institute for the Integration of Latin America and the Caribbean / Integration, Trade and Hemispheric Issues Division (INTAL/ITD), Inter-American Development Bank.
- [24] _____ (2007). *La migración internacional, la remesas y el desarrollo: una visión general*. Integración y Comercio, No. 27, pp. 1-20.
- [25] Matthews, Z., McDonald, J.W., and Stephenson, R. (2003). *The Impact of Rural-Urban Migration on Under-Two Mortality in India*. Journal of Biosocial Science, 35, 15-31.
- [26] McKenzie, D. and Rapoport, H. (2006(a)), *Migration and education inequality in rural Mexico*, Stanford Center for International Development, Working Paper No. 258.

- [27] _____ (2006(b)). *Can migration reduce educational attainment? Evidence from Mexico*. World Bank Policy Research Working Paper 3952. Washington, DC.
- [28] Mohapatra, S., Ratha, D., and Xu, Z. (2008). *Migration and Development Brief*, World Bank. Available from: http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1110315015165/MD_Brief8.pdf [March 14, 2009].
- [29] Nhacolo, A. Q., Nhalungo, D. A., Sacoor, C. N., Aponte, J. J., Thompson, R., and Alonso, P. (2006). *Levels and trends of demographic indices in southern rural Mozambique: evidence from demographic surveillance in Manhica district*. BMC Public Health, 6.
- [30] Nichols, A. (2007). Vincenty: Stata Module to Calculate Distances on the Earth's Surface. <http://ideas.repec.org/c/boc/bocode/s456815.html>.
- [31] Ponce, J., Olivie, I., and Onofa, M. (2008). *Remittances for Development? A Case Study of the Impact of Remittances on Human Development in Ecuador*. Workshop paper presented at the World Bank's Annual Bank Conference on Development Economics (ABCDE), 2008 at Cape Town, South Africa
- [32] Ratha, D. (2003). "Worker's Remittances: An Important and Stable Source of External Development Finance" in World Bank, *Global Development Finance 2003: Striving for Stability in Development Finance*. Washington, DC: The World Bank.
- [33] Reyes, T. (2008). *La importancia de las Remesas Familiares en la economía mexicana, 1990-2007*. Mexican Congress, Chamber of Deputies. Available from: <http://www.diputados.gob.mx/cedia/sia/se/SE-ISS-06-08.pdf> [March 10, 2009].
- [34] Sayan, S. (2006). *Business Cycles and Workers' Remittances: How Do Migrant Workers Respond to Cyclical Movements of GDP at Home?* IMF Working Paper, International Monetary Fund.
- [35] Singh, K., Karunakara, U., Burnham, G., and Hill, K. (2005). *Using indirect methods to understand the impact of forced migration on long-term under-five mortality*. Journal of Biosocial Science, 37(6), 741-760.
- [36] Thomas, C.M. and W.E. Featherstone (2005). Validation of Vincenty's Formulas for the Geodesic Using a Fourth-Order Extension of Kivioja's Formula. Journal of Surveying Engineering: 131(1), 20-26.
- [37] Vincenty, T. (1975). Direct and inverse solutions of geodesics on the ellipsoid with application of nested equations. Survey Review: 22(176), 88-93.

- [38] Yang, D. (2005). *International Migration, Human Capital, and Entrepreneurship: Evidence from Philippine Migrants' Exchange Rate Shocks*. Mimeo: University of Michigan.