# How Do Remittances Change In Times of Countrywide Crises for Developing Countries

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## I. Introduction

International migrant remittances most likely constitute the primary agent of external financing in developing countries. Remittances to developing countries were recorded as being $466 billion in 2017 according to the World Bank (Ong and Imtiaz, 2009). Developing countries are more vulnerable to crisis pertaining to natural disaster, conflicts and economic downturns (Yang and Choi, 2005). When the country of origin endures an economic downturn, economic crisis, natural disasters or political conflict, remittances rise significantly because workers send more financial funds to aid their friends and families back home (Ratha, 2013). Natural disasters and conflicts act as push factors that have forced millions of people to migrate from the country of origin to the country of destination (Masood and Nijkamp, 2017). The number of vulnerable people who are reliant on outside sources of assistance increases during times of natural disasters and crisis. The funds sent by the migrant workers abroad are used to alleviate vulnerabilities and shortages of resources (Mohapatra, 2012). Our goal of the study is to examine the relationship of remittances and different types of crises both during the year of the crisis and the year after.

## II. Literature Review

Empirical evidence that demonstrates the relationship between remittances and natural disasters in developing countries showed that remittances rise significantly as the country is exposed to natural disasters, conflicts, macroeconomic and financial shocks. Household level panel data for Jamaica was used to conclude that remittances assure households in the face of

exogenous shocks (Clarke and Wallsten, 2003). Countries with a larger emigrant stock as a share of the population of the origin country have a larger flow of incoming remittances during natural disasters. This phenomenon was examined by Mohapatra as he compared remittance flow during and after natural disasters using cross country panel data of developing countries (Mohapatra et al, 2012). Empirical research shows that large portions of the population who reside in conflict-laden areas are reliant upon incoming remittance flows.

Ratha hypothesized that remittances are countercyclical to economic downturns and financial crisis as evidenced in Mexico, Indonesia, and Thailand(Ratha, 2013). In the case of the Mexican financial crisis in the 1990s, the devaluation of the Mexican peso led to a rapid growth in emigration to the United States. (Hollifield et al, 2007). In a similar study by Bucevska, it was hypothesized that cyclicity of the remittances to the business cycle determines the impact of financial crisis on the remittance flow (Bucevska, 2015). Our study aims to add new literature by comparing conflict, natural disaster, and financial crises in a comprehensive analysis rather than individually.

**III. Data**

To examine the relationship between remittances and crises, we use panel data from 76 developing countries over the period of 1990-2017. To gather data on natural disasters and their impact on a specific country, we consulted the Emergency Events Database. For financial crisis we used self-collected data on select countries that was only used in our exploratory analysis. We found no significance and it was removed going forward due to the difficulty of collecting definitive data for 76 countries. The crisis data was gathered from Uppsala University and the Conflict Data Program, an aggregator of organized violence and civil war deaths.

The data on GDP and remittances was gathered from the World Bank over our observed time period. The migration data was compiled from the United Nations Department of Economic and Social Affairs: Population Division. This contained information on migrant stocks in certain countries which is an important factor in how many remittances are sent to a given country. Table 1 contains summary data on relevant variables that were used in exploratory analysis and model creation. Remittances Share of GDP is the percentage of a country's GDP that is composed of foreign remittances in a year *t*. Emigrant Percent is the percent of a country's population living outside of that country in year *t.* Natural Disaster Cost/GDP is the cost of all natural disasters in a country in year *t* given as a percent of that same country's GDP for that same year. The Natural Disaster Aff/Pop variable is the percentage of total population of a country affected by all natural disasters in year *t*. Conflict Deaths/Pop is the percentage of people killed as a result of conflict out of a country's total population in year *t*.

**Table 1: Summary statistics for data set**

| Variable | Obs | Mean | Standard Deviation |
|---|---|---|---|
| **Remittances Share of GDP** | 1822 | 5.824 | 10.318 |
| **Emigrant Percent** | 1822 | 0.0765 | 0.0962 |
| **Natural Disaster Cost / GDP** | 1822 | 3.82e-06 | 3.77e-05 |
| **Natural Disaster Aff / Pop** | 1822 | 0.0176 | 0.0558 |
| **Conflict Deaths / Pop** | 1822 | 6.25e-05 | 0.00193 |

## IV. Model and Results

To empirically examine whether or not different crisis in a country affect remittances sent to this country, we constructed a two way fixed effects model The decision to work with a two way fixed effects model was driven by industry standard and other similar reports (Mohapatra et

al, 2012), and then confirmed appropriate with appropriate tests. The rationale behind each test was driven by resources from an article in the Journal of Statistical Software, *Panel Data Econometrics in R: The plm Package,* and Chapter 15 from Principles of Econometrics with R, *Panel Data Models.*

First we tested between using a pooled OLS model or a fixed effects model. This was done by creating each model and applying the Chow test of stability. With a null hypothesis that the same coefficients apply to each country (there are no fixed effects), our p-value was < 2.2e-16, resulting in a rejection of the null hypothesis at the 99.9% level. We moved forward with a fixed effects model.

Next we tested for two way fixed effects (country and year) using the Lagrange Multiplier Test - two-ways effects (Gourieroux, Holly and Monfort) for unbalanced panels. With a null hypothesis that there are no significant two way effects, our p-value was < 2.2e-16, resulting in a rejection of the null hypothesis at the 99.9% level. There are significant two way fixed effects.

To test between using a random and two way fixed effects model we used the Durbin-Wu-Hausman test. WIth a null hypothesis that individual random effects are exogenous, our p-value was 1.567e-09, resulting in a rejection of the null hypothesis at the 99.9% level. With that result, a random effects model would be inconsistent so we moved forward with a fixed effects model..

Serial correlation was tested twice. Once using the Wooldridge's test for serial correlation, which can be used on any fixed effects model but is particularly good with short panel data. Then again tested with the Breusch-Godfrey/Wooldridge (BGW) test for serial

correlation, which can be biased towards rejection for shorter panel data models. Both of these tests have a null hypothesis of no serial correlation. Our p-value for the Wooldridge test was 0.06913 and for the BGW test the p-value was 1.093e-15. Our model rejects the null hypothesis at the 90% level and 99.9% level respectively. There could be a biased towards rejection with the BGW test since this is most effective using monthly or quarterly data, but since the Wooldridge test also rejected the null hypothesis (at the 90% level) we decide that our model has serial correlation.

Next we tested for cross sectional dependence using Pesaran's CD test. With a null hypothesis of no cross-sectional dependence, our p-value was < 2.2e-16, resulting in a rejection of the null hypothesis. There is cross-sectional dependence. Meaning that the changing of variables in one country can affect variables in another country. This was attempted to be corrected by incorporating regional dummies, but the same result occurred. Further analysis would be needed at the spatial level.

Stationarity was tested using the Augmented Dickey-Fuller. With a null hypothesis that there is a unit root (or not stationary), our p-value was < .01. Resulting in a rejection of the null hypothesis at the 99% level. Our data is stationary.

Lastly we tested for heteroskedasticity using the Breusch-Pagan test. With a null hypothesis of homoscedasticity our p-value was < 2.2e-16. Resulting in a rejection of the null hypothesis at the 99.9% level. There is heteroskedasticity.

In order to correct for serial correlation and heteroskedasticity we used the Arellano bond estimator, a robust covariance matrix estimator. This is a generalized methods of moments estimator that is particularly effective with dynamic panel data and can correct for serial

correlation and heteroskedasticity. Due to the fact we used the lagged dependent variable as an independent variable our model was dynamic.

Two models were then created. The first with our explanatory variables in the dependent variable observed year, and the other with the explanatory variables lagged one year behind. The choice to test the two models was to see if changes in remittances are different during the year of the crisis and if these changes continue into the next year.

$$\begin{aligned}\text{Remittances Share of GDP}_{i,t} &= \beta 0 + \beta 1*\text{Remittances Share of GDP}_{i,t-1} \\ &+ \beta 2*\text{Emigrant Percent}_{i,t} + \beta 3*\text{Time Trend} \\ &+ \beta 4*\text{Nat Disaster Cost}_{i,t} + \beta 5*\text{Nat Disaster Aff}_{i,t} + \\ &+ \beta 6*\text{Con Deaths}_{i,t} \\ &+ B7*\text{Nat Disaster Cost}_{i,t}*\text{Emigrant Percent}_{i,t} \\ &+ \beta 8*\text{Nat Disaster Aff}_{i,t}*\text{Emigrant Percent}_{i,t} \\ &+ \beta 9*\text{Con Deaths}_{i,t}*\text{Emigrant Percent}_{i,t}\end{aligned}$$

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Our dependent variables, *Remittances Share of GDP,* are measured for each year and each country. We then lagged this value as our first explanatory variable. Next we had controls of *Emigrant Percent* (of total population) and a *Time Trend.* The use of a time trend was decided since we have seen a steady increase of remittances over the 28 year period we measured, and its use in similar other articles (Mohapatra et al, 2012).

Then our explanatory variables were two natural disaster variables, *Natural Disaster Cost* and *Natural Disaster Total Affected*, which were both percentages of GDP and population respectively, then a conflict variable of *Conflict Deaths* as a percentage of population. Each of these three explanatory variables were multiplied by *Emigrant Percent* to examine how they change due to how much of a country's population lives abroad.

## V. Results

The following values were obtained after running our model on all countries in our data set. After observing the results we also ran the model just on one region of countries (Latin America) with 15 countries and 403 total observation. Where we do see increased significance, possibly due to the fact that Latin America has large amounts of natural disasters and remittances.

**Table 2: Regression results for all countries and for Latin America**

| Variable | All Countries Observed Year | Lagged Year | Latin America Observed Year | Lagged Year |
|---|---|---|---|---|
| **Remit Lagged** | **0.87926*** (.017911)** | **0.88083*** (.016205)** | **0.86104*** (0.047760)** | **0.93597*** (0.042760)** |
| **Emigrant Percent** | -2.4844 (1.6189) | -1.9654 (1.8229) | -1.4902 (2.9780) | **-5.9959` (3.6191)** |
| **Time Trend** | 0.0059332 (.0053201) | 0.0051582 (.0051830) | **0.014150` (0.0073030)** | 0.0071607 (0.0055891) |
| **Natural Disaster Cost** | -1,653.3 (1,015.5) | 316.17 ( 827.30) | **-3,831.6** (1,342.7)** | 1,034.8 (760.33) |
| **Nat Cost * Emigrant** | **16,681*** (4,849)** | **-23,034*** (3,039.6)** | **26,389*** (4,926.4)** | **-26,843*** (3,389.6)** |
| **Natural Disaster Affected** | **2.1094` (1.2077)** | 0.35125 (1.3534) | 4.4595 (3.5242) | **1.4518` (0.84182)** |
| **Nat Aff * Emigrant** | -5.5803 (4.3783) | **-7.2043* (3.0168)** | **-14.880` (7.9740)** | **-10.444*** (1.7346)** |
| **Conflict Death Percent** | 308.50 (349.02) | -36.842 (89.525) | -105.98 (6,173.2) | -105.53 (5,600.1) |
| **Con Death * Emigrant** | -972.29 (1,188.7) | 123.36 (251.80) | -943.37 (31,751) | 732.13 (28,901) |

" ` " p<.1 " * " p < .05 " ** " p < .01 " *** " p < .001

Adjusted R Squared (Observed): 0.923 / 0.863
MSE (Current Year): 2.493 / 1.320

Adjusted R Squared (Lagged): 0.920 / 0.879
MSE (Lagged): 2.46 / 1.167

The first item of note is the lack of significance from our conflict variable (neither conflict death or its interaction term). We did not see any significant effects from conflicts, at

least when measured in deaths. If we then focus on the natural disaster variables we do see significance in both datasets (all countries and Latin America) and both in observed year and lagged.

If we focus on the signs of both models there are two important observations. When applying the natural disaster cost interaction term we see a change in sign between the observed year and the lagged year, it goes from positive to negative. This would suggest that there is some sort of backlash in sent remittances. This could be explained by either individuals sending more than they planned in the year of the crisis and then not being able to send as much the next year, or there could be increases of migration after some natural disasters which could also reduce the amount of people remittance senders could send to. Though these are both speculation.

Another aspect we see is a difference in signs between explanatory variables and their respective interaction terms. This would suggest that the emigrant percent either increases or decreases the amount of remittances sent (as a share of GDP), depending on the variable. For natural disaster cost in the observed year, it is negative for the variable by itself and positive for the interaction term. Suggesting that in this case the effect of natural disaster costs increases if there is a larger portion of emigrants out of the country.

**VI. Conclusion**

Although one of our main variables of interest, conflict, did not bear significance within the model, we still gained insights into how remittances behave and how the data we worked with may not be suited for such macroeconomic level analysis. The significance we found within the lagged remittance variable and interaction variable between natural disaster costs and emigrant percent are consistent with what other studies have found regarding the impact that a

natural disaster might have on remittances. The timeframe of our analysis varies slightly, and therefore holds a different variance of natural disaster data than studies in the past. Conflict data also proved difficult to generalize in a way that equates conflict severity across all countries. For this reason, a country-level case study approach to studying conflict may be more advantageous in gaining an insight into for it was affected by a given conflict. Macro-level analysis is limited in its ability to differentiate between how one type of conflict affects a country. Another limitation is in the measurement error (and measurement ability) associated with gathering data in places where institutions are failing and accountability to report is low. Often, the estimates of deaths due to conflict varied greatly within a single observation. An element that may be useful in future analysis is the economic impact a conflict has. Our analysis primarily used deaths as a way to quantify severity of conflict, but countries likely experience a monetary cost to conflict without people necessarily dying.

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