



## Cost Elasticity of Remittances from Senegalese Migrants in Europe

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Immigration is an increasingly important political and economic phenomenon. Understanding the household and individual motivations that underlie migration is crucial to making informed policy decisions. There is a huge body of research surrounding migration and remittance patterns between various countries, from motivations for remittances, characteristics of migrants, characteristics of households receiving remittances, how remittance reception impacts household decision-making and measures of poverty, how the education level of migrants affects the amount of money they send home, and many other areas of interest. To situate this research in the current discussion, the focus is narrowed to immigration from developing countries to developed countries and therefore, remittances from developed countries to developing countries. A developing country with a strong flow of remittances and a high percentage of income remitted per worker permits the investigation of why migrants choose to remit at the volume and frequency that they do, and what would cause them to adjust their decision.

Senegal ranks among the top nations in the world for the percent of their income that migrants send home, as well as percent of GDP from remittances (Orozco, Burgess, and Massardier 2010). For Senegalese migrants who leave the African continent, Europe is one of the most common destinations, according to the World Bank's 2009 survey of 2100 randomly selected households (World Bank 2009). As seen in Table 1, migration to France, Italy and Spain constitutes 59% of migration in this sample. Additionally, remittances from these three countries account for 84.24% of the total transfers Senegalese migrants made in 2009 to the households surveyed. Tables 2 and 3 show descriptive statistics for the total amount of transfers from a migrant household member and the number of transfers received in one year, respectively. For the entire survey, the mean number of transfers is 7 and the mean amount received by the household in the previous year was 531,678.8 FCFA, which is about \$875.63. For the sub-sample of France, Italy, and Spain only, Tables 4 and 5 show the descriptive statistics. The mean number of remittance transfers is 8 per year, and the mean amount received by the household in the previous year was 866,234 FCFA, or \$1,426.61. The pattern of relatively small, regular transfers is consistent with the existing research, which is discussed below, that indicates that remittances are typically sent in small individual amounts but in high frequency (Yang 2011). This also indicates that the European sub-sample remits a higher amount, on average.

**Table 1: Percent of Senegalese migrants various countries & Percent of transfers originating there**

	France	Italy	Spain	Total
<b>% of Migrants</b>	12	26	21	59
<b>% of Transfers</b>	13.04	44.59	26.61	84.24

The cost of transferring funds through formal operators is often structured as a fixed fee. Formal transfer operators offer a number of products at different prices for international transfers. The fixed fees tend to make up a significant portion of the amount that is sent, especially when migrants are sending relatively small amounts of money almost every month (Orozco 2004). This research tests if lower fees result in significant changes in remittance patterns. The

household data does not include the cost of the transfers to the migrant, so I use the chosen transfer method as a proxy for cost of remitting, which may be observed or unobserved.

This paper addresses (I) the current situation of immigration and remittances in the case of Senegal and the findings of literature regarding patterns of remittances to developing countries. From there, I develop a conceptual framework (II) as the basis of a model that predicts cost elasticity of remittances, (III) describe the data used in empirical testing, and (IV) give the empirical specifications. Then, I report (V) my findings that, based on the variation of prices between transfer operators in France, Italy, and Spain, the transfer method migrants choose to transfer funds, and therefore the cost of sending, impacts the total amount of money they remit in a year. Lastly, I draw conclusions based on those findings (VI.)

## I. LITERATURE REVIEW

### *Importance of Remittances*

The volume of remittance transfers to developing countries is huge and continues to grow. Yang outlines the rapid growth, huge global magnitude, and potential developmental impact of remittances (2011). He states that remittances to developing countries have exceeded \$300 billion in nominal terms since the mid-2000's and have grown at an average annual rate of 12.9 percent. According to Freund and Spatafora, the current level of remittances has increased from \$66 billion in 2000 and \$100 billion in 2004 (2008). This growth exceeds that of foreign direct investment and official development assistance, and shows relative stability during economic downturn (Ratha 2005). In many developing nations, remittances make up a huge portion of GDP, with the highest level at 35 percent Tajikistan. In Senegal, 9 percent of GDP comes from remittances (World Bank 2011).

These massive annual remittance flows present a serious developmental potential for receiving countries. In a study of the Philippines, Aycinena, Martinez, and Yang confirm that households who receive remittances in the Philippines are less likely to live in poverty, are more likely to send their children to school, and are more likely to invest in small enterprises (2010). Gibson, McKenzie, and Rohorua also explore the importance of remittances (2006) and find that the majority of Tongan migrants in New Zealand, 73 percent, had remitted money in the previous year. In terms of the potential developmental impact of remittances, Gibson et al propose that the ability of the receiving nation to maximize the development effects of remittances depends on the competition between the formal transfer operators who provide service between the sending and receiving countries, and the migrant's sensitivity to cost (2006). They later discuss the possibility of policies to maximize development by decreasing market concentration and increasing the availability of market information.

### *Nature of Immigration and Remittances in Senegal*

Orozco states that half a million Senegalese migrants are working abroad in a given year, and that they remit approximately \$1.3 billion with 400,000 transfers total per month (2004). He also states that 85% of remittances to Senegal take place through formal transfer operators, which reinforces that the cost has a potentially serious role in behavior. The World Bank's 2009 data report that was published in conjunction with the 2009 household survey data explains that the long-standing tradition of migration in the Senegalese population, coupled with pervasive post-

colonial troubles, contributes to the rate of emigration. These problems include the prolonged decline of agriculture, increasing poverty in rural areas, and increasing inequality between rural and urban areas (World Bank 2009). Agriculture revenues fluctuate seasonally and are volatile based on the length of the rainy season, making work outside of the agricultural sector both attractive and often necessary to support a family unit. The report also cites higher growth rates in the population than in growth of production, and a historically weak labor market, as influences that bolster migratory tendencies. The World Bank Report also suggests that risk-sharing motivation for remittances, which is discussed further, have an important role for Senegalese households (2009).

### *Characteristics and Motivations of Remittances*

There are a number of notable characteristics of remittances to developing countries which have been subject to academic scrutiny. For instance, Yang notes that remittances are “typically sent in relatively small magnitudes and relatively high frequencies,” (2011). He suggests that this tendency may be explained by the desire of migrants to reduce exposure to the risk of adverse events, to account for the problem of self-control in spending, or to transition into their new employment and living conditions. Remittances often constitute a large portion of migrant workers’ earnings. For example, Senegalese workers in Spain remit 49.9% of their income and Senegalese workers in France remit 11.23% (Yang 2011).

Ashraf, Aycinena, Martinez and Yang point to the fact that migrants prefer to have control over how the money they remit is spent, and therefore remit more when they have control (2011). The response of migrants in amount remitted to the increased control of funds they sent was tested through random assignment of savings accounts, which were either solely controlled by the recipient or jointly controlled by the sender and recipient. Similarly, Gibson, McKenzie, and Rohorua found that senders often designated their remittances for specific uses by recipients (2006).

De la Briere suggests that migration is a strategy at the household decision-making level, and that sending family members abroad serves as diversification of income that can be compared to portfolio diversification (2002). She refers to remittances from a migrant worker as part of an informal insurance contract that reduces risk for the household as a whole. Rapoport and Docquier examine the micro-level determinants of remittances and divide the possible motives into individualistic and familial reasons to remit (2006). The individualistic motives include exchange and investing in future inheritance, while familial agreements are for income insurance or investment. While the most frequently reported reason for remitting is to provide for the people who remain in the migrant’s home country, the authors also propose an implicit contract where the family funds the migration in order to receive funds later. Alternatively, a migrant’s income may serve as insurance against volatile agricultural revenue. Inheritance is an effective enforcement device, accompanied with social pressures that require migrants to share their income. Jack and Suri also find that, on the level of household motivation to send a migrant abroad, remittances are used to smooth household consumption (2011).

Another characteristic of remittance transactions is that the availability of information to migrants regarding transfer methods and prices is somewhat difficult for migrants to access and understand. According to Gibson, McKenzie and Rohorua, most Tongans in New Zealand used Western Union or *Melie mei Langi*, a religious transfer operator (2006). The migrants’

knowledge of alternative operators and different prices among operators “appear limited,” because so few senders strayed from these two operators. Gibson and his co-authors’ study of Tongan migrants went on to explain that remitters are also relatively unaware of the extent of the exchange rate commission charged. The authors suggest that lack of market information may also contribute to the lack of competition and high barriers to entry in the market.

Chort, Gubert, and Senne (2012) also investigated the presence of migrant networks in communities of Senegalese migrants in France and Italy as a method of enforcing the social expectation that workers send money home to their families. Networks provide services to migrants, such as support for newly migrated workers and help accessing work and housing. However, these networks also serve as a control mechanism for the household, obligating migrants to be honest about how much money they are making and to send home appropriate funds to support their families.

### Remittance Pricing

The price of remittances through formal transfer operators is a crucial part of migrants’ decisions about how much money to send to their country of origin and how often they will send it. Freund and Spatafora found that the high costs of formal operators tend to influence migrants to switch from formal to informal channels (2008). Informal methods of transfer include *Hawala* and *Hundi* channels, which have religious association, or remittances passed person to person for a much lower cost (Yang 2011). However, Freund and Spatafora’s study of aggregate remittances does not include informal transfers and finds that worldwide, informal remittances may make up as much as 35 to 75 percent of official flows. Therefore, they believe that household surveys are “the most accurate means of estimating the informal sector for particular countries,” but that their difficulty is in accurate sampling.

The existing research on the price of remittances models the possible factors that determine prices for senders and receivers. This is the work that is most directly applicable to my research question. According to Freund and Spatafora, transaction costs are “systematically related to concentration in the banking sector, financial depth, and exchange rate volatility,” (2008). They also find that the costs of transferring funds consists of the transfer fee, the exchange rate spread, and the presence of a dual exchange rate, assuming that the remittances are through formal operators. On the receiving end, they suggest factors that would influence the cost to receivers, including the amount of competition in the financial services industry, financial development, business risk, exchange rate risk, and domestic wages. Gibson, McKenzie and Rohorua designed a basic model predicting the cost of remittances to a migrant as a two-part tariff, which consists of a fixed fee and an exchange rate commission (2006). The size of the market for remittances may also impact the fees charged by formal transfer operators (Gibson, McKenzie, and Rohorua (2006).

Mookerjee and Roberts argue that the development of the financial sector in receiving countries impacts the flow of remittances, rather than the transfer costs (2011). They define financial sector development as the number of banking institutions and the number of branches of those institutions. They use macroeconomic data between countries to show that transaction costs do not significantly impact remittance flows. Orozco looks at the case of competition for transfers from Europe to Senegal. He states that costs are high, an average 8% of the total expenditure per transfer, and that little competition exists in the banking industry (2004). According to Orozco,

transaction costs are determined by limited payment networks, lack of competition in transaction origin, and the presence of oligopoly (2004). Jack and Suri emphasize the role of transaction costs in consumption smoothing at the household level (2014). They find that mobile remittances through M-PESA in Kenya, which have low transaction costs, increase households' ability to share risk in the case of negative income shocks. They refer to risk-sharing networks within the country and show that low transaction costs increase the effectiveness of these networks.

Prices also vary between types of formal transfers that are offered by banks. In New Zealand, Gibson, McKenzie and Rohorua compared the prices of various methods of formal transfer from banks and other transfer operators (2006). They looked at availability of bank branches for senders and receivers to go to in order to complete transactions. The methods they found were telegraphic transfers from bank accounts to accounts in Tonga, bank drafts (checks that may be posted in other countries), ATM cards, or simple cash conversions to deliver in the mail or in person. The cost, speed and reliability of these methods are displayed in Table 2. The authors noted that there were different products and pricing offered by each bank and that larger operators offered more immediate services.

**Table 2: Cost, Speed, and Reliability of Bank Products for Tongan migrants in New Zealand**

Type	Cost	Speed	Reliability
Telegraphic transfers	NZ\$25	high	high
Bank drafts	NZ\$15-25	low	high
ATM	NZ\$5-8	high	high
Cash	NZ\$5-7.50	low	low

They also noted the possible costs of receiving funds, depending on transfer method and operator. The assessment of transfers from New Zealand to Tonga included the costs on the receiving end. Receiving a telegraphic transfer costs 5 Pa'anga, the Tongan currency costs between 10 cents and 5 Pa'anga to deposit a bank draft from a New Zealand bank. Some banks do not charge if the receiver has an account with them but do charge if they do not. Western Union and MoneyGram transfers have no cost to recipients of transfers (Gibson, McKenzie and Rohorua, 2006). All of this results in a range of costs, convenience, speed and reliability of transfers on both sides of the transaction.

*Cost Sensitivity and Elasticity*

Part of a migrant's decision to remit includes sensitivity to cost, but there has been little research determining the cost elasticity of remittances. One study by Aycinena, Martinez and Yang (2010) examined the causal impact of price on remittances by regressing remittance amount on price with a vector for baseline variables. The baseline variables categorize migrants by basic characteristics, such as gender, possession of a US bank account, relationship to recipient, and years in the United States. This study used empirical evidence without calculating elasticity but found a negative coefficient that was statistically significant at 5%. The study was a randomized field experiment among migrant workers from El Salvador in Washington D. C. Transactions made of an amount at or below \$1500 is subject to a \$10 flat fee. Migrants were randomly assigned lower fees so that their response to price in terms of transfer frequency and amount

could be tracked with the assistance of a partner transfer operator. The discounts ranged from \$0 to \$5. The key dependent variable was the average monthly remittances after the random treatment was applied. The authors discovered that reduced fees caused senders to remit more often, for a higher amount remitted total. The “partner institution” that allowed the study to take place was Banagricola. These findings are important to my work because they quantify migrant response to the variation in price.

There has been at least one study that models the elasticity of remittances in response to price changes, and key aspects of their model are the basis of the model used in this study. Gibson, McKenzie, and Rohorua studied Tongan migrants in New Zealand in 2006 and found that 30% of migrants had a cost elasticity of  $-.74$ , while 70% did not change their behavior. This resulted in an estimated average total elasticity of  $-.22$ . They modeled the elasticity of remittance as a function of the fee charges, exchange rate commission, motive for remitting, and migrant demographic characteristics. Remittances make up about 37% of Tongan GDP and costs of remitting are relatively high (Gibson, McKenzie, Rohorua 2006). The framework the authors used to estimate the cost elasticity of remittances first established the cost of remitting as a fixed fee plus the exchange rate commission. Other important variables are the motive for remitting and the characteristics of the migrant. The survey data were used to establish negative cost elasticity. Typically, recipients were the last family members the migrant had lived with, their parents, or their spouse. Migrants were asked how much they had most recently transferred, what their cost was, and how they would hypothetically adjust the amount they sent based on a smaller or larger fee. In this study, 30% of migrants would have sent more money if fees were reduced and 70% would not have changed the amount.

The research went further, by breaking down elasticity of specific sub-groups of the data. The study of Tongan migrants established a basic relationship of the amount of remittances sent by a migrant as a function of motive for remitting, migrant demographic characteristics, the fixed fee, and the exchange rate commission. Motive can often play an important role in determining the elasticity of demand for remittances, based on urgency. To account for this, the study also measured elasticity of remittances in groups according to “self-described remittance sending pattern.” For migrants sending a specified amount of Tongan pa’anga on a monthly basis, elasticity was  $-0.08$ . For those who send only on special occasions, elasticity is  $-0.15$ . For those sending a regular monthly amount of New Zealand dollars cost elasticity was  $-0.36$ . This supports the idea that the demand of people who sent regular amounts of Tongan currency home was less elastic, meaning that they would change the amount they send by a relatively small amount for a given increase in price. Also, the migrants who remitted in New Zealand dollars are more sensitive to the cost of remittances.

Gibson, McKenzie, and Rohorua also looked at elasticity of remittances relative to the exchange rate commission (2006). They found that remittances were relatively inelastic in terms of the exchange rate cost, because migrants are much more responsive to the fixed fee. This may be because remittances in each currency offset the elasticity of senders of Pa’anga and New Zealand dollars.

### Summary

Remittances are a relatively new aspect of international cash flows which are growing rapidly. Funds transfers to developing countries from migrant workers have serious potential to affect

measures of household poverty and to increase investment. On an individual scale, remittances are often sent by migrants in high frequency but low magnitude. The motivation of a sender determines the degree of their cost elasticity. Senders also have preferences about how their money is spent, and prefer to have power to designate what it should be used for. There are prices associated with both sending and receiving funds, which vary based on the transfer operator and transfer method. High costs may cause migrants to substitute to informal channels and reduced costs results in the opposite action, suggesting that the total remittance amount is not changed though it may appear to because of accounting processes. All of these factors lead to the examination of cost sensitivity of remittances, which has been researched in two studies. Both found negative responses to increased cost of remittances. This study approximates a similar relationship using key variables from previous studies to predict the amount of remittances.

## II. THEORETICAL FRAMEWORK

This research identifies the partial cost elasticity of remittances from Senegalese immigrants in France, Italy and Spain with respect to the migrant's chosen transfer channel and its associated fixed cost. It would be ideal to use the actual cost to the migrant, but because there is not reliable data collected on the cost, so transfer methods serves as a proxy. This means that the resulting coefficients show the partial elasticity in a regression of the logarithm of remittances. My methodology differs from the two proceeding studies of cost elasticity, Yang's survey of migrants from El Salvador in the United States and Gibson, McKenzie and Rohorua's survey of Tongans in New Zealand, and makes slightly different assumptions. Only the initial decision made by the migrant is observable with the variation of cost between transfer operators, rather than how migrants report that they would react to changes in cost hypothetically. This decision also incorporates unobservable costs to using a particular transfer method, such as the cost of accidents, theft when entrusting money to others to transport, or time required for the transfer. The migrant's assessment of transfer methods in a static framework may reflect other aspects of their decision-making, but will hopefully shed light on one stage of the process and lead to meaningful conclusions about their price sensitivity.

First, the migrant's motives for remitting are a combination of familial and self-interested motives that are enforceable through social pressure or the promise of later rewards. The motive to remit is therefore  $M_i$ , a function of  $S_i$ , a self-interested dummy variable for either exchange or investing in future inheritance, and  $I_i$ , a dummy variable for familial agreements, either for income insurance or investment.

$$(1) M_i = G(S_i, I_i)$$

As Gibson, McKenzie, and Rohorua (2006) determined, the cost of remittances can be modeled as a "two-part tariff, whereby the cost of remitting an amount  $X$ " of Euros to Senegal, as is given by their model:

$$(2) Cost(X_i) = F + R * X$$

Equation (2) shows  $F$ , a fixed fee, plus an exchange rate commission  $R$  per euro. Based on the work of Docquier and Rapoport (2006), Gibson et al model the "amount of remittances  $X$  by migrant  $i$ ":

$$(3) X_i = G(F, R, M_i, Z_i)$$

In Equation (3),  $Z_i$  is a vector for the migrant's personal characteristics. To measure elasticity, the natural log of the dependent variable,  $X_i$ , remittances, and the natural log of the fixed fee result in the coefficient on the fixed fee gives the elasticity of remittances with respect to fees.

$$(4) \ln(X_i) = G_i(\ln(F), R, Motive_i, Z_i)$$

Due to the lack of information on the fees, this framework uses dummy variables for each of the four most common transfer operators: Western Union, MoneyGram, the Postal Service, and using a friend to carry cash between locations. The natural log of the dependent variable, remittances, gives the partial elasticity for the operator.

$$(5) \ln(X_i) = G_i(Operator_i, Motive_i, Z_i)$$

Gibson et al predict that migrant motive and migrant characteristics are the fundamental determinants of the frequency and amount of remittances (2006). The purpose of the money being spent, and the intentions the migrant has for the funds, are the primary factors. Then, as Gibson et al state, there must be variation in the costs for transfers. In their research, they hypothetically reduced fees by half and asked migrants what their reaction would be to this change. In the case of the World Bank data, the variation is between transfer operators and the data is cross sectional.

There are two theories essential to measuring the cost elasticity of remittances. The first is the supply and demand for remittances, where the equilibrium price is where the demand of remitters meets the supply of transfer operators at a given cost. The second is the cost elasticity of remittances, where the higher or lower fixed fee charged by transfer operators may cause change in the amount of money transferred or how often remittances are sent. Variation in price may cause some consumers to adjust the amount of their remittances, the frequency of their remittances, or their average remittance amount over time. It is also logical that a threshold exists where the cost would become too great for each consumer to choose a formal transfer method, so they would substitute for a cheaper, slower, and less reliable option.

When the cost of remittances varies, the law of demand states that the quantity demanded decreases at a higher cost level. In terms of remittances, this may be seen in the magnitude of an individual transfer, the number of times per year remittances are made, or the average of remittances in a year. Remittances may be perfectly inelastic, which means that migrants determine the amount they send and do not react to variation in price. If remittances are relatively inelastic, a one dollar higher fee results in less than a one dollar decrease in the amount remitted. If remittances are perfectly elastic, a one dollar price difference results in a proportional change in remittances in the opposite directly. If remittances are relatively elastic, migrants sending remittances reduce the amount remitted by more than one dollar for every additional dollar added to the fee.

Cost elasticity of remittances for a sample of migrants sending money to Senegal differs for each migrant, as does the threshold where they would switch to an informal channel to escape high monetary costs of formal operators. Some migrants may have preferences that are perfectly cost inelastic and choose not adjust their remittances according to price. Others may be relatively elastic, relatively inelastic, or unit elastic. Depending on the ratio of individual consumers who

have relatively elastic, unit elastic, relatively inelastic, or perfectly inelastic response to changes in price, the cost elasticity of the sample also falls in this range because it is a weighted average. Gibson, McKenzie, and Rohorua (2008) found that the majority of Tongan migrants in New Zealand were perfectly cost inelastic and a minority of Tongans were relatively elastic, which resulted in a relatively inelastic negative value for the cost elasticity. Different characteristics of the banking industry, the distance between the sending and receiving countries, the cultural values, the international labor legislation, and any number of other factors may influence a different result for Senegalese workers in France, Italy, or Spain. In a framework with transfer method instead of cost, this elasticity is shown in the relative difference between methods with different associated costs.

$$(6) \ln(X_i) = G_i (\text{Operator}_i, \text{Motive}_i, Z_i, C_i)$$

### III. DATA DESCRIPTION

The data used for this research is from the 2009 World Bank household survey data in Senegal. The World Bank household survey data from 2009 was collected in order to “improve knowledge about the flow of internal and international migration, and the impact of migration and remittances on economic and social situation of households,” (World Bank 2009). The survey was conducted as a random two stage sampling of 2,100 households. The survey includes three types of households, those without migrants, those with an internal migrant, and those with an international migrant. The first step of the sampling identified 100 districts that were either (1) within the capital of Senegal, Dakar, (2) in other urban areas, or (3) in rural areas, and were either low or high migration zones. From those 100 districts, 21 households were selected from each; 7 households without a migrant, 7 houses with an internal migrant and 7 houses with an international migrant were surveyed. The dataset “Base Anciens Membres du Ménage” identifies characteristics of the migrant who left the household and the remittances they sent. The variables in this section include the money sending channel, the number of transfers to the household in the past 12 months, the total amount of remittances received by the household in the past 12 months, and the country of residence of the migrant. In the sampling, regions were considered to have “high” migration if 25% or more households reported having a migrant. The General Census of 2002 was used to determine the percent of households with a migrant in order to classify high and low migration regions.

### IV. EMPIRICAL SPECIFICATION

To estimate the elasticity of remittances with respect to cost, I use the follow empirical specification:

$$(7) \quad \ln(X_i) = \beta_0 + \beta_1 * \text{Operator} + \Phi_1 * \text{Motive} + \Phi_2 * \text{Characteristics} + \beta_3 * \text{Country} + u$$

The key parameters of interest in this study are the method of transferring funds, which is a proxy for the cost of remitting. The dependent variable is the natural log of the amount of remittances  $X$  from migrant  $i$ . The first set of independent variables includes dummy variables for the transfer options. The second set, the vector for the motive of the migrant consists of: (a) a dummy variables for network support, which serves as enforcement for remittances to the family, and (b) whether the remittances are regular, or more than 6 times a year. Regularity of

remittances distinguishes remittances that are a one-time purchase or exchange. Other variables that would have been useful proxies for motivation, but that were not available in the survey, are parental assets to show a migrant's investment in their inheritance and income shocks to show if the remittances are income insurance. The third set of variables in the regression, the vector for the migrant's personal characteristics,  $Z$ , includes variables for the migrant's age and sex, whether the receiving household is urban or rural, if the migrant is the child of the household head, if the migrant is monogamously married, if the migrant has had formal education, and the duration of the migrant's stay in their current country. Lastly,  $C$  indicates the country from which the migrant is sending remittances, France, Italy, or Spain.

The key hypothesis test is of the significance of the difference between transfer methods, with a null hypothesis of the key parameters for transfer operator all equal to zero and an alternative hypothesis of the null hypothesis is false. The secondary hypothesis test would be a test of the difference in elasticity between the countries of origin, to determine if there is a significant difference between the remittances of the two countries.

$$(8) \ln(X_i) = \beta_0 + \beta_1 * \text{WesternUnion} + \beta_2 * \text{Post} + \beta_3 * \text{MoneyGram} + \beta_4 * \text{Friend} + \beta_5 * \text{Urban} \\ + \beta_6 * \text{Network} + \beta_7 * \text{Regular} + \beta_8 * \text{Male} + \beta_9 * \text{Age} + \beta_{10} * \text{Education} \\ + \beta_{11} * \text{Duration} + \beta_{12} * \text{Child} + \beta_{13} * \text{Marriage} + \beta_{14} * \text{France} + \beta_{15} * \text{Spain} \\ + \beta_{16} * \text{Italy} + u$$

(A) Ho:  $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ ; Haa: Ho is false.

(B) Hob:  $\beta_{14} = \beta_{15} = \beta_{16} = 0$ ; Hab: Hob is false.

### Challenges in the Empirical Analysis

There is a strong possibility that variance between errors of the predicted values of remittances are not equally distributed in the regression of the level of remittances on the independent variables. For this reason, the logarithm of remittances is used to reduce the risk of heteroskedasticity. Additionally, robust standard errors address heteroskedasticity. Lastly, the Breusch Pagan test of the variables that are not robust identifies that heteroskedasticity is present in the regression.

It is also likely that the amount of remittances is equally influential for the cost of remittances to a given country, or the choice of transfer operator, as the cost of remittances is for the amount of remittances that are received. For this reason, instruments that are correlated with method or cost, but uncorrelated with error, are necessary.

Due to the complexity of the decision-making that determines the amount of money a migrant remits, there is a strong possibility that these empirical specifications do not capture all of them. An omitted variable bias is possible, especially in terms of the motives for remitting. This may be identified with an omitted variable test.

## **V. RESULTS**

The most basic regression is that of remittances on the dummy variables for four transfer methods, Western Union, MoneyGram, the Postal Service, and having a friend carry cash in person. This is the first model in Table 3. The second model is the logarithm of remittances

regressed on the same dummy variables. Models 3 and 4 are the regressions including indicators for France, Italy, and Spain with the methods of transfer, and have level of remittances and the logarithm of remittances as the dependent variable, respectively. Therefore, Models 2 and 4 show the partial elasticity of remittances with respect to each of the variables. The partial elasticity of all the transfer methods is significant at 1%, and all but the Post are significant at 0.1%. The partial elasticity of the coefficients on each country is all significant at 0.1% in Model 4 of Table 3.

**Table 3: Models 1-4**

<b>Variables</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
westernunion	421963*** (51488)	0.876*** (0.0858)	259311*** (56459)	0.533*** (0.0929)
post	55274 (75545)	0.384*** (0.128)	22229 (74788)	0.330*** (0.126)
moneygram	489661*** (121152)	1.021*** (0.199)	370132*** (121520)	0.742*** (0.198)
ami	-108188* (58216)	-0.400*** (0.0980)	-114076** (57391)	-0.408*** (0.0956)
france			338706*** (70348)	0.650*** (0.115)
italie			353930*** (64594)	0.713*** (0.106)
espagne			261006*** (82133)	0.736*** (0.137)
Constant	373117*** (39846)	12.09*** (0.0667)	340940*** (39590)	12.02*** (0.0656)
Observations	1440	1382	1440	1382
R-squared	0.084	0.150	0.112	0.193

*Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$*

These results show that migrants remitting through Western Union remit 421,962.5 FCFA, or \$693.55 more per year than any other method of transferring the funds. Migrants using MoneyGram remitted 489,660.5 CFA, or \$804.82 more per year. Migrants using MoneyGram instead of Western Union, then remit \$111.27 more per year on average. The logarithm version, giving the partial elasticity of each transfer method, has significant coefficients for all four methods at 0.1%. In this equation, migrants using Western Union remit 87.6% more than any other method, migrants using the post remit 38.4% more, migrants using MoneyGram remit 102% more, and migrants who have a friend carry the money remit 39.9% more, compared to carrying the money themselves. The difference between the two principal formal transfer operators, Western Union and MoneyGram, is that migrants using MoneyGram remit 14 percentage points more. This also means that the total cost, monetary and non-monetary, of a friend carrying the money is relatively high.

**Table 4: Models 5-8**

<b>Variables</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>	<b>(8)</b>
westernunion	237523*** (55704)	0.477*** (0.0892)	264949*** (53299)	0.520*** (0.0770)
post	-16884 (73844)	0.239** (0.120)	18254 (71023)	0.238** (0.105)
moneygram	365238*** (119839)	0.715*** (0.190)	389380*** (115358)	0.774*** (0.165)
ami	-117142** (56627)	-0.398*** (0.0917)	-35630 (54657)	-0.215*** (0.0799)
france	299711*** (70467)	0.544*** (0.112)	232251*** (68627)	0.470*** (0.0989)
italie	331826*** (63944)	0.627*** (0.102)	250282*** (61793)	0.461*** (0.0890)
espagne	239515*** (81149)	0.649*** (0.132)	227294*** (77133)	0.603*** (0.113)
urban	-50898 (44370)	-0.0318 (0.0713)	-29987 (42759)	-0.0305 (0.0619)
male	95177 (60054)	0.423*** (0.0970)	58115 (59098)	0.348*** (0.0860)
age	12417*** (1830)	0.0300*** (0.00298)	5267** (2213)	0.0160*** (0.00321)
noed	6574 (42551)	-0.122* (0.0685)	15224 (41122)	-0.0773 (0.0598)
networksupport			60559 (41817)	0.0906 (0.0607)
regular			558913*** (39144)	1.256*** (0.0575)
child			-60421 (41854)	-0.0135 (0.0607)
marriage			-64018 (40431)	0.0376 (0.0587)
yearslocation			8501 (5250)	-0.000133 (0.00828)
logduration			-13866 (41014)	0.0498 (0.0621)
Constant	-161678* (92296)	10.65*** (0.149)	-181699 (114497)	10.39*** (0.167)
Observations	1440	1382	1387	1331
R-squared	0.145	0.267	0.263	0.464

*Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$*

**Table 5: Models 9-12**

<b>Variables</b>	<b>(9)</b>	<b>(10)</b>	<b>(11)</b>	<b>(12)</b>
westernunion	256027*** (53333)	0.509*** (0.0771)	0.520*** (0.0800)	0.509*** (0.0804)
post	15877 (70917)	0.235** (0.105)	0.238** (0.100)	0.235** (0.100)
moneygram	557394*** (133055)	0.974*** (0.190)	0.774*** (0.156)	0.974*** (0.173)
ami	-36859 (54572)	-0.216*** (0.0798)	-0.215*** (0.0811)	-0.216*** (0.0812)
france	248074*** (69055)	0.492*** (0.0996)	0.470*** (0.101)	0.492*** (0.102)
italie	281846*** (63167)	0.497*** (0.0911)	0.461*** (0.0920)	0.497*** (0.0947)
espagne	219723*** (77069)	0.594*** (0.113)	0.603*** (0.123)	0.594*** (0.122)
urban	-33354 (42714)	-0.0346 (0.0619)	-0.0305 (0.0611)	-0.0346 (0.0609)
networksupport	56284 (41796)	0.0846 (0.0607)	0.0906 (0.0618)	0.0846 (0.0619)
regular	556391*** (39129)	1.252*** (0.0575)	1.256*** (0.0568)	1.252*** (0.0568)
male	53989 (59138)	0.341*** (0.0861)	0.348*** (0.0833)	0.341*** (0.0834)
age	5295** (2210)	0.0160*** (0.00321)	0.0160*** (0.00321)	0.0160*** (0.00321)
noed	19408 (41100)	-0.0725 (0.0598)	-0.0773 (0.0595)	-0.0725 (0.0595)
child	-57376 (41826)	-0.0104 (0.0607)	-0.0135 (0.0593)	-0.0104 (0.0595)
marriage	-65494 (40397)	0.0365 (0.0587)	0.0376 (0.0588)	0.0365 (0.0587)
yearslocation	8319 (5245)	-0.000493 (0.00828)	-0.000133 (0.00889)	-0.000493 (0.00892)
logduration	-10673 (40987)	0.0548 (0.0621)	0.0498 (0.0630)	0.0548 (0.0632)
frmg	-675020 (515092)	-0.991 (0.733)		-0.991*** (0.237)
itmg	-602478** (261459)	-0.679* (0.372)		-0.679** (0.338)
Constant	-182179 (114419)	10.39*** (0.167)	10.39*** (0.167)	10.39*** (0.167)
Observations	1387	1331	1331	1331
R-squared	0.267	0.466	0.464	0.466

*Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$*

Table 4 shows the regressions including variables for migrant demographic characteristics, such as sex, age, education level, and urban household location. Model 5 is the level-level regression, while Model 6 is the log-level. The partial elasticities are significant for sex and age. Models 7 and 8 include the variables for motive, which are network support, regularity of remittances, whether the migrant is the child of the household head, whether the migrant is married, the duration of migration in Europe, and the logarithm of the duration of migration. Model 7 is the level-level regression, while Model 8 is the log-level. The partial elasticities for motive are significant for regular transfers only.

In addition to these variables, tests of the interactions between the transfer operators and the countries of origin show combinations had significant results. In Table 5, Models 9 and 10 include interactions of transfer method and country of origin for the two that showed significance, which were France and Italy with MoneyGram. Model 9 is the level-level regression and Model 10 is the log-level regression. Next, I ran the full log-level regression of the model without the interactions but with robust standard errors. This is Model 11, which shows significance at the 0.1% level for Western Union, MoneyGram, and all three countries. The Post is significant at 5% and Friend is significant at the 1% level. Regularity of remittances, age, and sex are all significant at 0.1%. The last model, Model 12, shows the robust standard errors and includes the two interactions. The interaction of France and MoneyGram is significant at the 0.1% level, and the interaction of Italy and MoneyGram is significant at the 5% level.

### *Interpreting Hypotheses*

Considering the significant results from the robust full log-level model with interactions, there are a number of important relationships. Migrants remitting through Western Union remit 51% more than they would if they were carrying money on their person, those using the Post remitted 24% more, those using MoneyGram remitted 97% more, and those using a friend remitted 22% less. It is clear that migrants using MoneyGram remitted more than any other method of transferring funds. It also makes sense that there are unobservable costs to trusting funds to an individual that are not present with transfers facilitated by companies. Appendix A shows test of the primary hypothesis, indicating that the methods are valuable predictors of remittances.

All three countries of origin are significant at 0.1% in the robust model. Immigrants living in France remitted 49% more than those living at home, those living in Italy remitted 50% more, and those living in Spain remitted 59% more. Migrants remitted the most from Spain, and the test of the secondary hypothesis, shown in Appendix B. There is evidence that the three country indicators are valuable in the regression.

### *Empirical Testing*

Heteroskedasticity was addressed in the regression through the natural log of the dependent variable and the use of robust standard errors. A test of heteroskedasticity in the full model without robustness standard errors shows that heteroskedasticity was a problem. In Appendix C, the Breusch Pagan test on the full log-level model with interactions shows that heteroskedasticity was present, because the null hypothesis of homoscedasticity should be rejected.

Appendix D shows the test for omitted variables that would result in bias omitted variable bias. The Ramsey RESET test shows that the null hypothesis of no misspecification should be

rejected, in favor of the alternative that there is a relevant variable omitted. This is not surprising because variables for motivation from the literature that were not available from the survey questions asked by the World Bank, and it is likely that others exist that are not observable.

Appendix E shows the test for endogeneity, the Durbin Wu Hausman test. First, the full regression is used to predict the residuals. The next step is the regression of each individual transfer method on all the other variables from the full model, and the residuals as another independent variable. Then, tests of the significance of the residuals in each regression show that the null hypothesis should be rejected for the test from each of the four transfer methods, Western Union, the Post, MoneyGram, and Friend, respectively. This indicates an endogeneity problem.

Price of formal transfer methods is determined partly by market power of companies in the market, which is not observable. Cost is also instrumented for in the literature with financial development and dollarization (Freund and Spatafora, 2008). To proxy for financial development, the instruments in this study are measures of financial depth and efficiency from the World Bank's Global Financial Development Database (GFDD). The ratio of deposit money bank assets to GDP, which includes total assets held by deposit money banks as a share of GDP, is the measure of depth. The cost to income ratio, or share of operating expenses of a bank from sum of net-interest revenue and other operating income, measures financial efficiency (The World Bank 2013). A multinomial logit regression of transfer method on the two measures of financial depth and efficiency, with the base outcome set as all the possible ways to transfer funds other than the four indicator variables, is shown in Appendix F. This regression shows the predicted probabilities of selecting each of the four transfer methods, based on financial efficiency and financial depth of the financial system in the sending country, which play a role in determining fees paid abroad. These probabilities are then used to instrument for the transfer methods in the full equation.

The results in Appendix G show that only Western Union is still significant among the transfer operators with these instruments, and none of the three countries are significant. Of the other variables, only regularity of remittances, sex, and age have significance. The results are altered quantitatively as well, but MoneyGram still results in the highest average remittances. The most striking difference in the methods of transfer is the increase in the coefficient on the indicator for friends carrying funds in person, which was negative without the instruments and is now larger than that on Western Union. This magnitude conflicts with the intuition that trusting funds to an individual has much higher effective cost which reduces the average remittance substantially from those made through a transfer operator. A possible interpretation of this result is that the monetary cost of other transfers is high enough that the migrant accepts the risk associated with a cheaper option.

## VI. CONCLUSION

The results of this study confirm findings from previous studies about remittances and uncover interesting new ideas as well. Migrants from Senegal in the sample tended to remit in high frequency and low magnitude. Those in Europe remitted more money and made more frequent transfers, on average. Though the full regression in the study did not stand up to endogeneity tests of the transfer methods, the results present potentially valid relationships. Firstly, migrants remit the most through MoneyGram, almost 40% more than they do through the other major transfer operator, Western Union. This indicates that either the monetary cost is much lower, or migrants face other costs by using Western Union. One possibility is that there is less access to Western Union for recipients of the transfers living in Senegal. The second interesting relationship is that migrants sending money back through other travelers send significantly less funds. The reason for this may be trust in the carrier of money or the amount of time required for the money to reach its destination. Third, migrants from Spain remit about 10% more than their counterparts in France and Italy. This may imply that work is more available, or that wages are higher, or any other number of factors.

Additionally, while several of the proxy variables for motive did not yield significant results, the regularity of transfers did. This indicates that migrants who are remitting regularly remit more money over the year. If this is an accurate proxy, this means that those migrants who are supplementing income regularly for their household in Senegal send more throughout the year. In terms of characteristics of the migrants, males remit a higher amount on average and those who are older remit more as well. Lastly, the interaction terms imply that, though migrants in the entire sample remit more through Money Gram, migrants in Italy and France remit less using MoneyGram. This suggests costs specific to those migrants in Italy to using the transfer operator.

While valid instruments would strengthen the validity of these results, they do present a basis for understanding certain aspects of the migrant decision travel from Senegal to Europe for work. It is clear that the majority of households interviewed had migrants that had traveled to Italy, France, or Spain and that they are able to send home more money from these three destinations this way. Based on the available information, however, we can see that certain costs lead migrants to remit more through MoneyGram and migrants in Spain remit more than migrants in other countries. Assessing what unobservable costs exist for each type of transfer, as well as collecting data on the actual price paid by the migrant in order to make a transfer, would allow the ideal analysis of the question at hand.

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**VIII. APPENDICES****Appendix A: Primary Hypothesis Test**

```
. test (westernunion post moneygram ami)
```

```
( 1) westernunion = 0
( 2) post = 0
( 3) moneygram = 0
( 4) ami = 0
```

```
F( 4, 1311) = 26.38
Prob > F = 0.0000
```

**Appendix B : Secondary Hypothesis Test**

```
. test (france italie espagne)
```

```
( 1) france = 0
( 2) italie = 0
( 3) espagne = 0
```

```
F( 3, 1311) = 18.63
Prob > F = 0.0000
```

**Appendix C : Breusch-Pagan Test for Heteroskedasticity**

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of logremit

```
chi2(1) = 5.23
Prob > chi2 = 0.0222
```

**Appendix D : Ramsey RESET test for omitted variables**

Ramsey RESET test using powers of the fitted values of logremit

Ho: model has no omitted variables

```
F(3, 1308) = 9.30
Prob > F = 0.0000
```

**Appendix E : Durbin–Wu–Hausman test for Endogeneity**

```
. test remittances_res
( 1) remittances_res = 0
      F( 1, 1310) = 6.6e+16
      Prob > F = 0.0000

. test remittances_res
( 1) remittances_res = 0
      F( 1, 1310) = 7.9e+15
      Prob > F = 0.0000

. test remittances_res
( 1) remittances_res = 0
      F( 1, 1310) = 4.0e+16
      Prob > F = 0.0000

. test remittances_res
( 1) remittances_res = 0
      F( 1, 1310) = 1.1e+16
      Prob > F = 0.0000
```

**Appendix F : Multinomial Logit Regression Output**

VARIABLES	(1) 2	(2) 3	(3) 4	(4) 5
depth	0.0155*** (0.000944)	-0.000684 (0.00199)	0.0164*** (0.00201)	-0.00113 (0.00142)
efficient	-0.00967*** (0.00306)	-5.28e-05 (0.00473)	-0.0187** (0.00741)	0.00271 (0.00349)
Constant	-1.289*** (0.200)	-2.036*** (0.299)	-3.321*** (0.507)	-1.367*** (0.222)
Observations	2207	2207	2207	2207

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Appendix G: Instrumental Variable Regression Output**

VARIABLES	(1) logremit
westernunion	2.330*** (0.892)
post	1.364 (2.179)
moneygram	4.588 (2.813)
ami	2.516 (2.380)
france	0.297 (0.201)
italie	0.162 (0.292)
espagne	0.137 (0.272)
urban	0.0291 (0.141)
networksupport	0.00808 (0.104)
regular	1.432*** (0.182)
male	0.397***

	(0.153)
age	0.0118** (0.00573)
noed	-0.0998 (0.141)
child	0.0323 (0.120)
marriage	0.0602 (0.108)
yearslocation	-0.00449 (0.0150)
logduration	0.101 (0.134)
frmg	-2.893 (2.630)
itmg	-2.539 (2.530)
Constant	8.899*** (1.161)

---

Observations	1331
--------------	------

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1