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Workers' Remittances and Financial Inclusion

by Sami Ben Naceur, Ralph Chami and Mohamed Trabelsi

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Institute for Capacity Development and Middle East Center for Economics and Finance

Workers' Remittances and Financial Inclusion**Prepared by Sami Ben Naceur, Ralph Chami and Mohamed Trabelsi¹**

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Abstract

This paper explores the relationship between remittances and financial inclusion for a sample of 187 countries over the period 2004-2015, using cross-country as well as dynamic panel GMM regressions. The data on financial inclusion is collected from the IMF data set on financial inclusion while the explanatory variables are extracted from the World Development Indicators. We find that at low levels of remittance-to-GDP, these flows tend to *reduce* inclusion through formal channels. On the other hand, these flows tend to *enhance* inclusion, when remittance-to-GDP ratio is high. This nonlinear relationship has a remittance-to-GDP threshold of about 13%, on average. This result would suggest that when remittance flows are low, they act as a substitute for formal credit channels, by satisfying consumption demand by credit-constrained households, reducing the demand for bank credit while they are not large enough to increase the supply of bank credit. In contrast, when remittances are large enough, they tend to act as a complement to bank credit, by raising household savings in formal banking institutions. These flows lead to an increase in the demand for and supply of bank credit. This nonlinear result seems to hold in countries with stable financial systems. Interestingly, in fragile states characterized by markets with severe asymmetric information problems and absence of credit risk assessments, remittances do not seem to increase access to bank credit.

JEL Classification Numbers: F36, G21, O16

Keywords: Remittances, Financial Inclusion

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1. Introduction

The recent decade witnessed a substantial increase in remittance inflows to low and middle-income countries (LMICs) reaching 421.8 USD billion in 2015. Remittances are the second most important source of foreign finance in these countries, ranking after FDI inflows since 1996, in both percent of GDP and billions USD, ahead of both aid received and portfolio inflows (see Figures 1 and 2).

The increasing importance of remittances has raised interest in studying their development impact in policy and academia. The different contributions touch several dimensions, including growth (Chami et al. (2005), Cáceres and Saca (2006), Chami et al. (2008), Mundaca (2008), and Giuliano and Ruiz-Arranz (2009), Barajas et al. (2009), Chami, Hakkura and Montiel (2009)), poverty (Adams (2004) and (2006), Acosta et al. (2007), Anyanwu and Erhijakpor (2010) Inoue (2011), Inoue and Hamori (2012)), education (Yang (2008), Adams and Cuecuecha (2010), and Bredl (2011)), labor supply ((Kim (2007), Rodriguez and Tiongson (2001), Chami et al. (2018b)), health (De and Ratha (2012)), and entrepreneurship (Amuedo-Dorantes and Pozo (2006), Yang (2008)).

In addition, another part of the empirical literature highlights the positive effect of remittances on financial sector development (Martínez Pería, Mascaró, and Moizeszowicz (2008); Gupta, Pattillo, and Wagh (2009); Aggarwal, Demirgüç-Kunt, and Martínez Pería (2011); Chowdhury (2011); Cooray (2012), Chami et al. (2018a)). The empirical literature suggests that remittances are likely to promote financial development if worker transfers are transformed into available loanable funds for the private sector in financial intermediaries.

However, it is worth noting that promoting financial development does not necessarily mean that remittances induce more inclusiveness in the financial sector (Ansoategui, Demirgüç-Kunt and Martínez Pería (2014)). Remittances are likely to improve financial access and inclusiveness when unbanked recipient households deposit their money in the financial sector and benefit from the multitudes of financial services offered by formal institutions (Inoue and Hamori (2016)). The topic of financial inclusion has gained importance since it has been integrated in the development agenda by the G20 in 2013. The percentage of people with bank accounts across the world is still relatively low in some regions: 55% in East Asia, 39%

in Latin America, 35% in Eastern Europe, 33% in South East Asia and 25% in Sub Saharan Africa (Aga and Martínez Pería (2014)).

The literature on remittances and financial inclusion follows two strands where the first one is composed of papers based on household surveys while in the second we have cross-country studies. The literature using household surveys generally finds that remittances are positively and significantly correlated with whether a household has a bank account or savings account, but they are not significantly correlated with whether a household has requested or received a loan.

Anzoategui, Demirgüç-Kunt, and Martínez Pería (2014) used household level data in El Salvador over the years 1996, 1998, 2000, and 2002 to explore the relationship between remittances and financial inclusion in El Salvador. They found that remittances are positively and significantly correlated with households' use of deposit accounts, but not significantly correlated with their demand and use of formal loans. Aga and Martínez Pería (2014) used World Bank survey data covering 10,000 households in five Sub-Saharan African countries (Burkina Faso, Kenya, Nigeria, Senegal and Uganda) to test the impact of remittances on household financial inclusion. They found that, in presence of remittances, the probability to open a bank account increases. Ambrosius and Cuenca (2016) used data in Mexico for 7,572 households for 2002 and 2005 to investigate the effect of remittances on the use of formal and informal financial services. They found that remittances are positively and significantly correlated with the ownership of savings accounts and recent borrowing. However, the authors point out that informal finance seems to play an important role in accounting for the remittances and borrowing nexus which highlights the deficiencies of the formal banking market. Demirgüç-Kunt, Lopez-Córdova, Martínez Pería, and Woodruff (2011) use municipality level data on the fraction of households receiving remittances in Mexico to investigate the effects of remittances on banking breadth and depth. They find that remittances are positively and significantly correlated with bank branches per capita, bank accounts per capita, and deposits to GDP.

The second strand of the literature focuses on cross-country empirical investigations.

Aggarwal, Demirgüç-Kunt, and Martínez Pería (2011) used a panel of 109 countries over the period 1975 – 2007 to test the effect of remittances on financial development. They found

that remittances are positively and significantly correlated with credit and deposits to GDP ratios. Inoue and Hamori (2016) test the impact of remittance inflows on access to formal financial services using a panel data of 38 developing countries in Asia and Oceania over the period 2001 - 2012. The results highlight a robust positive impact of remittances on the branch network of commercial banks. Giuliano and Ruiz-Arranz (2005) used GMM dynamic panel estimations for 73 developing countries over the 1975-2002 to show that remittances are more effective in promoting growth in less financially developed countries.

Although there seems to be different results among several empirical investigations regarding the effect of workers' remittances on the number of banks accounts held by households and the on their requests for bank loans, the literature to did not try to reconcile these findings through using more comprehensive empirical models that allow for the presence of a non-monotonic effect in the remittances and financial inclusion nexus. To the best of our knowledge, there is no evidence that tried to test the presence of non-linear relationship when it comes to the effect of remittances on bank accounts or the access to loans in the banking sector.

In this paper we find that that there can be indeed a "U" shaped relationship between workers' remittances and financial inclusion. The intuitive explanation for this non-monotonic and "U" shaped relationship is that remittances start producing more inclusiveness in the financial sector only starting from a threshold. One explanation of this result is that in LMICs, low levels of remittances' inflows tend to serve rather consumption and investment purposes as poor households would prefer to use the deposits generated by remittances to overcome liquidity constraints given credit market imperfections. The demand for financial services would be very low and /or insignificant. Workers' transfers start producing more inclusiveness in the financial sector only if they are higher than a threshold. High remittances are assumed to boost the demand for safe storage by recipient households and the supply of financial services by formal banking institutions that are likely to improve the access to and use of loans and financial inclusion.

If the intuitive explanation is true and that the relationship between workers' remittances and financial inclusion is "U" shaped, this means that empirical models that do not allow for non-monotonicity are biased. The ambiguous effect of remittances on requests of bank loans

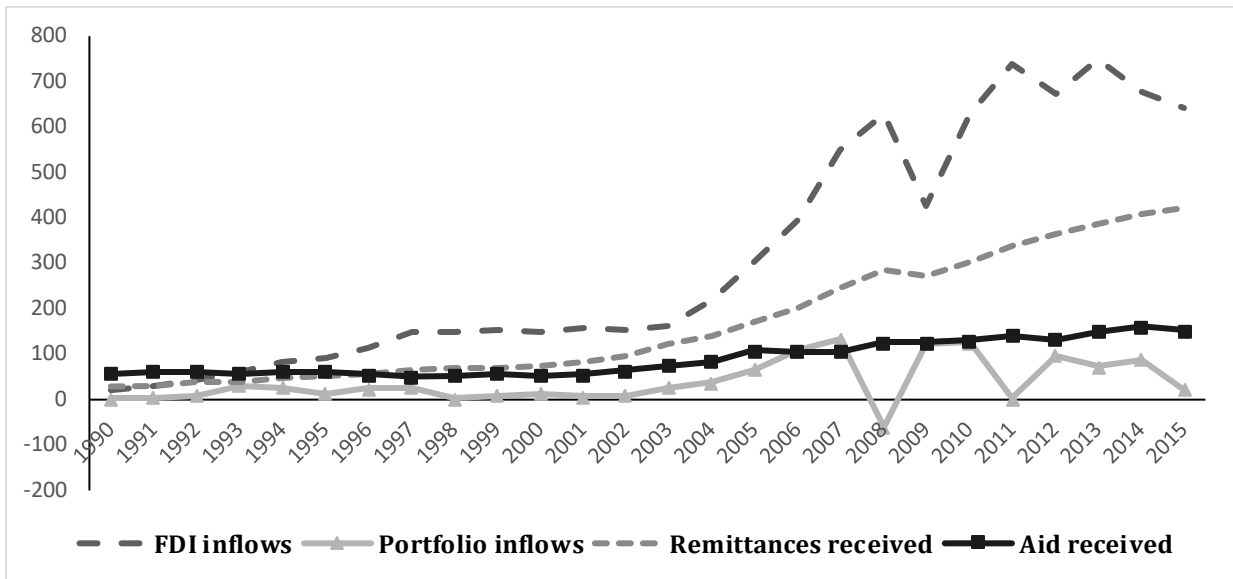
seems therefore to be driven not by a change in the fundamental relationship but by the misspecification of the determinants of financial inclusion.

This paper uses a large sample of 187 countries, including low, middle and high-income countries, and Generalized Method of Moments (GMM) regressions over the period 2004-2015, to show that financial inclusion starts being positive only when remittances reach the threshold of 13% of GDP in Low- and Middle-Income Countries (LMICs). This result is consistent with many measures of financial inclusion including the number of commercial bank branches per 100,000 adults (Branches) and Automatic Teller Machines per 100,000 adults (ATMs), the number of deposit accounts in commercial banks per 1,000 adults (Deposits), the average number of borrowers per 1,000 adults (Borrowers), and a weighted Financial Inclusion index (FII). These proxies are considered appropriate for representing financial access (Burgess and Pande (2005); Beck, Demirgüç-Kunt, and Martínez Pería (2007)) and has little missing observations (Inoue and Hamori (2016)).

This study, to the best of our knowledge, is the first to use such a large sample with heterogenous countries classified according to their income levels. The reason for classification is that LMICs are receiving most of the remittances across the world while in high income countries remittances are much lower than their LMICs average. Furthermore, unlike other contributions, this paper uses a macroeconomic approach to address the remittances and financial inclusion nexus; it focuses on the macroeconomic determinants of financial inclusion including remittances as a % of GDP. Financial inclusion is measured using the number of bank branches, deposits accounts, or borrowers.

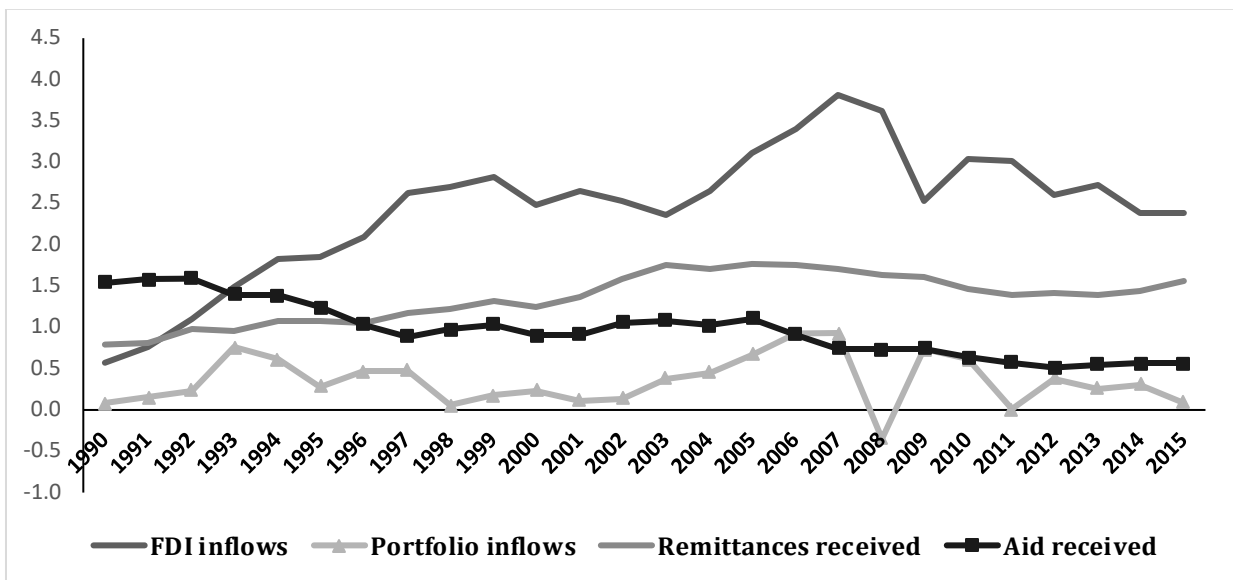
The rest of the paper is organized as follows: section 2 presents the literature on financial inclusion and remittances nexus; section 3 discusses the results of the empirical investigation; section 4 presents robustness analysis; and section 5 concludes the paper.

Figure 1: Inflows into low & middle-income countries (billions USD), 1990-2015



Source: World Development Indicators of the World Bank (2016)

Figure 2: Inflows into low & middle-income countries (% of GDP), 1990-2015



Source: World Development Indicators of the World Bank (2016)

2. Empirical methodology and data

The empirical investigation of the relationship between workers' remittances is based on the following equation:

$$FI_{i,t} = \alpha + \beta Remit_{i,t} + \delta X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

Where $FI_{i,t}$ represents the level of financial inclusion for country i in year t , $Remit_{i,t}$ represents remittances received by country i in year t , $X_{i,t}$ represents a vector of control variables, μ_i country-specific effect, λ_t time specific effect and $\varepsilon_{i,t}$ as an error term. In the Appendix Table 1 we find the definitions and sources of the all variables used in our estimations, while Appendix Table 2 provides the list of countries and periods. Tables 2 and 3 provide descriptive statistics and correlations, respectively.

We use, following Wang and Guan (2017), two dimensions to measure measures of financial inclusion (FI). The first-dimension deals with the access to financial services with two indicators that assess the outreach of financial services through the demographic penetration of the banking system. The first one is the number (in log) of branches of commercial banks per 100,000 adults (*Branches*) and the second is the number of ATMs per 100,000 adults (*ATMs*).

The second dimension reflects the usage that can everyone have of financial services. Indicators of this dimension are the log of deposit accounts with commercial banks per 1,000 adults (*Deposits*) and the log of the number of borrowers at commercial banks per 1,000 adults (*Borrowers*). All the measures of *Branches*, *ATMs*, *Deposits* and *Borrowers* are collected from the Financial Access Survey carried out by the International Monetary Fund as specified in Appendix Table 1. The two dimensions (access and usage) and four indicators are summarized in the following table:

Table 1: Dimensions and indicators of financial inclusion

Dimension		Indicators
Access	<i>Branches</i>	Branches of commercial banks per 100,000 adults
	<i>ATMs</i>	ATMs per 100,000 adults
Usage	<i>Deposits</i>	Deposit accounts with commercial banks per 1,000 adults
	<i>Borrowers</i>	Borrowers at commercial banks per 1,000 adults

As a last measure of financial inclusion, we use, following Wang and Guan (2017), a financial inclusion index (*FII*) based on the above indicators. We start by computing for each dimension (i = Access, Usage) and *FII* is calculated as follows:

$$FII_i = 1 - \frac{\sqrt{\sum_{j=1}^n w_{ij}^2 (1-x_{ij})^2}}{\sqrt{\sum_{j=1}^n w_{ij}^2}} \quad (2)$$

Where x_{ij} is the transformed value of each indicator j relative to dimension i as follows:

$$x_{ij} = 1 - \frac{X_{ij} - Min_{ij}}{Max_{ij} - Min_{ij}} \quad (3)$$

X_{ij} is the actual value of the indicators j and *Max* and *Min* are the maximum and minimum of X_{ij} , respectively. w_{ij} are the weights of each indicator j relative to each dimension i and is defined as follows:

$$w_{ij} = \frac{CV_{ij}}{\sum_{j=1}^n CV_{ij}} \quad (4)$$

CV is the coefficient of variation of the indicator and is defined, following the ratio of standard deviation (σ) to the mean value (μ). Thus, the weights w_{ij} are defined as the ratio of each indicator's coefficient of variation CV to the sum of all indicators' CV.

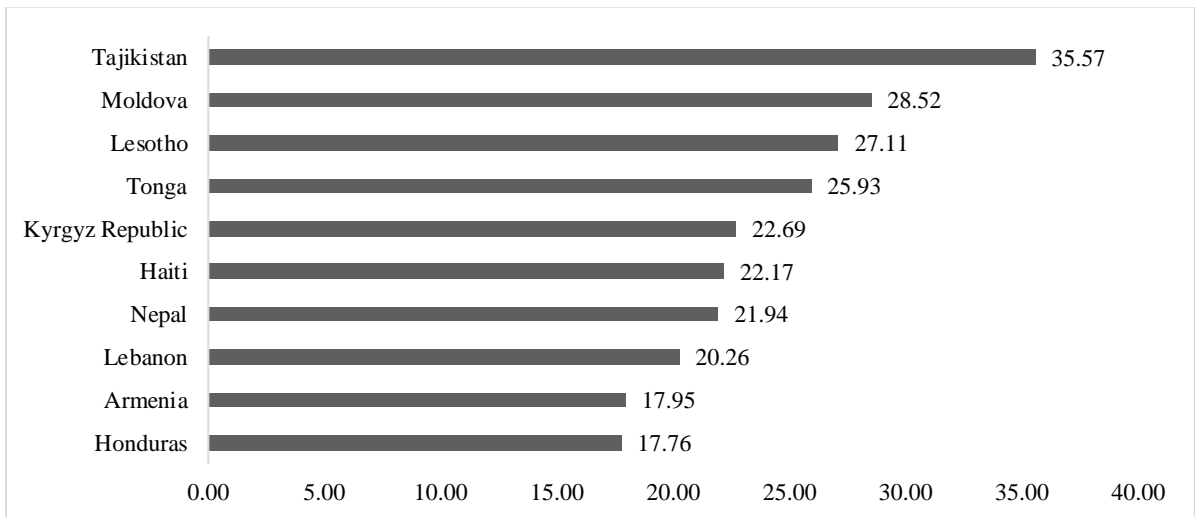
The financial inclusion index for all dimensions (*FII*) is therefore as follows:

$$FII = 1 - \frac{\sqrt{w_1^2(1-FII_1)^2 + w_2^2(1-FII_2)^2}}{\sqrt{w_1^2 + w_2^2}} \quad (2)$$

Where FII_1 and FII_2 are the financial inclusion indices for dimensions 1 and 2 (access and usage). w_1 and w_2 are the weights of the two dimensions. Wang and Guan (2017) calculated FII only 2011, while in this paper the effort consists in computing the indices for each year of the period 2004-2015. We also exclude the last indicator in Table 1 (*Borrowers*) from the FII because of data availability.

Regarding workers' remittances, they are measured by the ratio of received remittances to GDP and it is collected from the World Development Indicators of the World Bank (2016) based on averages for the period 2004-2015 and as percentages of GDP. For example, among the largest recipients, we find especially low-income countries such as Tajikistan (35.57%), Moldova 28.52%, Lesotho 27.11%, Tonga 25.93% and Kyrgyz Republic 22.69% (See Figure 3).

Figure 3: The 10 largest recipients of remittances (in % of GDP), 2004-2015.



Source: World Development Indicators of the World Bank (2016)

The matrix X in equation (1), refers to a set of control variables that are used as regressors. The first one is the logarithm of the GDP per capita (LGDP) expressed in 2010 US \$ as a proxy of the level of economic development. This variable is included on the ground that higher income levels would have a positive effect on financial inclusion as it is expected to

increase the demand for formal deposits and the available financial instruments in the banking sector (Sahay et al. (2015), Inoue and Hamori (2016)).

The second control variable is inflation and is measured as the percentage annual change of the consumer price index. Higher inflation is expected to push households to rely more on real assets to hedge against financial assets erosion and would end up hindering financial inclusion. This is also the case when it comes to financial deepening (Boyd et al. (2001)).

Table 2: Descriptive statistics

	Obs.	Mean	Std. Dev	Min	Max
<i>Branches</i>	2108	19.54	26.69	0.12	289.83
<i>ATMs</i>	1947	41.40	44.32	0	290.14
<i>Deposits</i>	1205	1110.86	1195.67	1.25	12.420.85
<i>Borrowers</i>	973	178.00	210.70	0.01	1156.04
<i>FII</i>	1107	0,10	0.09	0	0.69
<i>Remittances</i>	2060	4.71	6.85	0.00	49.28
<i>Log GDP per capita</i>	2197	8.45	1.49	5.32	11.60
<i>Inflation</i>	20.77	0.18	5.36	-0.35	244.11
<i>Trade</i>	2121	0.93	0.54	0.00	4.55
<i>Kaopen</i>	1877	4.27	1.60	-1.89	2.38

Source: Authors computations

The third regressor included is *Trade* which is measured as the ratio of the sum of exports and imports to GDP $((X+M)/GDP)$. Higher volumes of trade are likely to generate more payments to exporters and importers and create higher demand for financial instruments and more inclusion in the banking sector. Thus, the coefficient of *Trade* is expected to be positive in equation (1).

The last variable among the regressors is the state of financial openness and is measured by the Chinn and Ito's capital account openness index, generally known with the acronym of *kaopen* (Chinn and Ito (2011)). This index, initiated by Chinn and Ito (2006), is based on binary dummy variables setting codes on the restrictions on external accounts reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) for each country.

The index takes high values to indicate more openness of the economy to cross-border capital flows. More financial openness is expected to have a positive effect on financial inclusion and any increase in capital inflows in recipient countries is likely to increase the demand for financial products at formal institutions. The literature has already established a positive relationship between capital account liberalization and financial development (Summers (2000), Klein and Olivei (2008), Chinn and Ito (2002), Chinn and Ito (2006), Eichengreen, Gullapalli and Panizza (2011))

Table 3: Correlation Matrix

	Branches	ATMs	Deposits	Borrowers	FI Index	Remittances	GDP per capita	Inflation	Trade	Kaopen
Branches	1.00									
ATMs	0.52	1.00								
Deposits	0.46	0.69	1.00							
Borrowers	0.40	0.70	0.75	1.00						
FI Index	0.77	0.88	0.85	0.73	1.00					
Remittances	-0.01	-0.17	-0.03	-0.13	-0.08	1.00				
GDP per capita	0.49	0.73	0.71	0.70	0.78	-0.20	1.00			
Inflation	-0.03	-0.03	-0.04	-0.04	-0.04	-0.03	-0.06	1.00		
Trade	0.12	0.20	0.47	0.20	0.32	0.14	0.33	0.001	1.00	
Kaopen	0.30	0.42	0.40	0.39	0.45	-0.06	0.47	-0.07	0.15	1.00

Source: Authors Computations

GMM Dynamic panel estimations

The estimation of equation (1) is carried out using the dynamic panel GMM techniques, following Inoue and Hamori (2016), Aga and Martínez Pería (2014), Anzoategui, Demirgüç-Kunt, and Martínez Pería (2014) and Ambrosius and Cuecuecha (2016). Specifically, we use the GMM estimator in system as follows:

$$FI_{i,t} = \alpha FI_{i,t-1} + \beta Remit_{i,t} + \delta X_{i,t} + \mu_i + \lambda_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$\Delta FI_{i,t} = \alpha \Delta FI_{i,t-1} + \beta \Delta Remit_{i,t} + \delta \Delta X_{i,t} + \Delta \lambda_{i,t} + \Delta \varepsilon_{i,t} \quad (7)$$

Where $FI_{i,t-1}$ is the lagged dependent variable and Δ is the first difference operator. Equations (6) and (7) are estimated using a GMM panel estimator that combines the regressions in differences with those in levels, following Arellano and Bover (1995) and Blundell and Bond (1998). This estimator uses instruments to deal with the issue of endogeneity of explanatory variables and the correlation between the lagged dependent variable ($\Delta FI_{i,t-1} = FI_{i,t-1} - FI_{i,t-2}$) and the error term ($\Delta \varepsilon_{it} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$). It is known as a *system* GMM estimator which improves the efficiency (Blundell, Dearden, Goodman, & Reed, (2000)).

Two tests are used to check for the consistency of the system represented by equations (6) and (7). The first one is the autocorrelation test AR(2) for the autocorrected disturbances in equation (7). The second test is the validation of the instruments in the GMM system and it is carried out using the Hansen test of over-identifying restrictions. Finally, the panel used in the empirical investigation is composed of 187 countries over the period 2004-2015.

2.1 Results

Table 4 displays the GMM dynamic panel estimates using the same proxies of financial inclusion for the whole panel. Column (1) shows the coefficients of the regression with *Branches* as a measure for financial inclusion. The coefficient of remittances (*Remit*) is positive (0.0007) and statistically insignificant at standard confidence levels with a robust Hansen test of the overidentifying restrictions (+0.12). This means that higher workers' transfers are not likely to increase the number of commercial banks' branches per 100,000 adults. In other words, more transfers from expats are not found to encourage banking institutions to create more branches to allow recipient households to access more services from these institutions.

Table 4: Remittances and Financial inclusion, GMM dynamic panel estimates for the whole sample: 2004-2015.

	Dependent variable					
	<i>Branches</i>	<i>ATMs</i>	<i>Deposits</i>	<i>Borrowers</i>	<i>FII</i>	<i>FD</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>L.Branches</i>	0.9180*** (18.55)					
<i>L.ATMs</i>		0.8465 *** (33.82)				
<i>L.Deposits</i>			0.7815*** (12.02)			
<i>L.Borrowers</i>				0.7961*** (11.46)		
<i>L.FII</i>					0.7723*** (15.84)	
<i>L.FD</i>						0.7671*** (15.69)
<i>Remit</i>	0.0007 (0.72)	0.0032 (1.09)	0.0002 (0.04)	0.0013 (0.55)	0.0005 (0.14)	0.0031*** (2.85)
<i>LGDP</i>	0.0331 (0.48)	0.0799*** (3.35)	0.1231** (2.34)	0.1435* (1.82)	0.1768*** (3.02)	0.1214*** (3.89)
<i>Inf</i>	-0.0259*** (-3.00)	-0.0001 (-1.38)	0.0077 (0.98)	-0.0735*** (-6.66)	-0.0022*** (-6.42)	-0.2644* (-1.75)
<i>Trade</i>	0.0463* (1.79)	0.0112 (0.53)	0.0651* (1.80)	0.0699 (1.23)	0.0773** (2.05)	0.0423* (1.91)
<i>Kaopen</i>	0.0086 (0.70)	0.0010 (0.10)	0.0021 (0.13)	0.0005 (0.03)	-0.0964*** (-2.66)	-0.0116 (-1.06)
<i>Constant</i>	-0.1817 (-0.32)	-0.2233 (-1.14)	0.3778** (2.33)	-0.2372 (-0.65)	-2.0691*** (-3.36)	-0.1778*** (-1.32)
Observations	1323	1276	762	558	741	1450
AR(2) test, p-level	0.765	0.457	0.769	0.941	0.486	0.776
Hansen test, p-level	0.120	0.121	0.385	0.362	0.222	0.508

t-statistic in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

The coefficient of the GDP per capita is (*Lgdppc*) is positive but insignificant at the 99% confidence level (+0.0331) which doesn't confirm the above assumptions about the role of economic activity in boosting financial inclusion. This means that higher income is not likely to increase either the demand for deposits or other financial instruments for investment purposes.

The rest of the variables in column (1) show correct coefficients for inflation where the coefficient is negative and significant at the 1% level, confirming the above predictions of the literature. Openness to trade is found to have the expected positive effect on financial inclusion as the coefficient of *Trade* is positive and significant at standard risk levels. This means that allowing enterprises to be more involved in the exchange of commodities and services is likely to increase the demand for financial services from formal financial institutions. In the same vein, the coefficient of financial openness (*kaopen*) is positive but insignificant meaning that more capital inflows in the recipient countries are not likely to produce higher demand for financial services and more inclusion accordingly.

The second proxy of financial inclusion in the access dimension is *ATMs*; it is used in column (2). The obtained results show a positive but insignificant coefficient for remittances (+0.0032). In addition, the coefficients of inflation (*Inf*), trade openness (*Trade*) and financial openness (*Kaopen*) are also insignificant at standard risk levels.

Regarding the usage of financial services, the estimations show positive but insignificant effect of remittances on both usage indicators (*Deposits* and *Borrowers* in (columns (3) and (4)) at the 10% level of risk. This means that households' deposits in banks coming from remittances are not likely to develop more financial services linked to savings or loans, which is contradicting the conclusions of Inoue and Hamori (2016) and Ambrosius and Cuecuecha (2016). The picture is not much different when using the financial inclusion index (*FII*) (column (5)), as the regression does not show a different pattern.

In column (6), the financial inclusion proxy is replaced with financial development (*FD*) that is measured by total credit to the private sector (%) of GDP. The objective to test if remittances are likely to have a positive effect on financial development. The estimated coefficient is positive (+0.4930) and significant at the 1% risk level and is inline with the literature on remittances and financial development nexus (Aggarwal, Demirgüç-Kunt, and Martínez Pería (2011)).

In Table 5, we split the whole sample into two sub-groups as we estimate the impact of remittances on financial inclusion for low- and middle-income countries (LMICS) and high-income countries (HICs). Column (1) shows the regression results carried out for LMICS with *branches* as a measure of financial inclusion and they look like those obtained with the whole sample (+0.0003). The results for high-income countries (HICs) do not show a different picture as the coefficient of *Remit* is negative and insignificant at standard risk level (-0.0036). For the rest of financial inclusion proxies, *Deposits* and *Borrowers*, the coefficients of remittances are very low (+0.0001) and +0.001, respectively and insignificant for the case of LMICS. With the financial inclusion index (*FII*), the coefficient of remittances is still positive and insignificant for LMICS but turns to be negative in the case of HICs.

Thus, the results of Table 5 are not different when we split the whole sample into low- and middle-income countries (LMICS) and high-income countries (HICs). They point, overall, to an insignificant effect of remittance inflows on all measures of financial inclusion and even with negative coefficients in the case of HICs.

Table 5: Remittances and Financial inclusion, GMM dynamic panel estimates: 2004-2015.

	Dependent Variable									
	<i>Branches</i>		<i>ATMs</i>		<i>Deposits</i>		<i>Borrowers</i>		<i>FII</i>	
	LMICs	HICs	LMICs	HICs	LMICs	HICs	LMICs	HICs	LMICs	HICs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>L.Branches</i>	0.8310*** (19.97)	0.9976*** (59.95)								
<i>L.ATMs</i>			0.7819*** (16.23)	0.8376*** (16.25)						
<i>L.Borrowers</i>					0.6165*** (12.55)	0.9892*** (39.54)				
<i>L.Deposits</i>							0.8274*** (10.90)	0.8793*** (16.54)		
<i>L.FII</i>									0.8759*** (26.6)	0.9632*** (24.83)
<i>Remit</i>	0.0003 (0.14)	-0.0182 (-1.18)	0.0012 (0.55)	-0.0105 (-1.13)	0.0001 (0.03)	-0.0055 (-0.40)	0.0010 (0.40)	-0.0207 (-1.25)	0.0014 (0.63)	-0.0121 (-1.32)
<i>LGDP</i>	0.0571* (1.67)	-0.0331 (-0.92)	0.1199** (2.04)	-0.0361 (-0.64)	0.2716*** (4.93)	0.0002 (0.01)	0.1458 (1.50)	0.0357 (0.61)	0.0781* (1.78)	-0.0256 (-1.27)
<i>Inf</i>	-0.0426** (-2.31)	0.3115 (1.18)	-0.0001 (-0.38)	0.2989 (1.09)	-0.0027*** (-7.71)	0.2471 (1.24)	-0.0616*** (-6.68)	-0.0015 (-1.17)	-0.0017*** (-8.45)	0.3109 (1.66)
<i>Trade</i>	-0.0447 (-0.54)	0.0001 (0.01)	0.0838 (1.30)	0.1122** (2.04)	0.1918** (2.33)	0.0005 (0.01)	0.0983 (1.11)	0.0005 (1.40)	0.0075 (0.28)	0.0042 (0.30)
<i>Kaopen</i>	0.0519 (1.11)	-0.0211 (-0.63)	0.0146 (1.11)	0.0484** (2.05)	0.0201 (0.91)	-0.0169 (-0.86)	0.0183 (1.07)	0.0046 (0.17)	0.0044 (0.59)	0.0058 (0.55)
<i>Constant</i>	-0.1685 (-0.66)	0.3982 (1.23)	-0.3365 (-0.85)	1.1096 (2.27)	0.1381 (0.53)	0.1251 (0.48)	-0.3880 (-0.77)	0.3115 (0.50)	-2.9392** (-2.12)	0.1752 (0.76)
Observations	887	290	874	326	614	128	457	103	553	187
AR(2) test, p-level	0.796	0.820	0.490	0.238	0.695	0.712	0.95	0.300	0.498	0.098
Hansen test, p-level	0.316	0.373	0.601	0.676	0.234	0.905	0.382	0.949	0.348	0.945

t-statistic in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

At a first sight, this result seems surprising as it expected that workers' remittances would play a positive role in promoting financial inclusion. However, it might be acceptable if we deeply review of the literature. In fact, Ambrosius and Cuecuecha (2016) claim that "*the effect of remittances on access and the use of financial services is not straightforward...In particular, research so far failed to provide a clear picture on whether remittances have positive impact on access to and the use of credit*" P 81. Indeed, if parts of the households receiving remittances have still no or limited access to formal loans, this should be considered in investigating the effect of remittances on the use financial services. In other words, if the households are receiving remittances but only contributing to increase deposits in the banking sector and serving only consumption purposes without any effect on savings and borrowing, the expected impact on financial inclusion will be very weak or even insignificant.

Thus, a significant effect on financial inclusion would need enough transfers to households through the banking sector that are likely to boost savings and develop financial services for households and allow them to access more loans. Because of that, we think that the positive effect of remittances on financial inclusion cannot be obtained unless *enough* workers' incomes are transferred to the banking sector and used to facilitate the access to loans and borrowing in the economy. This explanation might be a reason behind the different results between the positive effect of remittances on financial development (column (6) in Table 4) and the absence of any significant effect on financial inclusion (Ansoategui, Demirgüç-Kunt and Martínez Pería (2014)). In other words, remittances are likely to improve the access to and usage of financial services only if unbanked income transfers are deposited in the financial sector so that recipient households can benefit from the institutions (Inoue and Hamori (2016)). And if remittance inflows are not *high enough* in the country, this has low likelihood to happen.

Furthermore, a thorough review of the literature on the remittances and financial inclusion nexus seems supportive of such an assumption. In fact, part of the literature claims that remittances play the role of a substitute for credit in the sense that when households are credit constrained they tend to use income transfers from abroad to fill consumption and investment gaps. Thus, because of credit market imperfections, poor households use remittances to

overcome liquidity constraints that restrict the access to loans that would finance investment in physical and human capital (Calero, Bedi and Sparrow, (2009); Taylor & Wyatt, (1996)).

The second part of the literature highlights the role of remittances in boosting the amount of deposits. Banking institutions have interest in targeting remittances given their effect on deposits, while for remittances receiving households' higher transfers of incomes from abroad are likely to increase their demand for savings available in the banking system (Aggarwal, Demirgüç-Kunt, and Martínez Pería (2011), Ashraf, Aycinena, Martínez, and Yang (2015)).

These conflicting views in the literature might bring support to the above explanation of the absence of positive effect of remittance inflows on financial inclusion with GMM dynamic panel estimations. The above explanation means that the effect of received remittances on the access and use of financial services is conditional on some pre-requisites and conditions. Specifically, the assumption, that a positive effect of remittances on inclusiveness would need *enough* remittance inflows in the economy, means the possibility of a threshold after which we expect financial inclusion to be increasing with remittances. This means that the relationship between remittances and financial inclusion might be non-linear and with a "U" shape that induces such threshold.

One way to take into consideration such a threshold is to add the squared remittances ($Remit^2$) to the of determinants of financial inclusion in equations (6) and (7) as follows:

$$FI_{i,t} = \alpha FI_{i,t-1} + \beta Remit_{i,t} + \gamma Remit_{it}^2 + \delta X_{i,t} + \mu_i + \lambda_{i,t} + \varepsilon_{i,t} \quad (8)$$

$$\Delta FI_{i,t} = \alpha \Delta FI_{i,t-1} + \beta \Delta Remit_{i,t} + \gamma \Delta Remit_{it}^2 + \delta \Delta X_{i,t} + \Delta \mu_i + \Delta \lambda_{i,t} + \Delta \varepsilon_{i,t} \quad (9)$$

According to the above intuitive explanation, we expect financial inclusion to be increasing with remittances only after a given level of remittances (as a % of GDP) represents a minimum.

This means that the coefficient of $Remit^2$ should be positive while the coefficient of $Remit$ is negative. With such specification, we have a "U" shaped relationship between remittances and financial inclusion, and the remittances threshold $Remit_{it}^*$ is obtained by deriving $FI_{i,t}$ with respect to $Remit_{i,t}$ and will as follows:

$$Remit_{it}^* = \frac{\beta}{2\gamma} \quad (10)$$

This intuitive explanation should reconcile the two views in the literature presented above. For low levels of remittances ($Remit_{it} < Remit_{it}^* = \frac{\beta}{2\gamma}$), there is a high likelihood that they would serve consumption purposes for receiving households without significant effects on financial inclusion especially when the income transfers are carried out through informal channels. However, with remittance levels higher than the threshold ($Remit_{it} > Remit_{it}^* = \frac{\beta}{2\gamma}$), we expect more savings and access to loans through formal banking institutions and thus higher financial inclusion.

Table 6 displays the results of the GMM dynamic panel estimates of the regressors in equation (6) and (7) augmented with the remittances squared ($Remit^2$) to reflect the non-monotonic nature of the relationship between financial inclusion and remittances. The estimates are carried out using *all* proxies of financial inclusion for the whole panel.

In column (1) we use *Branches* as a proxy for financial inclusion for the whole sample, and it shows that the coefficient of $Remit^2$ is positive and statistically significant at the 90% confidence level while the coefficient of $Remit$ is negative and statistically significant at the same confidence level. Column (2) displays the estimated coefficient for $Remit^2$ with the *ATMs* as the dependent variable and is similar to those in column (1). The usage dimension indicators of financial inclusion, i.e. *Deposits* and *Borrowers*, do not display a different outcome as the coefficients of the quadratic term ($Remit^2$) are with positive and significant at standard confidence levels ((columns (3) and (4)). With the financial inclusion index (*FII*) in column (5), we find that the coefficients associated with the linear and Quadratic terms are significantly negative and positive, respectively. This means that the relationship between financial inclusion and remittances tends to be non-monotonic and convex and takes a ‘‘U’’ shape with a threshold for remittances after which it impacts positively financial inclusion.

Table 6: Remittances and financial inclusion, GMM dynamic panel estimates of the ‘‘U’’ relationship: 2004-2015.

	Dependent Variable				
	<i>Branches</i>	<i>ATMs</i>	<i>Deposits</i>	<i>Borrowers</i>	<i>FII</i>
	(1)	(2)	(3)	(4)	(5)
<i>L.BranchesI</i>	0.9431*** (46.32)				
<i>L.ATMs</i>		0.8491 *** (22.72)			
<i>L.Deposits</i>			0.8122 (12.81)		
<i>L.Borrowers</i>				0.8948*** (16.10)	
<i>L.FII</i>					0.7900*** (22.44)
<i>Remit</i>	-0.0189** (-2.14)	-0.0208** (-2.44)	-0.0181* (-1.87)	-0.0179** (2.43)	-0.0171* (-1.69)
<i>Remit²</i>	0.0004* (1.93)	0.0005** (2.20)	0.0008** (2.43)	0.0004** (2.55)	0.0007** (2.27)
<i>LGDP</i>	-0.0261 (-1.35)	0.0333 (0.94)	0.0881* (1.71)	0.0281 (0.51)	0.1125*** (3.21)
<i>Inf</i>	-0.0004 (-0.91)	-0.0007*** (-3.18)	0.0010 (0.14)	-0.0666*** (-6.12)	-0.1188 (-0.43)
<i>Trade</i>	0.0456* (1.69)	0.0129 (0.53)	0.0549** (2.07)	0.0875 (1.62)	0.0165 (0.77)
<i>Kaopen</i>	0.0125 (1.28)	0.0159* (1.70)	0.0079 (0.60)	0.0116 (1.07)	0.0046 (0.42)
<i>Constant</i>	0.3704*** (2.17)	0.3143 (1.33)	0.5239*** (3.15)	0.3189 (1.31)	-1.4430*** (-3.63)
Observations	1266	1280	762	558	692
AR(2) test, p-level	0.897	0.473	0.681	0.86	0.378
Hansen test, p-level	0.173	0.116	0.461	0.724	0.27
Threshold	23.6%	20.8%	11.3%	22.4%	12.2%

The bottom panel of Table 6 reports the standard tests relative to the GMM dynamic panel estimates and show that all specifications do not reject the null of no second order correlation. Also, the Hanson tests of overidentifying restrictions provide support for the validity of the restrictions. The resulting thresholds from Table 6 estimates for the whole set of countries is varying between 11.3% and 23.6% according to the used proxy for financial inclusion.

2.2 Do country income levels matter in the non-monotonic nature of the relationship?

To explore the non-monotonic relationship between remittances and financial inclusion according to the level of income of countries, we estimate the determinants of financial inclusion represented by equations (7) and (8) separately for LMICs and HICs. Table 7 displays the output of the estimations for both subgroups.

In column (1) of Table 7, we estimate the quadratic relationship for the LMICs using *Branches* as a proxy of financial inclusion. The results look like those of Table 6 as the coefficients of the quadratic and linear terms ($Remit^2$ and $Remit$) are positive and negative and significant at the 10% risk level, respectively, and tend to corroborate the non-monotonic nature of the relationship in the case of LMICs with a threshold for remittances standing at a high of 15.7%. This means that only beyond such level of 15.7% for remittances (as a % of GDP) in LMICs that the relationship has an increasing slope. Regarding high-income countries (HICs), the estimates show that mostly the coefficients of $Remit$ and $Remit^2$ are mostly non-significant at standard confidence levels though they display the right sign.

The second measure of financial inclusion (*ATMs*) in column (3) for LMICs also seems producing similar results as the evidence is bringing support to the quadratic shape with positive and significant coefficient for $Remit^2$ at the 95% confidence level. The resulting threshold is also equal to 21.3%, and higher than the one in column (1).

In column (5) we use the number of deposit account holders at commercial banks and other resident banks, as a second proxy of financial inclusion (*Deposits*). The estimates also confirm the above results and the non-monotonic relationship between financial inclusion and remittances especially for LMICs. In fact, the results show that for these countries the threshold is lower than the previous cases as it stands at a high of 13.28%. This means that only in countries with received remittances (in % of GDP) higher than 13.3% financial inclusion will be increasing with remittances. This result is not surprising for this proxy and seems reflecting more the reality of LMICs. Having a high number of deposit account holders means that there is a higher probability that they would be used for consumption as well as investment purposes.

Finally, for the second indicator in the usage dimension (*Borrowers*) in (column (7)), the estimates show a similar trend for LMICs as they corroborate the non-monotonic nature of the relationship between financial inclusion and remittances with a threshold standing at a high of 22%. The financial inclusion index (*FII*) does not show a different picture though the threshold level is lower (13.0%)

Table 7: Remittances and financial inclusion according to income level, GMM dynamic panel estimates of the “U” relationship: 2004-2015.

	Dependent Variable									
	<i>Branches</i>		<i>ATMs</i>		<i>Deposits</i>		<i>Borrowers</i>		<i>FII</i>	
	<i>LMICs</i>	<i>HICs</i>	<i>LMICs</i>	<i>HICs</i>	<i>LMICs</i>	<i>HICs</i>	<i>LMICs</i>	<i>HICs</i>	<i>LMICs</i>	<i>HICs</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>L.Branches1</i>	0.9395*** (26.54)	0.9880*** (32.21)								
<i>L.ATMs</i>			0.8263*** (15.92)	0.9142*** (29.90)						
<i>L.Deposits</i>					0.8411*** (13.94)	0.9955 (30.75)				
<i>L.Borrowers</i>							0.9135*** (20.36)	0.9915*** (7.52)		
<i>L.FII</i>									0.7747*** (19.00)	0.9765*** (13.72)
<i>Remit</i>	-0.0378* (-1.94)	-0.0307 (-0.62)	-0.0256** (-2.28)	-0.0191 (-1.11)	-0.0186** (-2.25)	-0.0353 (-0.46)	-0.0220*** (2.97)	-0.0729 (-0.70)	-0.0235** (-2.26)	-0.0089 (-0.18)
<i>Remit</i> ²	0.0012* (1.71)	0.0148 (0.75)	0.0006** (2.20)	0.0028 (1.24)	0.0007*** (2.63)	0.0055 (0.32)	0.0005*** (3.15)	0.0081 (0.47)	0.0009*** (2.80)	-0.0002 (-0.03)
<i>LGDP</i>	-0.0258 (-0.87)	0.0276 (0.71)	0.1100* (1.67)	-0.0272 (-1.34)	0.0916* (1.73)	0.0068 (0.17)	0.0170 (0.29)	0.0111 (0.07)	0.0111 (0.07)	-0.0284 (-0.68)
<i>Inf</i>	-0.0383*** (-4.13)	0.5408 (1.19)	-0.0003 (-1.54)	0.1659 (1.50)	0.0025 (0.04)	0.2250 (0.75)	-0.0006*** (-6.19)	-0.1481 (-0.44)	-0.2887 (-0.87)	0.6202 (1.40)
<i>Trade</i>	0.0037 (0.09)	-0.0051 (-0.31)	0.0753 (1.30)	-0.0253 (-1.68)	0.0008** (2.32)	0.0405 (1.08)	0.0012 (1.52)	0.0881 (0.73)	0.0540 (1.32)	0.0029 (0.12)
<i>Kaopen</i>	0.0326** (2.03)	-0.0397 (-1.51)	0.0271 (1.65)	0.0053 (0.63)	0.0131 (1.06)	-0.0303 (-0.53)	0.0236* (1.72)	-0.0071 (-0.14)	0.0179 (1.33)	0.0166 (0.38)
<i>Constant</i>	0.4421* (1.85)	-0.1754 (-0.48)	-0.2583 (-0.62)	0.6969*** (3.75)	0.3191* (1.99)	0.0073 (0.01)	0.3351 (1.01)	-0.0541 (-0.05)	-1.9099 (-3.94)	0.1955 (0.51)
Observations	614	271	981	406	565	129	457	103	505	123
AR(2) test, p-level	0.237	0.840	0.804	0.435	0.704	0.462	0.851	0.510	0.374	0.665
Hansen test, p-level	0.345	0.439	0.270	0.998	0.813	0.898	0.983	0.949	0.949	0.962
Threshold	15.7%	-	21.3%	-	13.3%	-	22.0%	-	13.0%	-

t-statistic in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

The results found in Table 7 seems to be corroborated by the data resulting from bank balance sheets. In fact, we display in Table 8, following Chami et al. (2018a), the average of time, saving and foreign currency deposits (%) GDP, demand deposits (DD) and credit to the private sector (CSP) as a percentage of GDP, according to different intervals of remittances. The assumption here is that more financial inclusion is equivalent to higher financial services by financial institutions, including more deposits that would lead to more loans for recipient households.

Table 8: Deposits and credits in bank balance sheets of LMICS

	Time, saving and foreign currency deposits (%) GDP	Demand Deposits (%) GDP	Total Deposits (%) GDP	Total credit as a (%) of GDP
Remit \leq 1%	52.63	56.84	110.10	31.51
Remit \leq 5%	35.67	31.49	66.77	28.77
Remit \leq 10%	33.55	27.61	61.05	29.98
Remit \leq 11%	33.28	27.29	60.46	29.86
Remit \leq 12%	33.01	26.94	59.83	29.76
Remit \leq 13%	33.07	26.64	59.61	29.94
Remit \leq 14%	33.13	26.47	59.53	29.95
Remit \leq 15%	33.38	26.30	59.66	30.13
Remit \leq 20%	35.91	25.35	61.29	30.97
Remit \leq 25%	37.15	24.79	61.96	31.20
Remit \leq 30%	37.28	24.54	61.83	31.26

Data in Table (8) show that time, saving and foreign currency deposits in financial institutions are decreasing with remittances until the threshold of 12%. Starting from the level of 13% (Remit \leq 13%), households' behavior changes as deposits switches to a growing curve. The credits allocated by banks are flowing suit. This might be considered as a confirmation of the of the "U" shape relationship between remittance inflows and financial inclusion.

2.3 Do financial development levels matter in the non-monotonic nature of the relationship

To test the effect of financial development on the remittances and growth nexus, we split the LMICs sample into two sub-groups, less financially developed countries (*LFDCs*) and more financially developed countries (*MFDCs*). The LFDCs are the economies whose credit to the private sector ratio (% of GDP) is below the median level while the MFDCs have a higher CPY level than the median². The level of financial development is measured, following, Levine (1997) and De Gregorio and Guidotti (1995) by the credit to the private sector (% of GDP) (CPY). It is a widely used indicator in the empirical literature as it highlights the role of the banking sector in providing funding to private activities.

Table 9 displays the estimates of the non-monotonic relationship for LFDCs and MFDCs. The regressions are carried out with all the proxies of financial inclusion: *Branches*, *ATMs*, *Deposits*, *Borrowers* and the composite index *FII*. Column (1) shows the result of the regression using the *Branches* as dependent variable for *LFDCs*. The coefficient of remittances is negative and significant at the 10% risk level while the quadratic term $Remit_{it}^2$ is not significant. This latter turns to be significant at the 90% confidence level in column (2) when the regression is carried out for *MFDCs*. The picture does not look different when it comes to the rest of the proxies of financial inclusion, except for *Borrowers* (columns (7) and (9)) as the coefficients of $Remit_{it}$ and $Remit_{it}^2$ are significant at standard risk levels and with expected signs.

Thus, the non-monotonic relationship between workers' remittances and financial inclusion tends to be corroborated only when the financial system is developed enough to create more financial services for the economy, including new loans and facilities for businesses.

² The median is equal to 26.8%

Table 9 : Remittances and financial inclusion, the role of financial development, GMM dynamic panel estimates: 2004-2015.

	Dependent Variable									
	<i>Branches</i>		<i>ATMs</i>		<i>Deposits</i>		<i>Borrowers</i>		<i>FII</i>	
	<i>LFDCs</i>	<i>HFDCs</i>	<i>LFDCs</i>	<i>HFDCs</i>	<i>LFDCs</i>	<i>HFDCs</i>	<i>LFDCs</i>	<i>HFDCs</i>	<i>LFDCs</i>	<i>HFDCs</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>L.Branches1</i>	0.7826*** (10.54)	0.9999*** (82.53)								
<i>L.ATMs</i>			0.7913*** (11.33)	0.8508*** (25.54)						
<i>L.Deposits</i>					0.7745*** (8.98)	0.9519*** (33.70)				
<i>L.Borrowers</i>							0.6926*** (13.47)	0.7394*** (13.53)		
<i>L.FII</i>									0.7899*** (16.64)	0.7567*** (9.79)
<i>Remit</i>	-0.0191 (-1.02)	-0.0071* (-1.98)	-0.0139 (-0.96)	-0.0147** (-2.58)	-0.0113 (-0.68)	-0.0132* (-1.84)	-0.0341 (-1.46)	-0.0117* (-1.78)	0.0221* (1.69)	-0.0364*** (-3.06)
<i>Remit</i> ²	0.0004 (1.06)	0.0001* (1.69)	0.0003 (1.12)	0.0003** (2.15)	0.0006 (0.93)	0.0003* (1.72)	0.0008 (1.64)	0.0002* (1.96)	-0.0006 (-1.37)	0.0013* (3.06)
<i>LGDP</i>	0.0336 (0.60)	-0.0255 (-0.91)	0.1106* (1.80)	0.1047* (1.86)	0.1454** (2.57)	-0.0214 (-0.58)	0.2382** (2.15)	0.1561** (2.31)	0.1668*** (3.73)	0.1091 (1.58)
<i>Inf</i>	-0.0280 (-0.33)	0.0053 (0.45)	0.1253 (0.59)	-0.0005 (-2.22)	0.0785 (1.29)	-0.0080** (-2.10)	-0.1851 (-1.57)	-0.0013 (-2.34)	0.0798 (0.19)	-0.0025*** (-9.07)
<i>Trade</i>	-0.1065 (-1.12)	0.0003 (0.01)	0.0361 (0.25)	0.0714* (1.87)	0.0085 (0.11)	0.0259 (0.92)	0.4440* (1.91)	-0.0246 (-0.37)	0.0236 (0.23)	-0.0179 (-0.42)
<i>Kaopen</i>	0.0660** (2.02)	0.0004 (0.02)	0.0408 (1.55)	-0.0063 (-0.57)	0.0329 (1.27)	0.0016 (0.18)	0.0694* (1.72)	0.0069 (0.35)	0.0042 (0.25)	0.0042 (0.25)
<i>Constant</i>	0.0403 (0.10)	0.2812 (1.34)	-0.2999 (-0.78)	-0.2751 (-0.71)	0.2534 (1.09)	0.5888 (3.24)	-0.8034* (-1.08)	0.1584 (0.44)	-2.0221** (-3.94)	-1.3287* (-1.72)
Observations	371	463	309	457	247	336	232	247	210	343
AR(2) test. p-level	0.959	0.344	0.262	0.282	0.978	0.587	0.302	0.202	0.382	0.219
Hansen test, p-level	0.668	0.467	0.812	0.337	0.956	0.810	0.989	0.945	0.994	0.708

t-statistic in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

2.4 Do financial stability levels matter in the non-linear nature of the relationship

To explore if financial stability matter in the non-linear relationship between workers' remittances and financial inclusion, we split the LMICs sample into two sub-samples composed of less financially stable countries (LFSCs) and more financially stable countries (MFSCs) based on the median of the Z-score financial stability indicator³. LFSCs have lower values of their Z-score than the median of the sample while MFSCs have higher values.

Table 10 shows the GMM dynamic panel regressions for both sub-groups with all financial inclusion proxies. The regressions tend to show mostly that the non-linear relationship tends to be confirmed only in countries with more stable financial countries (MFSCs). In fact, the coefficients of the quadratic terms positive and significant at the 10% and 5% risk levels, respectively, and vary between 0.0001 and 0.0005, while the coefficients of linear term ($Remit_{it}$) are negative and significant at standard risk levels.

³ The Z-score is defined as follows: $Z = (ROA + CAP) / \sigma ROA$, Where ROA stands for return on Assets and CAP is the capitalization ratio and equal to equity to Assets (Equity/Assets) and σ is the standard deviation. The median of the Z-score for the whole sample of countries is equal to 9.62.

Table 10: Remittances and financial inclusion, the role of financial stability, GMM dynamic panel estimates: 2004-2015

	Dependent Variable									
	<i>Branches</i>		<i>ATMs</i>		<i>Deposits</i>		<i>Borrowers</i>		<i>FII</i>	
	<i>LFSCs</i>	<i>MFSCs</i>	<i>LFSCs</i>	<i>MFSCs</i>	<i>LFSCs</i>	<i>MFSCs</i>	<i>LFSCs</i>	<i>MFSCs</i>	<i>LFSCs</i>	<i>MFSCs</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>L.Branches1</i>	0.9071*** (20.26)	0.9916*** (72.70)								
<i>L.ATMs</i>			0.8196*** (19.27)	0.6540*** (6.45)						
<i>L.Deposits</i>					0.7237*** (5.57)	0.8762*** (11.63)				
<i>L.Borrowers</i>							0.9128*** (25.05)	0.9494*** (18.87)		
<i>L.FII</i>									0.9081*** (10.78)	0.9414*** (34.01)
<i>Remit</i>	-0.0177 (-1.04)	-0.0119** (-2.53)	-0.0063 (-0.76)	-0.0227** (-2.27)	-0.0028 (-0.16)	-0.0167* (-1.84)	-0.0053 (-0.33)	-0.0131** (-2.22)	-0.0118 (-0.90)	-0.0058* (-1.67)
<i>Remit²</i>	0.0004 (1.07)	0.0002* (2.20)	0.0002 (1.03)	0.0005* (1.93)	0.0004 (0.84)	0.0005** (2.11)	0.0002 (0.73)	0.0003** (2.25)	0.0004 (1.19)	0.0002* (1.71)
<i>LGDP</i>	-0.0090 (-0.25)	-0.0440 (-1.36)	0.1966*** (3.00)	0.2377* (1.83)	0.2346* (1.84)	0.0543 (0.87)	0.0380 (0.68)	0.0136 (0.23)	0.0785 (0.91)	0.0167 (0.64)
<i>Inf</i>	-0.0332*** (-4.12)	-0.0332 (-0.36)	-0.2182 (-1.00)	0.0001 (0.20)	0.010 (0.93)	-0.0037*** (-12.92)	-0.0603*** (-4.47)	0.0456 (0.10)	0.1029 (0.32)	-0.2176 (-1.14)
<i>Trade</i>	-0.0145 (-0.24)	0.1190 (1.59)	0.1047 (1.64)	0.0918 (1.06)	0.1091 (1.42)	0.0554 (1.06)	0.0796 (0.81)	0.0273 (0.49)	0.0303 (0.57)	0.0070 (0.27)
<i>Kaopen</i>	0.0393* (1.69)	-0.0313 (-1.22)	-0.0030 (-0.22)	0.0305 (1.19)	0.0006 (0.03)	0.0153 (1.16)	0.0257 (1.37)	0.0090 (0.72)	0.0078 (0.62)	-0.0008 (-0.17)
<i>Constant</i>	0.3215 (1.07)	0.4078 (1.49)	-0.9666** (-2.16)	-0.8966 (-1.10)	-0.1340 (-0.39)	0.4072** (2.18)	0.1603 (0.47)	0.2315 (0.66)	-0.8037* (-0.81)	-0.2282 (-0.76)
Observations	457	476	323	443	269	345	244	213	218	230
AR(2) test, p-level	0.266	0.340	0.137	0.197	0.869	0.675	0.792	0.759	0.367	0.491
Hansen test, p-level	0.461	0.407	0.671	0.918	0.958	0.478	0.991	0.997	0.995	1.000

t-statistic in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

2.5 The efficiency of the banking sector

In this section we will test if the efficiency of the financial sector is important in explaining the nonlinear relationship between remittance workers and financial inclusion. We split the LMICs sample between countries with less efficient banking sectors (*LEFSs*) and more efficient banking sectors (*MEFSs*), according to the median level of the interest rate spread (*spread*)⁴. This latter is defined as the difference between lending and deposit interest rates. Thus, for LMICs countries with interest rate gap higher than the median level, they are considered as less efficient, while for countries, with spread lower than the median, they are considered as more financially efficient.

Table 11 displays the results of the GMM dynamic panel regressions of equations (8) and (9) for both sub-samples. In column (1), we estimate the nonlinear relationship for *LEFSs* with branches as measure of financial inclusion, but it doesn't show any significant coefficient for either *Remit* or *Remit*². However, in *LMICs* with more efficient banking sectors (column (2)), the coefficients are significant at standard risk levels and with the expected signs for the quadratic and linear terms. Similar results are also found with access or usage measures of financial inclusion, which confirms above nonlinear assumption only in *LIMCs* with efficient banking sectors.

Furthermore, if we take into consideration the thresholds, we find that the values are lower in general compared the those in previous (Tables (7) and (8)). The intuition behind is that when we restrict the sub-sample of LMICs to those endowed with efficient banking sectors, the threshold level of remittances (*Remit**) starting from which remittance inflows have positive effects on financial inclusion should be lower. Efficient banking institutions are likely to offer attractive services that would encourage unbanked recipient households to open accounts and benefit from offered services to start profitable projects. Thus, the threshold is equal to 10.5% with *branches* and 15.2% with *borrowers* as measures of financial inclusion, respectively.

⁴ The median of the spread is equal to 6.53.

Table 11: Remittances and financial inclusion in LIMCs, the role of financial sector efficiency: GMM dynamic panel estimates: 2004-2015

	Dependent Variable									
	<i>Branches</i>		<i>ATMs</i>		<i>Deposits</i>		<i>Borrowers</i>		<i>FII</i>	
	<i>LEFSs</i>	<i>MEFSs</i>	<i>LEFSs</i>	<i>MEFSs</i>	<i>LEFSs</i>	<i>MEFSs</i>	<i>LEFSs</i>	<i>MEFSs</i>	<i>LEFSs</i>	<i>MEFSs</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>L.Branches1</i>	0.8875*** (19.30)	0.9901*** (64.43)								
<i>L.ATMs</i>			0.7799*** (9.17)	0.9025*** (19.71)						
<i>L.Deposits</i>					0.7966 (11.25)	0.9789 (58.38)				
<i>L.Borrowers</i>							0.9101*** (12.73)	0.9887*** (26.02)		
<i>L.FII</i>									0.9100*** (21.66)	0.9722*** (17.76)
<i>Remit</i>	-0.035 (-0.30)	-0.0263** (-2.44)	-0.0205 (-1.62)	-0.0115* (-1.85)	-0.0029 (-0.24)	-0.0194** (-2.05)	-0.0119 (-1.29)	-0.0086 (-0.73)	-0.0032 (-0.19)	-0.0083** (-1.75)
<i>Remit²</i>	0.0008 (0.33)	0.0012** (2.54)	0.0005* (1.75)	0.0003* (1.96)	0.0003 (1.15)	0.0004* (1.89)	0.0003 (1.66)	0.0003 (1.09)	0.0001 (0.23)	0.0002* (2.28)
<i>LGDPPC</i>	.0298 (0.87)	-0.0187 (-1.15)	0.1787* (1.83)	0.0208 (0.37)	0.1507** (2.36)	-0.0552 (-0.93)	0.0617 (0.70)	-0.0298 (-0.55)	0.0643 (1.57)	0.0418 (0.64)
<i>Inf</i>	-0.0296*** (-4.93)	-0.3772*** (-2.60)	-0.0005 (-0.01)	0.1522 (1.22)	0.0108 (0.97)	0.2992 (0.80)	0.0002 (1.22)	-0.0421 (-0.08)	-0.0851 (-0.27)	0.4299 (1.66)
<i>Trade</i>	-0.0722 (-1.03)	-0.0631 (-1.57)	0.1012 (0.95)	0.0545 (1.37)	0.0228 (0.41)	0.1798* (1.94)	0.0504 (0.69)	0.0447 (1.35)	0.0063 (0.12)	-0.0121 (-0.26)
<i>Kaopen</i>	0.0073 (0.51)	0.0159* (1.68)	0.0261 (1.31)	0.0003 (0.04)	0.0055 (0.50)	0.0056 (0.50)	0.0164 (1.17)	0.0082 (0.56)	-0.0009 (-0.07)	-0.0072 (-0.47)
<i>Constant</i>	0.0342 (0.14)	0.3563** (2.41)	-0.7365 (-1.22)	0.2104** (0.60)	0.1055* (0.55)	0.5354** (1.14)	0.0121 (0.03)	0.3629 (1.05)	-0.6879** (-1.42)	-0.3509 (-0.52)
Observations	521	224	475	291	357	208	323	172	312	172
AR(2) test, p-level	0.740	0.270	0.397	0.800	0.629	0.248	0.054	0.155	0.366	0.855
Hansen test, p-level	0.815	0.835	0.905	0.853	0.784	0.721	0.660	0.652	0.562	0.810

t-statistic in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

2.6 Regional features of the non-monotonic relationship

In order to study the regional features of the relationship workers' remittances and financial inclusion, we use, following Chami *et al.* (2018b), the approach that consists in removing each region at a time and calculate the difference between the coefficients of remittances in the LMICs sample (columns (1), (3), (5), (7) and (9) in Table (9)) and the one in the reduced sample. The specified regions are South Asia (SA), Middle East and North Africa (MENA), East Asia and Pacific (EAP), Sub Saharan African countries (SSA) and Latin America & Caribbean (LAC).

More specifically, we use the estimated coefficients of *Remit* and *Remit*² for LMICs with the different financial inclusion proxies to see whether they are higher or lower than the coefficients obtained for each region. Thus, for *Remit*², if the resulting difference between estimated coefficient for LMICs sample and the one in the sample ruling out the region is positive, this means that the exclusion of this latter has lowered the coefficient of *Remit*². This should point to the importance of the countries of that region in the non-linear relationship between remittances and financial inclusion if they are added to the sample. For *Remit*, a negative difference between the coefficients indicates that the region contributes to the effect by lowering the coefficient in absolute value (i.e making it less negative). All estimated coefficients are carried out using dynamic GMM panel approach and they are significant at standard levels.

Figures 4 to 8 show the difference in the coefficients of *Remit*² and *Remit* with five proxies of financial inclusion. Red bars, showing differences in coefficients for *Remit*², are positive for specified regions with most financial inclusion measures. Removing one region at a time and re-estimating seems providing lower coefficients with respect to the full sample of LMICs and positive differences, accordingly. Blue bars relative to differences in coefficients for *Remit* are also negative for the same proxies and confirming lower coefficients with reduced sample of countries. This seems to be the case of most regions with *ATMs*, *Borrowers* and financial inclusion index (*IFI*).

However, a closer inspection of figures 4 to 8 across regions reveals absence of pattern for Latin American & Caribbean (LAC) Countries as red bars are not always positive and some of them are absent because of insignificant coefficients with the reduced sample (i.e. with *branches* and *IFI* proxies of financial inclusion).

Remittances and Financial inclusion by region, differences between the estimated coefficients of *Remit* and *Remit*² using GMM dynamic panel: 2004-2015.

Figure 4: Differences with *Branches*

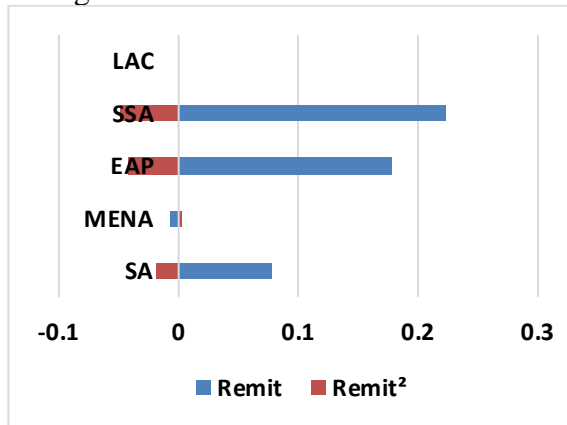


Figure 5: Differences with *ATMs*

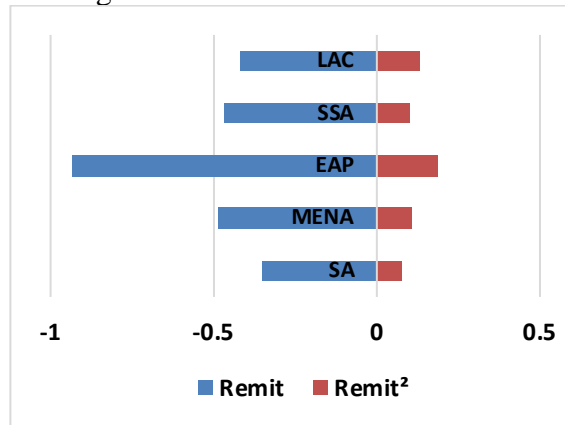


Figure 6: Differences with *Deposits*

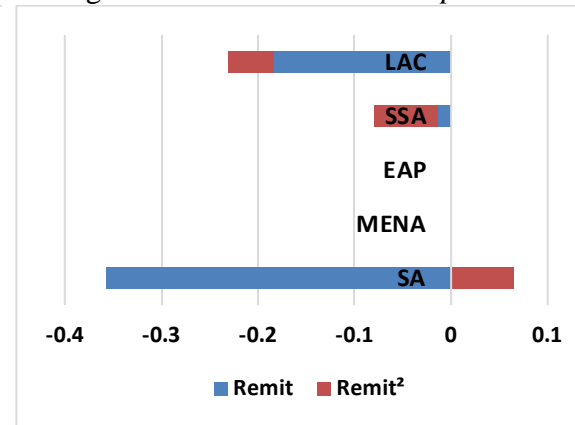


Figure 7: Differences with *Borrowers*

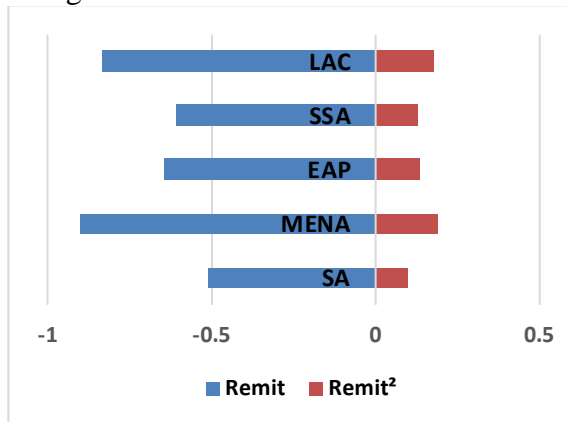
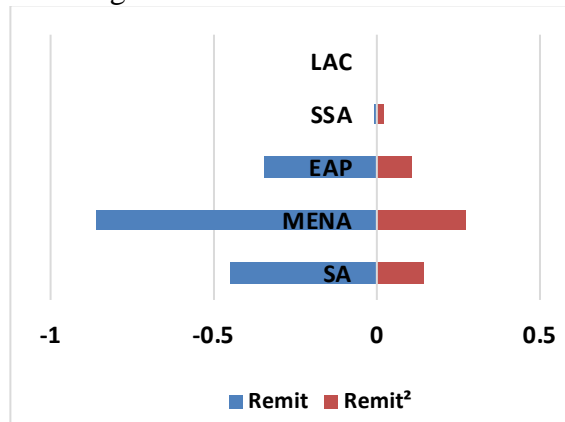


Figure 8 : Differences with *FII*



*Absent bars for LAC (figures 4 and 8), EAP and MENA (figure 6), LAC and SSA (figure 8) is due to insignificant coefficients with GMM estimators.

The case of Sub-Saharan African (SSA) countries should also be treated with precaution as red bars are negative and blue bars are positive (i.e. with *branches* and *Deposits*). This means that countries of this region do not seem to have influence on the non-linear relationship between workers' remittances and financial inclusion.

All in all, the regional analysis of the non-linear relationship between remittances and financial inclusion is indicative of the importance of South Asia (SA) and East Asia & Pacific (EAP) in accounting for such relationship. Red and blue bars for these two regions with most financial inclusion proxies are positive and negative, respectively. Removing these countries of these from the basic sample of LMICs is likely to reduce key coefficients of the estimated equation. Asian countries of these two regions are well known for their high ratios of workers' remittances to GDP.

2.6 The case of fragile states

This section investigates empirically the relationship between workers' transfers and financial inclusion for fragile states based on equation (1). However, the features of these countries, including the problems of data availability, impose a careful empirical analysis of the effect of workers' remittances on the use of formal and informal financial services. Thus, the investigation is restricted to pooled OLS regressions because of lack of data that makes using other developed techniques difficult to achieve⁵.

Figure 9 displays the estimated coefficients of *Remit* using pooled OLS regressions for fragile states using IMF⁶ and World Bank⁷ approaches in defining Fragile states. Blue bars represent

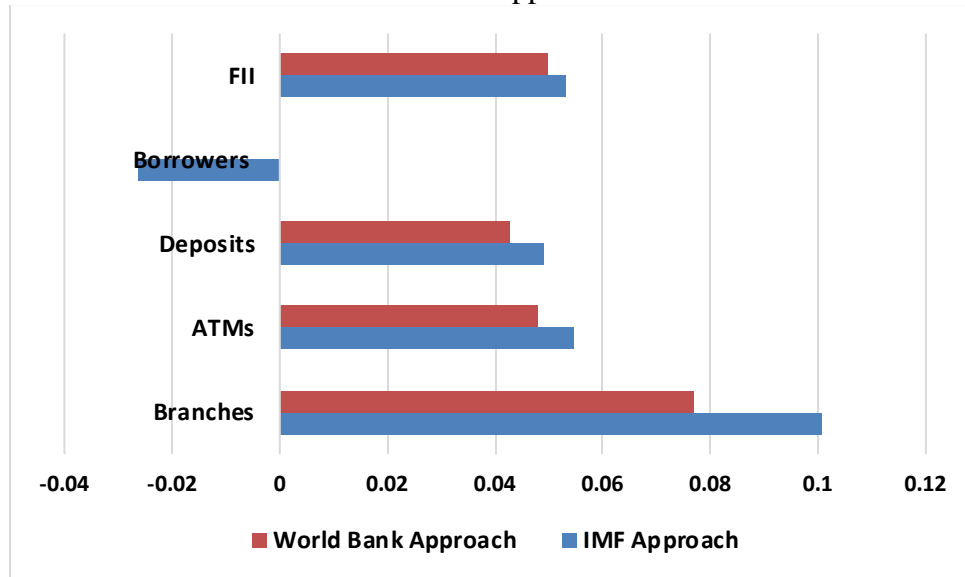
⁵ GMM dynamic panel estimations of equation (1) did not bring significant results especially with “*usage*” indicators of financial inclusion because of low number of observations. The results are available upon request.

⁶ Fragile States are defined here, based on IMF (2017) as having either “*weak institutional capacity as measured by weak institutional capacity according to the World Bank’s Country Policy and Institutional Assessment (CPIA) score (average of 3.2 or lower) and/or experience of conflict (signaled by presence of a peace-keeping or peace-building operation in the most recent three-year period)*”, page 8. Almost 30 percent of IMF members are considered as “fragile” at some point” between 2006 and 2016. At end-2016, there were 39 countries and more than half of them are sub-Saharan African countries.

⁷ The World Bank approach is based on the “*CPIA score against 16 criteria grouped in four clusters: economic management, structural policies, policies for social inclusion and equity, and public-sector management and institutions. Countries eligible for assistance under IDA1 are classified as fragile when they have a rating of 3.2 or less. The maximum score is 6.0*”, IMF (2017), page 8.

the estimated coefficients using the IMF approach in defining fragile countries, while red bars refer to estimated coefficients of World bank approach. The estimations are carried out using all the measures of the financial inclusion.

Figure 9: Remittances and Financial inclusion in fragile states, OLS panel estimates IMF and World Bank approaches*



*All coefficients are significant at standard levels except for Borrowers with the World bank approach. Consequently, the red bar is removed.

Results in figure 9 are indicative of a positive effect of remittances on financial inclusion with most indicators. This means that higher remittances contribute to the development of financial services in fragile economies. The negative sign found with the IMF approach as well as the absence of significant effect with the World Bank approach, when using *Borrowers* as a proxy for financial inclusion, might be explained by the weaknesses in their banking systems to transform the deposits into productive loans.

3. Conclusion

While the development potential of workers' remittances has been largely investigated in available literature, the effect of remittances on financial inclusion has not been thoroughly studied. The investigations addressing the remittances and financial inclusion nexus are mainly survey-based studies within individual country samples and few papers have used a macroeconomic approach with cross-country data to tackle such issue.

This present paper is an attempt to fill this gap as it explores the relationship between financial inclusion and remittances for a sample of 187 countries over the period 2004-2015, using cross-country as well as dynamic panel GMM regressions. The data on financial inclusion is collected from the IMF data set on financial inclusion while the explanatory variables are collected from World Development Indicators of the World Bank including received remittances as a % of GDP.

The main result of the paper is that the relationship between remittances and financial inclusion is a "U" shaped, and that remittances positively impact financial inclusion only after a threshold ranging between 22% and 12.28% in LMICs with more stable, efficient and developed financial sectors. This means that in presence of remittances lower than this threshold, consumer behavior would be focusing more on consumption and investment purposes rather than looking for savings out of received remittances. However, with income transfers higher than this threshold, there is a high probability that remittances increase savings in formal banking institutions that would in turn improve the access and use of financial services, including loans. The financial inclusion curve has consequently an increasing slope only when we have enough remittances that would boost formal banking institutions' supply of financial instruments, including various types of loans and savings.

This result is robust to using different proxies for financial inclusion and regional distribution of countries as the non-linear relationship is found to be confirmed only in East and South Asia and Pacific. Future research on remittances and inclusiveness in the financial sector is needed to address the endogeneity issues of remittances.

Appendices

Table A1: Variable definitions

Variable	Definition and Calculation	Source
Branches of commercial banks per 100,000 adults (Branches)	Commercial bank branches are retail locations of resident commercial banks and other resident banks.	International Monetary Fund, Financial Access Survey.
Automatic Teller Machines per 100,000 adults (ATMs)	An automated teller machine (ATM) is an electronic banking outlet, that allows customers to complete basic transactions, including dispensing cash and accepting deposits, without the aid of a branch representative or teller.	International Monetary Fund, Financial Access Survey.
Deposit accounts with commercial banks per 1,000 adults (Deposits)	Depositors with commercial banks are the reported number of deposit account holders at commercial banks and other resident banks. For many countries, because of lack of information on account holders, the data cover the total number of deposit accounts. The deposits are composed of checking accounts, savings accounts, and time deposits.	International Monetary Fund, Financial Access Survey.
Borrowers at commercial banks per 1,000 adults (Borrowers)	Population in urban agglomerations of more than 1 million (% of total population)	International Monetary Fund, Financial Access Survey.
Financial Inclusion Index (FII)	Composite index based on three indicators (<i>Branches, ATMs, Deposits</i>)	Wang and Guan (2017)
Remittances (Remit)	Personal remittances, received (% of GDP): Personal remittances are composed of personal transfers and compensation of employees. Data are the sum of two items defined in the sixth edition of the IMF's Balance of Payments Manual.	World Bank staff estimates based on IMF balance of payments data, and World Bank and OECD GDP estimates.
GDP per capita	GDP per capita (constant 2010 US\$): GDP per capita is gross domestic product divided by midyear population. Data are in constant 2010 U.S. dollars.	World Bank national accounts data, and OECD National Accounts data files.
Inflation (Inf)	The annual change (%) of the consumer price index.	International Monetary Fund,

		International Financial Statistics and data files.
Trade Openness (Trade)	Trade (% of GDP): Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank national accounts data, and OECD National Accounts data files.
The financial openness state (Kaopen)	the Chinn and Ito's capital account openness index, generally known with the acronym Kaopen (Chinn and Ito (2011)).	(Chinn and Ito (2011))

Table A2: List of countries and periods

Country	Years	Country	Years	Country	Years
Afghanistan	2008-2015	Guinea	2004-2015	Pakistan	2004-2015
Albania	2004-2015	Guinea-Bissau	2004-2015	Palau	2005-2015
Algeria	2004-2015	Guyana	2004-2015	Panama	2004-2015
Angola	2008-2015	Haiti	2004-2015	Papua New Guinea	2004-2014
Antigua and Barbuda	2004-2015	Honduras	2004-2015	Paraguay	2004-2015
Argentina	2004-2015	Hong Kong SAR,	2004-2015	Peru	2004-2015
Armenia	2004-2015	Hungary	2004-2015	Philippines	2004-2015
Aruba	2004-2011	Iceland	2004-2015	Poland	2004-2015
Australia	2004-2015	India	2004-2015	Portugal	2004-2015
Austria	2004-2015	Indonesia	2004-2015	Qatar	2011-2015
Azerbaijan	2004-2015	Iran, Islamic Rep.	2004-2014	Romania	2004-2015
Bangladesh	2004-2015	Iraq	2005-2015	Russian Federation	2004-2015
Barbados	2004-2015	Ireland	2004-2015	Rwanda	2004-2015
Belarus	2004-2015	Israel	2004-2015	Samoa	2004-2015
Belgium	2004-2015	Italy	2004-2015	Sao Tome and Principe	2004-2015
Belize	2004-2015	Jamaica	2004-2015	Saudi Arabia	2005-2015
Benin	2004-2015	Japan	2004-2015	Senegal	2004-2015
Bhutan	2005-2015	Jordan	2004-2015	Serbia	2005-2015
Bolivia	2004-2015	Kazakhstan	2004-2015	Seychelles	2004-2015
Bosnia and Herzegovina	2004-2015	Kenya	2004-2015	Sierra Leone	2004-2015
Botswana	2004-2015	Kiribati	2005-2015	Slovak Republic	2004-2015

Brazil	2004-2015	Korea, Rep.	2004-2015	Slovenia	2004-2015
Bulgaria	2004-2015	Kosovo	2004-2015	Solomon Islands	2004-2015
Burkina Faso	2004-2015	Kuwait	2010-2015	South Africa	2004-2015
Burundi	2004-2015	Kyrgyz Republic	2004-2015	South Sudan	2014-2014
Cabo Verde	2004-2015	Lao PDR	2004-2015	Spain	2004-2015
Cambodia	2004-2015	Latvia	2004-2015	Sri Lanka	2004-2015
Cameroon	2004-2015	Lebanon	2004-2015	St. Kitts and Nevis	2004-2015
Canada	2004-2015	Lesotho	2004-2015	St. Lucia	2004-2015
Chile	2004-2015	Liberia	2004-2015	St. Vincent and the Grenadines	2004-2015
China	2004-2015	Libya	2004-2011	Sudan	2004-2015
Colombia	2004-2015	Lithuania	2004-2015	Suriname	2004-2015
Comoros	2004-2015	Luxembourg	2004-2015	Swaziland	2004-2015
Congo, Dem. Rep.	2005-2015	Macao SAR, China	2004-2015	Sweden	2004-2015
Congo, Rep.	2004-2007	Macedonia, FYR	2004-2015	Switzerland	2004-2015
Costa Rica	2004-2015	Madagascar	2004-2015	Syrian Arab Republic	2004-2007
Cote d'Ivoire	2004-2015	Malawi	2004-2015	Tajikistan	2004-2015
Croatia	2004-2015	Malaysia	2004-2015	Tanzania	2004-2015
Cyprus	2004-2015	Maldives	2004-2015	Thailand	2004-2015
Czech Republic	2004-2015	Mali	2004-2015	Timor-Leste	2005-2015
Denmark	2004-2015	Malta	2004-2015	Togo	2004-2015
Djibouti	2004-2015	Marshall Islands	2005-2015	Tonga	2004-2015
Dominica	2004-2015	Mauritius	2004-2015	Trinidad and Tobago	2004-2015

Dominican Republic	2004-2015	Mexico	2004-2015	Tunisia	2004-2015
Ecuador	2004-2015	Micronesia, Fed. Sts.	2005-2015	Turkey	2004-2015
Egypt, Arab Rep.	2004-2015	Moldova	2004-2015	Uganda	2004-2015
El Salvador	2004-2015	Mongolia	2004-2015	Ukraine	2004-2015
Estonia	2004-2015	Montenegro	2005-2015	United Kingdom	2004-2015
Ethiopia	2004-2015	Morocco	2004-2015	United States	2004-2015
Fiji	2004-2015	Mozambique	2004-2015	Uruguay	2004-2015
Finland	2004-2015	Myanmar	2004-2015	Uzbekistan	2006-2015
France	2004-2015	Namibia	2004-2015	Vanuatu	2004-2015
Gabon	2004-2015	Nepal	2004-2015	Venezuela, RB	2004-2013
Gambia, The	2004-2015	Netherlands	2004-2015	Vietnam	2004-2015
Georgia	2004-2015	New Zealand	2004-2015	West Bank and Gaza	2004-2015
Germany	2004-2015	Nicaragua	2004-2015	Yemen, Rep.	2004-2015
Ghana	2004-2015	Niger	2004-2015	Zambia	2004-2015
Greece	2004-2015	Nigeria	2004-2015	Zimbabwe	2005-2015
Grenada	2004-2015	Norway	2004-2015		
Guatemala	2004-2015	Oman	2004-2015		

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