# IMF Working Paper

# Credit Quality in Developing Economies: Remittances to the Rescue?

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**Credit Quality in Developing Economies: Remittances to the Rescue?[1]**

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**Abstract**

This paper analyzes the link between remittances inflows and nonperforming loans (NPLs) in a large sample of developing countries. Theoretical transmission channels include risk coping, exchange rate and growth impacts. Panel data estimates uncover the significant role of remittance inflows in reducing the size of NPLs in recipient economies. Econometric results also indicate a stronger marginal impact of remittances in a context of high macroeconomic instability, suggesting a significant effect of remittances on the likelihood of the private sector's credit default during shocks. These results hold even after factoring in: (i) the endogeneity of remittance inflows and, (ii) the use of an alternative estimator (panel *fractional logit*) aimed at dealing with bounded dependent variables.

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## I. INTRODUCTION

1.      Remittances to developing countries have grown significantly in recent year, leading to an extensive literature on their macroeconomic and social impact (Chami and others, 2008; Amuedo-Dorantes and Pozo 2009, Mongardini and Rayner, 2009, Adams and Page, 2005). However, little attention has been paid to the effects of remittances on credit quality. This paper attempts to fill this gap by analyzing the impact of remittances on nonperforming loans (NPLs). This question is important particularly in light of the growing trend of remittances, and given that studies have shown that remittances can boost credit to the private sector (Aggarwal Demirgüç-Kunt, and Peria, 2011).

2.      Theoretically, the impact of remittances on NPLs is unclear. On the one hand, remittances could increase banks' loanable funds and result in higher credit to the private sector. Many studies have shown that increasing the volume of credit to the private sector could be associated with higher risk in the financial system (risk-inducing effect), which may in turn translate into a deterioration of the quality of credit. On the other hand, remittances may negatively affect NPLs if they enhance borrowers' capacity to repay. This is particularly true if the transfers are stable and serve implicitly or explicitly as collateral (income stabilizing effect). In addition, remittances could also help banks to know and better discriminate their clients, thereby limiting risks and NPLs.



Figure 1. Remittances and other resource flows to developing countries
(US$ billions)

Source: World Development Indicators, World Bank.

3.      Using panel data of 141 developing countries in 2000–2011, and various estimation techniques, we found remittances are negatively correlated with NPLs, suggesting that in our sample the income-stabilizing effect dominates the risk-inducing effect. The results hold even after accounting for the possible endogeneity of remittances and other sensitivity tests. The rest of the paper is as follows. Section II provides a brief theoretical background on the relationship between remittances and NPLs. Section III presents the econometric model and Section IV reports the econometric results and robustness checks. Section V concludes and discusses the policy implications.

## II. Theoretical Background

4.      The existing empirical and theoretical literature has highlighted several economic, social and institutional factors that affect NPLs through borrowers' capacity to repay; and banks' ability to manage risks.

- Drawing from the financial accelerator theory (Bernanke and Gertler 1989; Kiyotaki and Moore 1997), many studies argue that the interaction between credit and the real economy depends on information asymmetries between lenders and borrowers and their impact through a balance sheet effect. An increase in assets prices pushes up the net

worth of firms and households and improves their capacity to borrow. Because of the higher revenue of borrowers during boom periods, several empirical studies have found that credit quality is likely to increase during boom and to decrease during recessions (Espinoza and Prasad, 2010; Nkusu, 2011; De Bock and Demyanets, 2012). De Bock and Demyanets (2012) for example found that deteriorating growth prospects, a depreciating exchange rate, and weaker terms of trade will decrease private credit and worsen loan quality. These authors also found evidence of feedback loops from credit quality on the economy.

- Many empirical studies have also shed light on the link between credit quality and several institutional and bank-specific factors, particularly since the 2008 global financial crisis. Herd behavior of bank managers taking more risks can lead to a deterioration of credit standards during economic booms (Keeton, 1999, Fernandez De Lis, Marinez, and Saurina, 2000). The loosening of credit standards in turn would depend on the existing regulatory and supervisory framework, highlighting the role of institutional or structural factors in inducing or preventing banks from taking more risks. In particular, key factors that have been found to influence banks' risk taking behavior are the level of diversification and capitalization of the financial sector (Winton 1999, Berger and DeYoung 1997), banks' size (Hu, Li, and Chiu, 2004), and public ownership (Salas and Saurina, 2002; Garciya-Marco and Robles-Fernandez, 2007). Espinoza and Prasad (2010) also found strong evidence that the size of capital and banks' efficiency (noninterest expenses/assets) could affect NPLs.

5.      In line with the existing literature, we do agree that credit boom could be associated with deterioration in the quality of credit, especially in a weak regulatory and supervisory environment. However, we argue that high and stable remittances can contribute to improve borrowers' capacity to repay. Remittance inflows, when transferred through official channels, could increase deposits, play the role of collateral, and increase credit to the private sector (Aggarwal, Demirgüç-Kunt, and Peria, 2011). Higher credit to the private sector could have a positive impact on NPLs, that is, increase NPLs, particularly in an environment of poor governance and weak institutions (*risk-taking effect*).[1] However, this positive impact on NPLs could be limited if remittances improve borrowers' capacity to repay particularly by stabilizing their income and aggregate demand. There is a growing empirical literature on the stabilizing properties of remittances in receiving economies. It is now well recognized that on average, remittance inflows lower households' income volatility (Amuedo-Dorantes and Pozo, 2011), reduce aggregate output growth and private consumption volatility (Craigwell, Jackman, and More, 2010; Bugamelli and Paternò, 2011; Combes and Ebeke, 2011; Chami, Hakura, and Montiel, 2012), help prevent current account reversals (Bugamelli and Paternò, 2009) and significantly increase economic resilience in disaster prone environments (Mohapatra, Joseph, and Ratha, 2012; Ebeke and Combes, 2013). In the presence of lower volatility and uncertainty, banks are less likely to face borrowers' default, and repayment rates are significantly improved. Thus, by reducing the vulnerability to exogenous shocks, and by fueling macroeconomic stability, remittances help preserve financial and banking

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[1] Recent papers tend to confirm that remittance-dependent economies do exhibit lower indices of governance and institutional quality (Abdih and others, 2012; Ahmed, 2012).

stability. In addition to their stabilizing properties, remittances can also improve borrowers' capacity to repay through their effect on overall economic growth. Although, there is mixed evidence in the literature regarding the average impact of remittance inflows on output growth, the existence of non-linearity is now well established. The bottom line of these recent papers is that the growth impact of remittance inflows is maximized in the presence of good institutions (public governance and financial development). We are therefore in the presence of self-reinforcing mechanisms in the remittance-financial stability nexus. Countries that have already reached certain levels of institutional quality and financial development are more likely to be those in which the impact of remittances on financial stability is stronger. But again, we should be cautious. An increase in income could be associated with banks' excess risks, counteracting the initial positive effects on borrower capacity to repay. Nevertheless, the credit risk could be limited if the new loans are extended mostly to remittances' receivers.

### III. EMPIRICAL FRAMEWORK AND DATA

6.      This section describes the empirical framework and data used in our analysis. We estimate two models where we first test the linear effect of remittance inflows on the NPL ratio. Next, we focus on the stabilizing properties of remittances by looking at the marginal effect of macroeconomic volatility conditional upon the level of the remittance-to-GDP ratio.

### A.    Model Specifications

7.      The regression equations are the following:

$$NPL_{i,t} = \theta R_{i,t} + \phi \sigma_{i,t} + \mathbf{X}_{i,t}\mathbf{\Gamma} + u_i + \epsilon_{i,t}$$
$$NPL_{i,t} = \left(\theta_1 + \theta_2 \sigma_{i,t}\right) \times R_{i,t} + \phi \sigma_{i,t} + \mathbf{X}_{i,t}\mathbf{\Gamma} + u_i + \epsilon_{i,t}$$

The first specification estimates the linear impact of remittances on NPLs. $NPL_{i,t}$ is the NPL ratio observed in each country *i* at each period (year) *t*.; $X_{i,t}$ represents the vector of the traditional determinants of NPLs, including real GDP growth, GDP per capita, trade openness (measured by the exports-to-GDP ratio), and a dummy indicating the existence of a credit boom.[2] We also control for the quality of governance via a composite index aggregating all six dimensions of governance quality available from the World Bank Governance Indicators Dataset. The principal component analysis (PCA) is applied to the data to build the synthetic index of governance which is finally transformed to range between 0 (lowest score of governance) to 100 (highest score).[3] We therefore expect a negative association between this index of governance and the size of NPLs.

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[2] Following Mendoza and Terrones (2008), we define credit boom as a period during which credit to private sector expands more than during typical economic expansions, formally, a credit boom episode occurs when the cyclical component of credit is greater than 1.75 times its standard deviation. Deviations from the long-run trend were calculated using the Hodrick-Prescott filter.

[3] See Ebeke (2012) for more details regarding the technique and its implementation.

8.      We expect the NPL ratio to be negatively correlated with the level of economic development and the growth rate of per capita income. However, the output growth volatility is expected to lead to an increase in the banking sector fragility as both the borrowers' capacity to repay would be negatively affected and the banks' ability to manage risk in an uncertain environment would worsen. Trade openness is controlled for to capture the effects of competiveness gains on the private sector's repayment capacity and the banking sector credit quality. The credit boom indicator is included in the model to account for episodes of excessive risk taking behaviors by banks which can impede their capacity to select good projects. Excessive risks are usually a harbinger of deeper turmoil, especially when the credit allocation has been concentrated in few sectors exposed to risks of bubble burst. The credit boom variable is also included to rule out the potential confounding bias that may arise in a case where remittance inflows increase the volume of credit to the private sector (through a stronger financial intermediation of the remittance deposits or through other channels) and therefore mechanically reduce the size of the NPL ratio (because the denominator would grow thanks to larger remittances).[4]

9.      $R_{i,t}$ represents remittances-to-GDP;[5] $\sigma_{i,t}$ is the output growth volatility measured by the five-year rolling standard deviation of the real GDP growth per capita in each country; $u_i$ is a vector of country fixed effects that capture time invariant factors such as the heterogeneity in countries' NPL definitions and various differences in banking regulations across countries; $\varepsilon_{i,t}$ is a vector of disturbances.

10.     The second specification tests the income-stabilizing channel through which remittances may impact NPLs, by adding an interaction term between remittances and output growth volatility. This specification also shows how remittances' impact on NPLs differs according to the level of output growth volatility of the reported countries or whether the effect of macroeconomic volatility on the NPL ratio is dampened by the share of remittances.

11.     We use an unbalanced panel dataset of 141 low- and middle-income countries over 2000–2011.[6] We first apply simple ordinary least squares (OLS) regressions with country fixed effects and run the regressions using the ratio of NPLs to total loans as the dependent variable. However, because estimating a fractional dependent variable with OLS encounters some well-known issues, and alternative attempts to transform the data also have their own limitations, we then run the regression with fractional logit, a quasi-likelihood estimation method specifically conceived for bounded dependent variables (between zero and one).[7] As

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[4] See Aggarwal, Demigüç, and Peria (2011) on the positive impact of remittance inflows on financial development.

[5] We use the World Bank's definition of remittances, which aggregates the three items listed above, given that many low-income countries are not capable of distinguishing workers' remittances from compensation of employees in their balance of payments statistics.

[6] As defined by the World Bank, countries are classified as middle income economies if their GNI per capita is between $1025 and $12475, and as low-income economies if their GNI per capita is below $1025.

[7] The fractional logit estimation was popularized by Papke and Wooldridge (1996). The standardization of this procedure could not be handled in econometric software until recently.

opposed to previous methods, the fractional logit regression model ensures the predicted values of the dependent variables lies in the unit interval, and the logistic function is well defined even if the response variable takes the values zero or one with positive probability.[8] Descriptive statistics of all the variables and the list of countries included in the sample are shown in Appendix.

## B. Data

12. Remittances to developing countries have increased steadily from $700 million on average in the 1990s to $2.8 billion in 2010. In terms of top receivers in our sample (Figure 2), Lesotho is the largest receiver in sub-Saharan Africa (SSA), Tonga in East Asia Pacific (EAP), Nepal in South Asia (SAS), Lebanon in Middle East and North Africa (MENA), and Haiti in Latin America and Caribbean (LAC). In terms of GDP and exports, the increase has been particularly strong in low- income countries (Figure 3).

| Figure 2. Five Largest Recipients by region (in percent of GDP, 2007-11 average) | | | | |
|---|---|---|---|---|
| Sub-Saharan Africa | East Asia Pacific | South Asia | Middle East and North Africa | Latin America and Caribbean |
| Lesotho (35.5) | Tonga (23.6) | Nepal (21) | Lebanon (21.2) | Haiti (21.3) |
| Togo (10.5) | Samoa (20.2) | Bangladesh (10.9) | Jordan (15.7) | Honduras (18.8) |
| Senegal (10.5) | Philippines (10.9) | Sri Lanka (8) | Morocco (7.5) | El Salvador (16.9) |
| Cape Verde (9) | Vietnam (7.4) | Pakistan (5) | Egypt (5.4) | Jamaica (15.4) |
| Gambia (8.7) | Fiji (4.6) | India (3.5) | Yemen (5.1) | Guyana (15.1) |

Source: World Bank.

13. Looking at the distribution by region, MENA has the largest share of NPLs with an average of almost 14 percent in 2000–11, followed by SAS with 13 percent, and SSA with 11 percent (Figure 4).

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[8] The drawbacks of linear models for fractional data are analogous to the drawbacks of the linear model for binary data, which include that the predicted values from an OLS regression can never be guaranteed to be between zero and one. Moreover, transforming the data, for example with log odds ratio models would require further ad hoc adjustments if the variables takes on the value of zero or one, and does not allow the expected value of the dependent variable to recover.

## IV.   RESULTS

### A.   Baseline Estimates

14.     The first set of regressions excludes remittances and focuses on the effects of the traditional macroeconomic and institutional determinants of NPLs in developing countries. As expected and in line with existing empirical studies, the results suggest that output growth volatility, the level of income per capita, output growth and credit booms are important determinants of NPLs. Governance quality and the ratio of export to GDP were not found to be significant (Table 1).[9] An increase in per capita income is associated with a lower NPL ratio whereas countries where private sector credit is booming significantly experience a rise in repayment defaults. This is explained by the excess risks taken by banks which reduce the screening and the better selection of projects early on. The adverse selection problem is usually exacerbated during boom times. Finally, macroeconomic instability is significantly correlated with the size of NPLs as it creates uncertainty and affects both borrowers' capacity to repay and banks' ability to manage risks.

15.     The second set of regressions includes the ratio of remittances to GDP both linearly and in interaction with output growth volatility (Tables 2 and 3).  When focusing on the linear effect of remittance inflows on the NPL ratio (Table 2), the results point to a robust and negative association between migrant remittances and the size of NPLs in the sample. Regardless of the specification (with or without the credit boom variable) or the econometric technique (OLS with fixed effects or fractional logit), the coefficient associated with remittances remains negative, and statistically significant. The point estimate ranges from –0.25 to –0.5. Perhaps, a better quantification of the economic impact can be done with the following calculation: an increase in the remittance-to-GDP ratio by about one half standard-deviation of the variable in the sample (4 percent of GDP) would be associated with a drop in the NPL ratio of about 1–2 percentage points, all else equal. These results suggest that even after controlling for the credit boom, real GDP per capita growth, and growth volatility, the effect of remittances on NPLs remains negative and significant, pointing to the existence of a stronger direct impact on banking and financial stability.

16.     In Table 3, we allow the remittance variable to enter the model in a nonlinear way through an interaction with output growth volatility. The specification aims at testing whether remittance inflows dampen the effects of macroeconomic volatility on the NPL ratio in developing countries by acting as a shock absorber. Several important results emerge. First, the results indicate that as the remittance-to-GDP rises, the marginal effect of output volatility on the NPLs diminishes, suggesting that remittance inflows help mitigate the transmission of real economy shocks to the financial system. Indeed, while the coefficient of the additive term of the output growth volatility is significant and positive, the coefficient associated with the interaction term exhibits a negative and statistically significant value. Similarly, the results point to a stronger marginal effect of remittances on the NPL decline in a context of high macroeconomic uncertainty, suggesting that the countries that benefit the most from remittances in terms of banking stability are those exposed to high macroeconomic volatility. Statistical tests indicate that the non-linearities are econometrically significant.

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[9] The lack of significance of the governance variable in the estimations controlling for country fixed effects could suggest that the bulk of the variability in the governance variable (which changes slowly over time) is largely absorbed by country fixed effects in our short panel dataset.

## Figure 3. Remittances trend in low-income countries
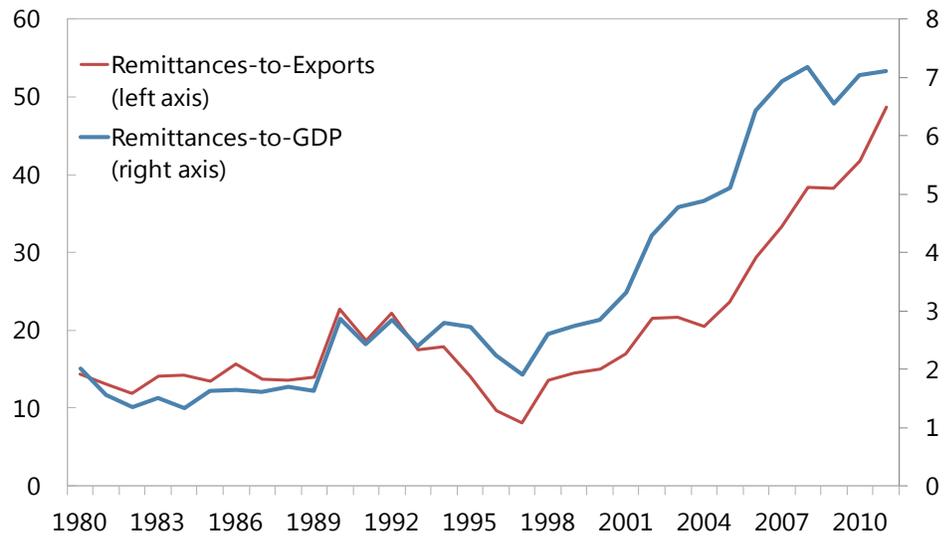


Source: World Development Indicators, World Bank.

## Figure 4. NPLs - sample average over 2000-11
(in percent)
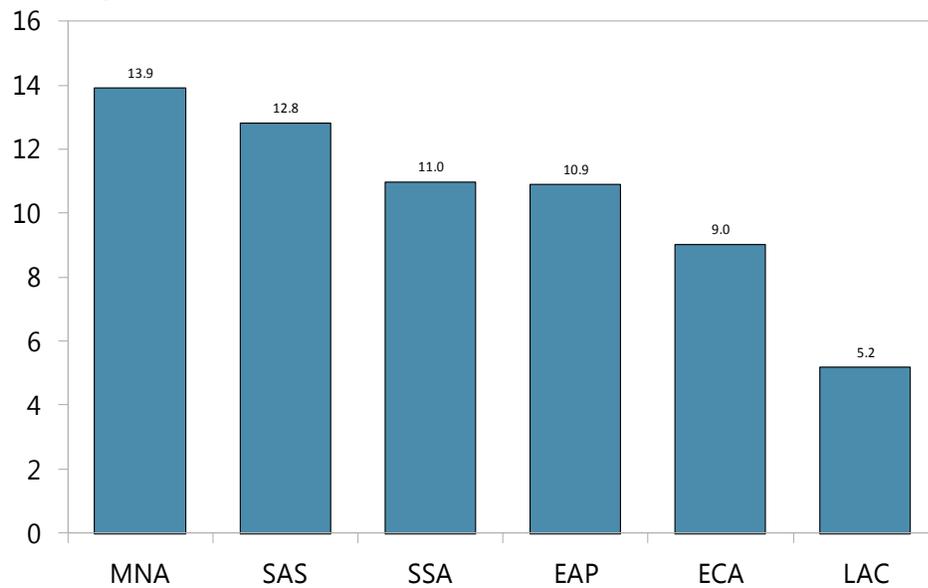


Sources: IMF-IFS, World Bank.

**Table 1. Traditional Determinants of NPLs, 2000–11**

| Dependent Variable: NPL Ratio<br>Period: 2000–11 | OLS-FE<br>(1) | Fractional Logit<br>(2) |
|---|---|---|
| Output growth volatility | 0.439 | 0.335 |
| | (0.211)** | (0.118)*** |
| Credit boom | 0.010 | 0.013 |
| | (0.005)** | (0.004)*** |
| Ln GDP per capita | -0.187 | -0.194 |
| | (0.026)*** | (0.013)*** |
| Real GDP growth | -0.317 | -0.327 |
| | (0.079)*** | (0.057)*** |
| Exports-to-GDP | 0.033 | 0.046 |
| | (0.074) | (0.042) |
| Governance index | 0.004 | 0.012 |
| | (0.016) | (0.006)* |
| Country fixed-effects | Yes | Yes |
| $R^2$ | 0.32 | 0.67 |
| Observations | 638 | 638 |
| Number of countries | 71 | 71 |

Robust standard errors in brackets. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

**Table 2. Effects of Remittances Inflows on NPLs, 2000–11**

| Dependent Variable:<br>NPL Ratio<br>Period: 2000–11 | OLS-FE<br>(1) | OLS-FE<br>(2) | OLS-FE<br>(3) | Fractional Logit<br>(4) | Fractional Logit<br>(5) | Fractional Logit<br>(6) |
|---|---|---|---|---|---|---|
| Remittances-to-GDP | -0.517 | -0.438 | -0.515 | -0.364 | -0.25 | -0.354 |
| | (0.168)*** | (0.162)*** | (0.170)*** | (0.108)*** | (0.097)** | (0.106)*** |
| Output growth volatility | 0.481 | | 0.481 | 0.387 | | 0.396 |
| | (0.187)** | | (0.179)*** | (0.109)*** | | (0.103)*** |
| Credit boom | | 0.009 | 0.01 | | 0.012 | 0.012 |
| | | (0.005)* | (0.005)* | | (0.004)*** | (0.004)*** |
| Ln GDP per capita | -0.187 | -0.188 | -0.183 | -0.187 | -0.192 | -0.184 |
| | (0.026)*** | (0.028)*** | (0.027)*** | (0.014)*** | (0.014)*** | (0.014)*** |
| Real GDP growth | -0.323 | -0.371 | -0.320 | -0.328 | -0.366 | -0.327 |
| | (0.079)*** | (0.084)*** | (0.078)*** | (0.055)*** | (0.060)*** | (0.055)*** |
| Exports-to-GDP | 0.048 | 0.047 | 0.042 | 0.055 | 0.048 | 0.396 |
| | (0.074) | (0.080) | (0.074) | (0.045) | (0.047) | (0.103) |
| Governance index | -0.000 | 0.001 | 0.001 | 0.006 | 0.008 | 0.008 |
| | (0.017) | (0.018) | (0.017) | (0.007) | (0.007) | (0.007) |
| Country fixed-effects | Yes | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.34 | 0.32 | 0.35 | 0.67 | 0.67 | 0.68 |
| Observations | 624 | 624 | 624 | 624 | 624 | 624 |
| Number of countries | 70 | 70 | 70 | 70 | 70 | 70 |

Robust standard errors in brackets. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

**Table 3. Effects of Remittances Inflows on NPLs: Non-Linearity, 2000–11**

| Dependent Variable: NPL Ratio | OLS-FE | Fractional Logit |
|---|---|---|
| Period: 2000–11 | (1) | (2) |
| Remittances-to-GDP | -0.413 | -0.239 |
| | (0.176)** | (0.103)** |
| Output growth volatility | 0.714 | 0.634 |
| | (0.266)*** | (0.148)*** |
| Remittances-to-GDP*output growth volatility | -1.911 | -1.715 |
| | (0.952)** | (0.545)*** |
| Credit boom | 0.008 | 0.012 |
| | (0.005) | (0.004)*** |
| Ln GDP per capita | -0.184 | -0.187 |
| | (0.026)*** | (0.014)*** |
| Real GDP growth | -0.305 | -0.309 |
| | (0.083)*** | (0.056)*** |
| Exports-to-GDP | 0.032 | 0.037 |
| | (0.072) | (0.041) |
| Governance index | 0.001 | 0.008 |
| | (0.017) | (0.007) |
| Country fixed-effects | Yes | Yes |
| Joint significance of the non-linearity: P-value | 0.0002 | 0.0000 |
| $R^2$ | 0.36 | 0.68 |
| Observations | 624 | 624 |
| Number of countries | 70 | 70 |
| Remittances threshold (in percent of GDP) | 35.5 | - |

Robust standard errors in brackets. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

## B. Robustness Checks

17.     The results presented so far ignored an important issue that would significantly bias our estimates of the effect of remittances. The endogeneity of remittances in the econometric models estimated could come from different sources, from the reverse causality, to the omitted variable bias, and the redundancy effect. Reverse causality may arise when the countercyclicality of remittances with respect to financial shocks is exacerbated in a context of high risks of default. In this set-up, migrants insure those left behind by remitting money to help avoid repayment defaults. The redundancy effect may arise because we are using balance of payments data that capture primarily flows intermediated by banks. This in turn implies that our data relate to countries that already have a certain level of financial development, therefore potentially interacting with the dynamics of NPLs. Finally, the omitted variable bias is a concern as some unobserved and time-varying factors may be simultaneously correlated with the size of the NPLs and the level of remittance inflows. For example, migrants do not only remit money, but also some norms and values acquired abroad that can be correlated with the incentives to repay a loan obtained from a bank, or simply affect the willingness to demand a loan for a well-structured project. All these factors are likely to bias our estimates and thus require us to resort to an instrumental variable strategy.

18.     Instrumenting remittances is not an easy task, because most of the domestic factors correlated with remittances are likely to be correlated with the NPLs as well. To address the endogeneity issue, we propose an identification strategy based on an exogenous source of variation for remittances, that is, the real per capita GDP growth in remittance-sending countries, computed as the weighted average of GDP growth rates in all potential migrant destination countries with weights being the bilateral migration shares between the migrant-

sending country and the migrant destination countries.[10] The instrument follows previous studies on remittances (Acosta, Baerg, and Mandelman 2009; Aggarwal, Demirgüç, and Peria, 2011; Combes and Ebeke, 2011; Ebeke, 2012; Lartey, Mandelman, and Acosta, 2012). The identification strategy is based on the assumption that better economic conditions in migrant-destination countries would be associated with larger remittances flowing into migrant sending-countries, after controlling for country fixed-effects, for the economic conditions in the remittance-receiving country (through real per capita growth rate) and for other sources of economic globalization (via trade openness). To complement this instrument, we also include as the second instrument the two-year lag of the remittance variable. Standard diagnostic tests to gauge the instrumentation validity are performed (test of the strength of instruments in the first-stage equation) and tests of the orthogonality of the instruments (Hansen over-identification test)

19.     The results are shown in Tables 4 and 5. The instrumental variable estimate of the linear effect of remittances on the NPL ratio is presented in Table 4, and the stabilizing role of remittances is assessed in Table 5. The results do not reject the earlier findings of a negative and robust association between remittance inflows and the decline in NPL ratios. The point estimates derived from the instrumental variable estimate is in absolute terms higher than its OLS counterpart, suggesting that the direction of the endogeneity bias was positive. Assuming that the reverse causality was the only source of concern, the two-stage least square estimates suggest that instrumenting the remittance variable helps rule out the positive reverse causality running from higher risk of default to higher remittance inflows. The bottom panel also provides interesting results regarding the quality of the proposed instrumentation framework. The instruments are strongly correlated with remittances, have the expected signs, and perform well.

20.     In Table 5, we repeat the exercise but allow an interaction between the remittance variable and the output growth volatility. Because the remittance variable enters the model twice, we instrument both its linear and nonlinear component by entering the instrumental variables linearly and in interaction with the output growth volatility in the first-stage regressions (bottom panel: Table 5). The results of the instrumentation procedure do not alter the previous findings. They suggest a strong and robust effect of remittances on NPLs, which is reinforced in countries characterized by high macroeconomic volatility.

21.     We also use remittances to deposits as an alternative measure of remittances. The results (shown in the Appendix) confirm the robust and negative impact of remittances on the size of NPLs.

22.     Besides potential biases arising from omitted variables, another sensitivity analysis related to sample bias was also conducted. Dividing our country sample into different income groups (low income, lower middle and upper middle income categories) broadly confirm the previous results.[11]

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[10] We use the bilateral migration shares computed from the World Bank Bilateral Migration Database.

[11] Available upon request.

**Table 4. Instrumental Variable Estimates, 2000-11**

| Dependent Variable: NPL Ratio | IV Estimates[a] |
| --- | --- |
| Period: 2000–11 | (1) |
| | Second-stage: |
| Remittances-to-GDP | -0.636 |
| | (0.183)*** |
| Output growth volatility | 0.380 |
| | (0.130)*** |
| Credit boom | 0.006 |
| | (0.004) |
| Ln GDP per capita | -0.199 |
| | (0.016)*** |
| Real GDP growth | -0.295 |
| | (0.061)*** |
| Exports-to-GDP | -0.002 |
| | (0.049) |
| Governance index | -0.003 |
| | (0.011) |
| | |
| | First-stage: |
| Growth in migrant host countries | 0.09 |
| | (0.041)** |
| Remittances-to-GDP (in t-2) | 0.493 |
| | (0.060)*** |
| F-statistic of remittances-to-GDP | 54.2 |
| Instrumental equation | |
| Hansen over-identification test (p-value) | 0.57 |
| Country fixed-effects | Yes |
| Observations | 560 |
| Number of countries | 65 |

Robust standard errors in brackets. [a] For conciseness, the full set of control variables included in the first-stage regression are not shown. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

**Table 5. Instrumental Variable Estimates: Non-Linearity, 2000–11**

| Dependent Variable: NPL Ratio | IV Estimates[a] | |
|---|---|---|
| Period: 2000–11 | (1) | |
| | Second-stage: | |
| Remittances-to-GDP | -0.485 | |
| | (0.172)*** | |
| Remittances-to-GDP*output growth volatility | -1.301 | |
| | (0.728)* | |
| Output growth volatility | 0.539 | |
| | (0.197)*** | |
| Credit boom | 0.005 | |
| | (0.004) | |
| Ln GDP per capita | -0.201 | |
| | (0.015)*** | |
| Real GDP growth | -0.285 | |
| | (0.063)*** | |
| Exports-to-GDP | -0.008 | |
| | (0.048) | |
| Governance index | -0.003 | |
| | (0.011) | |
| | First-Stage: Remittances-to-GDP | First-Stage: Remittances-to-GDP*Output Growth Volatility |
| Growth in migrant host countries | 0.121 | 0.002 |
| | (0.036)*** | (0.001) |
| Remittances-to-GDP (in t-2) | 0.514 | -0.005 |
| | (0.069)*** | (0.003)* |
| Growth in migrant host countries*output growth volatility | -1.006 | -0.034 |
| | (1.012) | (0.65) |
| Remittances-to-GDP (in t-2)*output growth volatility | -0.196 | 0.568 |
| | (0.157) | (0.008)*** |
| F-statistic of instrumentation equation | 31.6 | 2624.0 |
| Country fixed-effects | Yes | Yes |
| Hansen over-identification test (p-value) | 0.66 | |
| Joint significance of the non-linearity: P-val | 0.0001 | |
| Observations | 560 | 560 |
| Number of countries | 65 | 65 |

Robust standard errors in brackets. [a] For the sake of conciseness, the full set of control variables included in the first-stage regression are not shown. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

## V. CONCLUSION

21. With the increasing importance of remittances in total international capital flows, literature on both the determinants and the macroeconomic effects of remittances has grown. This study contributes to this debate by analyzing the impact of remittances on the quality of credit, particularly on the level of NPLs. The results not only confirm the role of traditional determinants of NPLs, that is, macroeconomic factors together with banks' specific and institutional factors, but they also show that remittances can reduce NPLs by enhancing and stabilizing borrowers' capacity to repay. Therefore, remittances can be expected to pave the way for a sound development of a formal financial sector, critical for sustaining high economic growth.

**APPENDIX**

**Table A1. Descriptive Statistics**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| NPL ratio | 624 | 0.09 | 0.08 | 0.00 | 0.57 |
| Remittances-to-GDP | 624 | 0.05 | 0.07 | 0.00 | 0.51 |
| Output growth volatility | 624 | 0.03 | 0.03 | 0.00 | 0.34 |
| Credit boom | 624 | 0.43 | 0.50 | 0.00 | 1.00 |
| ln GDP per capita | 624 | 7.48 | 0.96 | 5.03 | 9.36 |
| Real GDP growth | 624 | 0.05 | 0.04 | -0.18 | 0.27 |
| Exports-to-GDP | 624 | 0.37 | 0.18 | 0.07 | 1.20 |
| Governance index | 624 | 5.91 | 1.35 | 2.79 | 10.00 |

**Table A2. Sample Countries**

| | | | | |
|---|---|---|---|---|
| Albania | Colombia | Jordan | Morocco | Senegal |
| Argentina | Costa Rica | Kazakhstan | Mozambique | Seychelles |
| Armenia | Dominican Republic | Kenya | Namibia | Sierra Leone |
| Azerbaijan | Ecuador | Latvia | Nicaragua | South Africa |
| Bangladesh | Egypt | Lebanon | Nigeria | Sri Lanka |
| Belarus | El Salvador | Lesotho | Pakistan | Swaziland |
| Bhutan | Gabon | Lithuania | Panama | Thailand |
| Bolivia | Georgia | Macedonia | Paraguay | Tunisia |
| Bosnia and Herzegovina | Ghana | Madagascar | Peru | Turkey |
| Botswana | Guatemala | Malaysia | Philippines | Uganda |
| Brazil | Honduras | Mauritius | Poland | Ukraine |
| Bulgaria | India | Mexico | Romania | Uruguay |
| Chile | Indonesia | Moldova | Russia | Venezuela |
| China | Jamaica | Montenegro | Rwanda | Yugoslavia |

**Table A3. Impact of remittance-to-deposits on the NPL ratio**

|  | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Remittances-to-deposit | -0.020 | -0.020 | -0.019 | -0.019 | -0.017 |
|  | (0.011)* | (0.007)*** | (0.007)*** | (0.007)*** | (0.008)** |
|  |  |  |  |  |  |
| Inflation rate, log | 0.188 | 0.141 | 0.160 | 0.162 | 0.158 |
|  | (0.088)** | (0.070)** | (0.070)** | (0.069)** | (0.067)** |
| GDP per capita, log |  | -0.235 | -0.230 | -0.228 | -0.214 |
|  |  | (0.033)*** | (0.035)*** | (0.034)*** | (0.032)*** |
| GDP growth rate |  | -0.402 | -0.377 | -0.378 | -0.259 |
|  |  | (0.089)*** | (0.099)*** | (0.099)*** | (0.103)** |
| Export-to-GDP ratio |  |  | -0.074 | -0.075 | -0.085 |
|  |  |  | (0.097) | (0.097) | (0.086) |
| Credit boom |  |  |  | 0.002 | 0.000 |
|  |  |  |  | (0.005) | (0.005) |
| Output growth volatility |  |  |  |  | 0.631 |
|  |  |  |  |  | (0.351)* |
| Intercept | -0.779 | 1.199 | 1.099 | 1.079 | 0.976 |
|  | (0.410)* | (0.424)*** | (0.447)** | (0.434)** | (0.411)** |
| # Countries | 59 | 59 | 59 | 59 | 59 |
| $R^2$ | 0.03 | 0.37 | 0.38 | 0.38 | 0.40 |
| N | 475 | 475 | 473 | 473 | 473 |

Robust standard errors (clustered at the country-level in parenthesis). * $p<0.1$; ** $p<0.05$; *** $p<0.01$

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