Do Remittances Not Promote Growth? A bias-adjusted three-step mixture-of-regressions

Maty Konte *
United-Nations (UNU-MERIT)

November 2014

Abstract

This paper re-examines the impact of remittance inflows on growth using data for developing countries over the period 1970-2010. The paper seeks to understand why it has been so difficult to find a positive impact of remittances on growth despite the growing amount of remittances in many developing countries and the different studies that have emphasized the positive effect of remittances on poverty and inequality. We relax the hypothesis that all countries follow the same unique growth regime and test whether the impact of remittances on growth depends on the growth regime to which a country belongs. We apply the newly bias-adjusted three-step finite mixture approach, which incorporates corrections into the different steps of the estimation. We find that our data are best described by an econometric model with two different growth regimes: one in which remittances have a positive and significant impact on growth and another in which the effect of remittances is insignificant. The analysis of the determinants of the probability of being in the remittances growth-enhancing regime shows that an increase in the level of financial development decreases the probability of a country being in this growth regime, while being a Sub-Saharan African country increases this probability.

Key words*:* Remittances, Growth Regimes, Three-step Mixture of regression,
JEL Classification*:* F24; O47

*konte@merit.unu.edu Keizer Karelplein 19, 6211 TC, Maastricht The Netherlands

1 Introduction

Remittance inflows have significantly increased in many developing countries during the last years, surpassing the international official aid inflows, and they are currently ranked as the second-largest external capital flows after foreign direct investment (hereafter FDI). Data from the World Bank report an amount of approximately US $ 325 billion of remittances for the year 2010. In many developing countries, workers remittances relative to the gross domestic product are estimated to have been more than 10% for instance in Honduras or Senegal and to have exceeded 20% in Lesotho, Moldova or Nepal in 2010. Influential literature has shown that remittances lead to desirable development features by alleviating poverty and inequality and smoothing the consumption of the receivers. Yet, there is no consensus on whether remittances are beneficial or detrimental to economic growth, and the debate on the impact of remittance inflows on growth remains inconclusive.

On the one hand, the optimistic view supports the evidence that remittances have a positive direct impact on countries' growth rate; see Catrinescu et al. (2009), World Bank (2006a) among others. There are different explanations for the mechanisms through which remittances enhance economic growth. For instance, remittance inflows may stimulate investment in human capital by rising the school expenditures and the incentive of the recipient households (Edwards and Ureta (2003)). It may also increase the stock of physical capital (Lucas (2005), Glytos (2002)), which in turn is beneficial for the investment of small businesses and good, talented entrepreneurs who do not have access to finance (Amuedo-Dorantes and Pozo (2006a)).

On the other hand, the more skeptical view argues that remittances are a curse for the growth rate (e.g, Chami et al. (2003) and Singh et al. (2011)), or at best do not affect it (see Rao and Hassan (2011), Barajas et al. (2009)) [1]. Different channels of transmission have been proposed to explain the curse of remittances. It has been suggested that remittances are not particularly spent towards growth-enhancing activities. Instead, these inflows have an altruistic effect since they are oriented into consumption ((Stark 1995)) rather than productive activities. It has also been argued that remittances may increase the receivers' incentive to switch from labour activities to leisure, known as the moral hazard effect (e.g,Amuedo-Dorantes and Pozo (2006b), Lokshin and Glinskaya (2009), Cox-Edwards and Rodríguez-Oreggia (2009), and Ebeke (2012)). Remittance inflows are also associated with the appreciation of the real exchange rate, slowing down the exportation activities, a phenomenon known as the Dutch Disease Hypothesis

[1] See also Senbeta (2012), Ahamada and Coulibaly (2013) for recent findings on the neutral impact of remittances on growth.

(Acosta et al. (2009), Bourdet and Falck (2006)). Other scholars have attempted to investigate whether the impact of remittances on the growth rate depends on certain country characteristics, such as the level of financial development or the institutional climate (Catrinescu et al. (2009)). [2]

Surprisingly, in these different studies the possibility that countries may follow different growth regimes or processes has received very little attention, despite the recent influential literature that has rejected the hypothesis of a single, unique growth regime that is identical for all countries in growth regressions (e.g, Durlauf and Johnson (1995), Owen et al. (2009), Bos et al. (2010)). This paper contributes to the empirical literature on the effect of remittances on economic growth in developing countries, endogenously taking into account the possible unobserved heterogeneity in the data that may yield an inconclusive conclusion on the impact of remittances on the growth rate in the literature. We relax the hypothesis that all countries follow a single, unique growth regime in favour of multiple growth regimes such that remittances may affect growth differently across the different growth regimes. We then test whether the impact of remittances on the growth rate depends on the growth regime to which an economy belongs. We further investigate the determinants of the probability of a country being the remittances growth-promoting regime and control for financial development and geographical location.

Although some scholars have tried to divide the sample according to a-priori imposed variables, such as financial development or institutions (e.g Giuliano and Ruiz-Arranz (2009) and Bettin and Zazzaro (2011)), and to allow for heterogeneity in the effect of remittances on growth, the possible heterogeneity that may exist in common coefficients on the other regressors included in the models are ignored and not tested. In addition, some recent studies have restricted their sample to countries that share similar observed characteristics and considered for instance data only for developing countries, Sub-Saharan African nations or Small Island Developing States (e.g, Singh et al. (2011) or Feeny et al. (2014)). [3], However, there is no consensus on whether countries that share comparable observed characteristics, such as the level of income or geographical location, behave similarly in their growth process. In contrast, some influential studies have provided evidence that countries with different characteristics may follow similar growth trajectories, and that countries with similar observed characteristics may follow different growth trajectories; e.g Paap et al. (2005), Alfo et al. (2008) and Owen et al. (2009).

In our framework, countries are not a-priori assigned to growth clusters or regimes based on

[2]The mechanism channel through investment in physical capital has also been analyzed (Ahamada and Coulibaly (2013))

[3]See also Senbeta (2012)

observed characteristics such as income, financial development or geographical location. Instead, the identification of the existence of the different growth regimes is based on the similarity of countries in terms of their growth trajectory over time given all the available information in the data. In other words, countries that present similar conditional distributions of their growth rates are sorted into the same growth regime. For this purpose, we propose to use a bias-adjusted three-step finite mixture-of-regressions method, a semi-parametric approach suited to model heterogeneity. In the first step, we define the latent class model; next, in the second step, we predict the posterior probabilities of growth regime membership for all countries; and in the third step, we use these estimated probabilities to assess the relationship between growth regime membership and external variables, also known as concomitant variables. One concern that we may face with the three-step approach is that the results in the third step may be downward biased because of the classification errors that may occur in the second-step when assigning countries into latent growth regimes (See Bolck et al. (2004)). Recently, Vermunt (2010) and Bakk et al. (2013) have proposed an adjusted three-step approach that provides a correction of the classification errors in the third step, which then helps our three-step mixture-of-regressions model to perform better. [4]

This approach has several desirable features compared with the previous literature on the effect of remittances on growth. First, in contrast to studies that have examined whether the impact of remittances on growth varies according to a country's financial development and/(or) quality of institutions, we leave the data to detect whether yes or no countries in our sample follow the same, unique growth regime without any ex-ante assumptions on the assignment of countries to growth regimes. In fact, the heterogeneity is modelled based on a latent effect on each country's growth trajectory, which provides greater flexibility and a better estimation of the effect of remittances on the growth rate. For each country, we are able to estimate its probability of belonging to the growth regime in which remittances have a significant positive impact on growth. Compared with the previous studies that have included a term of interaction between financial development and remittances in the growth regression, we adopt a different strategy and consider whether the level of financial development has any effect on the probability of a country being assigned to the remittances growth-enhancing regime.

Second, as far as we know, this paper is the first to proceed in three-steps in the estimation of the mixture-of-regressions model in the empirical growth literature. Most of the previous studies have proceeded in one step in which the determination of the latent growth regimes and

[4]This adjusted step-three analysis procedures proposed by Vermunt (2010) and Bakk et al. (2013) is implemented in the latest version of the LatentGold, 5.0

the prediction of the countries' growth regime membership are computed simultaneously in one step. However, this one-step procedure may present the disadvantage that the latent growth regime profiles may change when a variable used to predict regime membership is added or removed, besides the fact that the number of parameters to estimate increases with the number of concomitant variables. To overcome these different issues, we propose to take one further step and apply the new adjusted three-step mixture-regression that introduces a correction of the bias that may occur from the classification errors in the second step.

In this study, we use a sample of more than 90 developing countries covering the period 1970-2010. We find that the data are best described by an econometric model of 2 different growth regimes. In the first regime, the impact of remittances on growth remains insignificant, while in the second regime, remittances have a positive and significant effect on the growth rate. Roughly 47% of the countries are in the first group and the remaining 53% are in the second one. There is substantial heterogeneity of countries within growth regimes, in terms of their level of development and remittances as well as in terms of their geographical location, indicating that our classification does not coincide with the ones obtained by ad hoc ex ante classifications. SSA countries represent 21% of the countries in the first group, while they are more likely to be in the remittances growth-enhancing group, in which they account for slightly less than half of the components. The analysis of the determinants of the probability of being in the remittances growth-enhancing regime shows with some reservation that an increase in the level of financial development decreases the probability of a country being in the remittances growth-enhancing regime, while being a Sub-Saharan African country increases this probability.

This paper is closely related to three strands of the literature. First, it is in line with the empirical literature on the impact of remittances on the growth rate in developing countries. The results are mixed and the debate remains open-ended. While some scholars have argued that remittances have a negative impact on growth, others have supported the optimistic view, arguing that remittances have a significant impact on the growth rate. Singh et al. (2011), in a sample of SSA countries, found that remittances have on average a negative impact on the growth rate of African countries. Catrinescu et al. (2009) reconsidered the relationship between remittances and long-run economic growth, and extended the framework of Chami et al. (2003) by addressing the heterogeneity issue, which may be a source of inconsistent conclusions. Employing dynamic panel regression techniques, they found that remittances have a positive and robust effect on the long-run growth rate. Another part of this literature has instead supported a neutral view in this debate, and has been argued that the different results

from the previous studies may be subject to some econometric issues, and that overall the effect of remittances on growth is not statistically significant. For instance, Ruiz et al. (2009) pointed-out the non-linearity in the relationship between remittances and economic growth, something that may be a source of bias. The authors applied a non-parametric strategy that does not impose any a-priori functional form on the relationship between economic growth and remittances. Their results showed a significant positive effect of remittances on growth, but it became insignificant once the non-linearity correction was considered. Senbeta (2012), in a sample of developing countries, analysed the effect of remittances on key important factors for growth: the capital accumulation and the total factor productivity (TFP). They found a positive impact of remittances on the former but a non-significant effect on the latter, a result that enabled them to argue that remittances do not generate growth because of the neutral effect of remittances on TFP, an important factor in the growth process.

Second, this paper also contributes to the literature that tries to determine the possible indirect mechanisms through which remittances may affect growth. One of the most explored channels is the one linking remittances and the level of financial development. For instance, Giuliano and Ruiz-Arranz (2009) tested whether remittances and financial development are substitutes or complements in panel data of developing countries. They found that remittances do not have a direct significant impact on growth, but their effect depends on the level of financial development. Similar findings were also provided by Nyamongo et al. (2012), but these results are not robust and depend on the indicator of financial development used. In contrast, Bettin and Zazzaro (2011) did not support the substitution theory; instead, their results are in line with the complementary view. These authors used different indicators of financial development that capture the efficiency of the financial system in a country, compared with the previous studies that rather focused on indicators of depth. Additional mechanisms through which remittances may affect growth have been tested, among them, the investment in physical capital (see Ahamada and Coulibaly (2013)), capital accumulation and total factor productivity (see Senbeta (2012)).

The current paper also follows the recent literature on the existence of multiple growth regimes in growth analysis, placing particular attention on the unobserved heterogeneity that may provide biased estimates in growth regressions. Starting with Durlauf and Johnson (1995), the hypothesis that all countries follow the same unique growth regime has been rejected in favour of multiple regimes in a number of papers with different econometric tools. [5] Recently, scholars

[5]The econometric approach mainly used in this paper is the classification analysis and regression tree proposed by Breiman et al. (1984). This methodology has also been applied by Giuliano and Ruiz-Arranz (2009) who

have proposed the use of the mixture-of-regressions method, which is an endogenous semi-parametric clustering method. This approach presents desirable features in terms of flexibility and goodness of fit, which explain its use in recent studies. Starting with Paap et al. (2005) and Owen et al. (2009) who investigated the question of whether countries follow the same growth process/regime, a more recent line of the literature has used this methodology to re-analyse some open-ended debates. For instance, Flachaire et al. (2014) used this approach to examine why it has been so difficult to find a positive and significant impact of political institutions on the growth rate, despite the existing theory that has proven their importance in the growth process. Konte (2013) also used this approach and showed that the impact of natural resources on growth depends on countries' growth regime.

The rest of the paper is organized as follows. Section 2 describes the data used for the estimations, while Section 3 presents the econometric method. Section 4 discusses the main findings and provide some robustness checking, and the last section concludes.

2 Data

We use 5-year panel data of more than 90 developing countries for the period 1970-2010, which yields 8 different time periods. The dependent variable is the average annual growth of the real GDP per capita ($growth_{i,t}$). Data on the GDP per capita are taken from the Pen World Table PW 7.1. Our main variable of interest is remittance inflows, measured as the ratio of the total personal inflows to the total gross domestic product. Both, the remittance inflows data and the GDP are taken from the World Development Indicators database. The remittances inflows' calculation is based on a number of different sources, and it includes data from the IMF Balance of Payments Statistics database, as all as data from central banks, national statistical agencies, and the World Bank country desks.

As additional explanatory variables, we include the initial level of the GDP per capita from the PW 7.1, which allows us to assess the convergence versus divergence hypothesis in our data. We also control for the investment in physical capital taken from the PW table, averaged over the 5-year period. Furthermore, we include the following explanatory variables: the average population growth rate from the PW 7.1 augmented by a depreciation and technological change term commonly fixed at 0.05; a proxy for the degree of openness defined as the share of the total amount of the imports and the exports in the total GDP from the PW 7.1; and an index

segregated countries with respect to the level of financial development. This approach segregates countries with respect to the optimal level of threshold of at least of a-priori defined variable. This method presents the limitation that we need first to choose a-priori variables that we would like to use to discriminate the data, ignoring the possible heterogeneity that may exists on the other variables included in the models.

of inflation from the World Development Indicators. These different variables are all averaged over the 5-year period. The data description and sources are shown in table 1.

Another important issue that we would like to investigate in this paper is the extent to which the degree of financial development may explain the classification of the countries into the different growth regimes. We are specifically interested in determining whether the level of financial development may have a significant effect on the probability of countries following the growth regime in which remittances may affect growth positively. We mainly consider quantitative indicators of financial development that measure financial depth. We use the indicator of liquid liabilities relative to the GDP from the Financial Development and Structure Dataset, as well as an index of broad money and an index of domestic credit, both relative to the GDP and taken from the World Development Indicators.

Table 1 presents the descriptive statistics of the main variables used in the empirical analysis, and the coefficients of correlation between these variables are reported in table 2.

3 Empirical Strategy

3.1 Baseline model

Our baseline parametric model of estimation is expressed as follow:

$$\begin{aligned} \mathsf{growth}_{\mathsf{i,t}} &= \beta_0 + \beta_1 \mathsf{gdp}_{\mathsf{0,i,t}} + \beta_2(\mathsf{pop}_{\mathsf{i,t}} + 0.05) + \beta_3 \mathsf{inv}_{\mathsf{i,t}} \\ &+ \beta_5 \mathsf{remit}_{\mathsf{i,t}} + \beta_6 \mathsf{openness}_{\mathsf{i,t}} + \beta_7 \mathsf{inflat}_{\mathsf{i,t}} + \beta_8 \mathsf{findev}_{\mathsf{i,t}} + \varepsilon_{\mathsf{i,t}} \end{aligned} \tag{1}$$

We assume that the error terms ε_{it} are identically and independently distributed and follow a normal distribution with mean zero and variance σ^2.

The key parameter of interest is β_5, which tells us the average marginal impact of increasing the level of remittances on the growth rate. However, this equation assumes that all countries follow the same unique growth regime or process, and that the effect of the explanatory variables, such as remittances on growth, is similar for all countries. This hypothesis of homogeneity may be questionable given the recent literature that has investigated in depth the question of whether all countries follow the same growth process. It has been well established that the models with multiple growth regimes dominate the single growth regime models. However, little effort has been made to test endogenously, without any ex ante assumption, whether the effect of remittances on growth is heterogeneous and depends on the growth regimes to which countries are assigned. One study that may be an exception is by Giuliano and Ruiz-Arranz (2009) who attempted to sort countries into groups according to their level of financial development using classification and regression tree analysis. They found that the regime with a high level

of financial development shows a lower marginal impact of remittances on the growth rate. However, this approach presents a number of limitations in profiling the countries of the growth regimes. First, the determination of the growth regimes is based on a single variable, financial development, without testing the influence that the other variables included in the model may have on grouping countries into regimes. Second, the classification analysis and regression tree method has been criticized because of its lack of appropriate asymptotic assumption needed for inference on threshold variables choices and their values (Tan (2010)). The recent literature on multiple growth regime analysis has extensively used the mixture-of-regressions approach, which is a semi-parametric method suitable for the analysis of the existence of multiple growth regimes. Our paper follows this line of the literature and proposes to apply the new bias-adjusted three-step mixture-of-regression method.

3.2 Bias-adjusted three-step finite mixture-of-regressions

This section presents the mixture-of-regressions approach using the three-step strategy instead of the-one step strategy. Most of the studies on growth empirics that have used this approach have applied the one-step method, in which the determination of the latent growth regimes and the prediction of countries' growth regime membership are computed simultaneously. However, this one-step approach presents some limitations. [6] First, the growth regime profile determination may be affected when we add or remove a variable used for the growth regime membership analysis. Second, when we proceed in one step, we include simultaneously in the same model variables that participate in the determination of the growth regimes, and variables used to explain the countries' growth regime membership probabilities. This substantially increases the number of parameters to estimate and may require an increase in the sample size, something that can be problematic given the limited number of countries for which data may be available.

In this paper, we propose to use a three-step approach in which we estimate first the latent class of our baseline growth regression model; then, in the second step, we estimate the posterior assignment probabilities using the estimated parameters from the first step; finally, we assess the determinants of the probability of a country being assigned to the latent growth regime in which remittances have a positive effect on economic growth using a bias-adjusted correction.

3.2.1 Step 1: The determination of the latent classes

In order to define the model in a simple way let us consider our dependent variable growth, the key variable of interest remit, and X the set of the additional controls defined above. The

[6] See Vermunt (2010) for a detailed discussion of these different issues.

mixture-of-regressions model in its general specification is defined as follow:

$$f(\mathsf{growth}|\mathsf{remit},\mathsf{x};\Theta)=\sum_{k=1}^{K}\pi_k f_k(\mathsf{growth}|\mathsf{remit},\mathsf{x};\beta_k,\sigma_k) \tag{2}$$

The parameter K is the number of groups or growth regimes which is unknown, and its optimal value will be chosen using some goodness of fit criteria such as the BIC and CAIC statistics. The parameter π_{k} is the proportion of the countries that belongs to the specific growth regime k; $\mathsf{f_k}(\mathsf{growth}|\mathsf{remit},\mathsf{x};\beta_{\mathsf{k}},\sigma_{\mathsf{k}})$ is the conditional density of the growth rate in the latent regime k. The parameters in the latent growth regime k are β_{k} and σ_{k}. Both β_{k} and σ_k are unknown and will be estimated. We suppose that $\mathsf{f_k}(.)$ is a Gaussian distribution.

For simple illustration if our data is generated by a model with a single growth regime, which implies that K=1 then equation 2 is identical to the parametric specification expressed in the above equation 1 which can be re-written as follow:

$$\mathsf{growth_{i,t}}=\beta_0+\beta_1\mathsf{remit_{i,t}}+\beta_2\mathsf{x_{i,t}}+\varepsilon_{i,t},\qquad \varepsilon_1\sim N(0,\sigma^2) \tag{3}$$

In this case the impact of remittances on growth is given by β_1 and this value is identical for all countries. In contrast, if we suppose that the data is better generated by two different growth regimes, assuming that $K=2$ then equation 2 can be simplified as follows:

$$\begin{aligned}&\text{Group 1:}\quad \mathsf{growth_{i,t}}=\beta_{01}+\beta_{11}\mathsf{remit_{i,t}}+\beta_{21}\mathsf{x_{i,t}}+\varepsilon_1,\qquad \varepsilon_1\sim N(0,\sigma_1^2),\\ &\text{Group 2:}\quad \mathsf{growth_{i,t}}=\beta_{02}+\beta_{12}\mathsf{remit_{i,t}}+\beta_{22}\mathsf{x_{i,t}}+\varepsilon_2,\qquad \varepsilon_2\sim N(0,\sigma_2^2)\end{aligned} \tag{4}$$

In this second scenario, the error terms ε_1 and ε_2 are assumed to be independent. The coefficients on remittances may be different across the two regimes simply because the environment in which growth occurs differs across regimes. This implies that countries are heterogeneous and behave differently in their growth process. Hence, ignoring the existence of multiple growth regimes may lead to wrong conclusions on the effect of remittances on the growth rate. We may also have more than two growth regimes. The choice of the number of regimes K is crucial and to select its optimal value one can refer to the previous literature as guidance or simply use some statistical criteria. In this paper, we combine both the previous results in the literature and some criteria such as the BIC and the CAIC for the selection of the optimal value for K. In fact, we refer to the previous studies to fix the maximum number of growth regimes, which we define as the highest value found in the literature; and then, we use the statistical criteria to select the number of regimes that may take a value between one and the maximum number found in the literature.

3.2.2 Step 2: Countries assignment into latent classes

Once the number of regimes, K, is selected, and the parameters of the model estimated, we can compute the posterior probability of each country being assigned in a given latent growth regime k, using the Bayes rule such that:

$$\hat{\pi}_{ik} = \frac{\hat{\pi}_k f_k(\text{growth}|\text{remit}, x\,; \hat{\beta}_k, \hat{\sigma}_k)}{\sum_{k=1}^{K} \hat{\pi}_k f_k(\text{growth}|\text{remit}, x\,; \hat{\beta}_k, \hat{\sigma}_k)} \tag{5}$$

These estimated probabilities will be used to sort countries into the different growth regimes found in our sample. The rule is that a given country i belongs to the growth regime k if the estimated probability $\hat{\pi}_{ik}$ is higher than the probability $\hat{\pi}_{ij}$ where $i \neq j$.

3.2.3 Step 3: Determinants of the latent class membership assignment

The third and last step of this methodology aims at identifying the determinants of variables that explain the assignment of countries in the growth regime in which remittances have a significant positive effect on growth using multinomial logistic regression. Let us define k_P the growth regime where remittances have a positive effect on the growth rate. For each country we assign a value of 0 or 1 using the following rule:

$$k_p^{(i)} = \begin{cases} 1 & \text{if the country } i \text{ has a higher probability to be in regime } p \text{ than in regime } j \text{ where } p \neq j, \\ 0 & \text{otherwise} \end{cases} \tag{6}$$

We can then estimate:

$$p_i = \text{Prob}(k_p^{(i)} = 1, \omega_i) \tag{7}$$

More explicitly we can express this probability as:

$$p_i = \frac{1}{1 + exp(-\omega_i)} \tag{8}$$

where,

$$\omega_i = \delta_0 + \delta_1 Z_i + \epsilon_i \tag{9}$$

Where Z is a vector of control variables. This third step may provide inconsistent and biased results in certain circumstances due to the classification errors that may occur in the second step. Recently, Vermunt (2010) developed the maximum likelihood adjusted-three-step method, which aims to correct the amount of the classification error from the second step during the

procedure in the third step. [7] This adjustment procedure has recently been implemented in LatentGold 5.0, which makes it suitable for use in our estimations.

4 Empirical results

4.1 Parametric method results

Table 3 presents the results of the parametric approach, in which we consider all countries to follow the same growth regime or process. Hereafter, we consider 2 different samples of developing countries. The smaller sample, which includes 92 developing countries, is restricted to countries that have data available for at least 4 different time periods, half of the total number of periods in our data. The table reports the pooled, FE and RE effects' estimations with and without instrumenting remittances using the first lag. Time dummies are also included in all of the different estimations. Across the 8 different specifications, the coefficient on remittances is never significant, even though the sign varies across the columns.

Regarding the other explanatory variables included in the model, we can see that the convergence hypothesis indicated by the negative sign on the coefficient of the initial level of the GDP per capita is strongly supported in our sample, while the negative effect of the growth of the population becomes insignificant once we use the FE or RE technique. The investment in physical capital, which has been considered as one of the most robust determinants of growth (see Sala-I-Martin et al. (2004)), is positive and significant across the different specifications. The degree of openness and the inflation affect growth differently but neither of these effects is robust. Similar to the results on remittances, across the different specifications, the effect of the level of financial development on the growth rate remains insignificant.

In summary, the results in table 3 show that under the hypothesis of the existence of a single, unique growth regime for all countries, remittances have neither a negative nor a positive significant impact on growth. Indeed, across the different columns, remittances have a neutral effect on the growth rate of countries. Such a result confirms the results of the previous studies that have found a neutral effect of remittances on the growth rate using different samples and different techniques under the hypothesis of a single growth model (e.g, Rao and Hassan (2011), Barajas et al. (2009), Ahamada and Coulibaly (2013) among others). However, if our data are better generated by a model with more than one growth regime, the results presented in this section may be biased, and the conclusion on the impact of remittances on the growth

[7] Bolck et al. (2004) have proposed the use of weighted step-three method for the correction of the classification error in the third step. Bakk et al. (2013) have presented an extension version of these two methods of adjustment in a situation where the estimated probabilities are used as independent variable also known as distal variable .

rate found would be inappropriate. To deal with this issue, we proceed by trying to determine whether or not the observations in our data are generated by a single growth regime and testing whether the impact of remittances on the growth rate varies across the detected regimes using the mixture-of-regressions method.

4.2 Three-step Finite-Mixture-of-Regressions Results

i) First step

We estimate a finite-mixture-of-regressions model in which we assume that our data may be generated between one and four growth regimes, estimating four different mixture-of-regressions models. Indeed, according to the previous literature, the optimal number of growth regimes found using the mixture-of-regressions methodology varies between two and three (Paap et al. (2005), Alfo et al. (2008), Owen et al. (2009)) [8]. Hence, we limit the number of growth regimes to four based on these previous findings but also because of the limited number of observations, which may be questionable when we increase the number of regimes, significantly increasing the number of parameters to estimate.

Table 4 shows the goodness of fit derived from the log-likelihood values of the four different models estimated. It reports the Bayesian and the consistent Akaike information criterion, which allow us to select our best model, the one that minimizes these two statistical values. We find that the econometric model with two regimes records the lowest BIC and CAIC, which indicates that our data are best generated with a model of two growth regimes. We can also point-out that the model with one growth regime is the one that records the highest BIC (BIC=2558 for K=1 versus 2524 for K=2, 2530 for K=3 and 2535 for K=4), indicating that there is some heterogeneity in the data that should not be ignored.

Table 5 presents the estimated coefficients of our selected model with K=2. The first regime includes 47% of the countries and the remaining 53% are in the second growth regime. When we focus on our parameter of interest, the coefficient on remittances, we find that in the first regime remittances do not have a significant impact on the growth rate while in the second group the coefficient on remittances is positive and significant at the conventional 1% level. The last two columns of the table show respectively the Wald statistics test and the p-value, which help to test whether the coefficients on remittances across the two regimes are statistically equal. The values reported suggest that the impacts of remittances on the growth rate are statistically different across the two regimes at the 5% level.

[8] See also Owen and Temesvary (2014), Flachaire et al. (2014) and Konte (2013) among other.

Turning to the rest of the coefficients that we have in the model, we find that in the second regime, the financial development and the investment in physical capital have positive and statistically significant effects on the growth rate, while an increase in the degree of openness decreases the growth rate. In contrast, in the first regime, all the coefficients are significant except the one on financial development. The convergence hypothesis is confirmed in this regime, and more investment in physical capital and more trade openness tend to increase the growth rate substantially, while high levels of inflation and of population growth tend to hurt the growth rate of the countries in this regime. The null hypothesis under which the coefficients across the two regimes are equal is rejected for all the coefficients except for the coefficients on the variable inflation, for which the rejection is possible only above the 15% level. When we compare the coefficients that are significant in the two regimes, we can note that policies that are intended to increase the level of investment in physical capital increase the growth rate in the two regimes, but such policies have greater potential to increase the growth rate in the first than in the second regime. Indeed, one can observe that the coefficient on the investment in physical capital is three times higher for the first regime than for the second one. The degree of openness boosts the growth rate of countries in the first regime but it hurts the growth rate for countries that are located in the remittances growth-enhancing regime.

For robustness purposes, we first re-estimate our mixture model using the full sample of developing countries, which includes all the countries for which data on remittances are available for at least one period, and second we include education and institutions in our core explanatory variables. Table 6 and table 7 refer to our first robustness analysis in which we re-estimate our baseline mixture-of-regressions model using the full sample of developing countries. Again, the model with two different components is superior to the other models. Furthermore, the effect of remittances on growth is insignificant for the first regime and significantly positive in the second regime, which applies to more than 50% of the countries included in the sample. The estimated coefficients are very similar to the results reported in table 5 with our preferred sample. The exceptions are the estimated coefficients on financial development and inflation for which we lose now some significance.

Table 8 shows the goodness of fit for the model in which we include the investment in human capital, which is measured by the average years of schooling in the population aged over 25 from the compilation of Barro and Lee (2013). We also include a proxy for political institutions using the index of democracy from the latest Polity IV table. This index is ranked from 0 to 10, where 0 is allocated to full autocracies like Syria and 10 to full democracies like Costa Rica. It is

worth noting that the amount of data decreases significantly when we include these 2 additional variables. Now the number of countries falls from 92 to 70 and the total number of observations is reduced by more than 100. This significant number of missing data is the reason why we do not include these 2 variables in our baseline model, but given the importance that education and institutions have received in the literature, it is worth investigating whether our results may be affected once we include these 2 variables. The estimations of the selected model with 2 components reported in table 9 support our previous results that remittances have a significant effect on growth in the second regime while their effect is neutral in the first one. The estimates of the other variables are quiet similar to the one reported in the previous table 5, except for the coefficients on financial development and on the degree of openness, which now turn insignificant in the second regime for the former, and in the first group for the latter. Education has a positive and significant impact only for the growth rate of the first regime, while the level of democracy remains insignificant in the first regime and weakly significant in the second regime. Indeed, the effect of political institutions on the growth rate has received important attention in recent years and it has been shown that political institutions do not have a direct impact on growth but may affect it indirectly; e.g Acemoglu et al. (2005) and Flachaire et al. (2014) among others.

ii) Second step

The second step of the mixture-of-regression method consists of classifying countries into the two different growth regimes using the estimated posterior probabilities. In fact, we consider that a country will be classified in the growth regime for which its estimated posterior probability is higher given that the sum of the probability of being in the first regime and the probability of being in the second regime is equal to 1. Table 10 shows the classification of the countries into the two regimes using our preferred model reported in table 5 which includes 92 developing countries. This table shows that roughly 47% of the countries are in the first group and the remaining 53% are in the second one. It is worth noting that the classification for Ecuador and Venezuela in the second regime is less clear since their estimated probabilities are slightly higher than 0.5. There is substantial heterogeneity of countries within growth regimes, in terms of the level of development and remittances, as well as in terms of geographical location, indicating that our classification does not coincide with the ones obtained by ad hoc ex ante classifications.

SSA countries represent 21% of the countries in the first group, while they are more likely to be in the remittances growth-enhancing group, in which they account for almost half of the components. Furthermore, the classification reported in table 11, which corresponds to the classification of the model using the full sample, presents similar results. If we look at the

countries that appear in both table 10 and table 11, we can observe a certain level of stability. Indeed, only three countries are classified into different regimes across these two tables. These countries are El Salvador, which has moved from the first regime to the second in the latter classification table, and the Central African Republic and Venezuela, which have switched from the second to the first growth regime.

iii) Third step

We now move on the third and last step of the estimation of our mixture-of-regression in which we assess the determinants of countries' growth regime membership. Recall that the model that we estimate here has already been described in section 3.2.3. It is a logit model and the dependent variable takes a value of one if the country has a higher probability of being in the remittances growth-enhancing regime and zero otherwise. We control for different indicators of financial development, a dummy for SSA, a dummy for Latin American and Caribbean countries and a dummy for being landlocked.

The results in table 12 show the estimations of the probability of being in the remittances growth-enhancing group using the classification based on the results obtained with our preferred sample restricted to the developing countries for which data on remittances are available for at least four time periods. The results show that an increase in the level of financial development decreases the probability of being in the growth regime for which remittances promote the growth rate of countries. However, this effect is not statistically significant when we use the domestic credit provided by the financial sector relative to the GDP as the indicator of financial development, while the coefficients on liquid liability and broad money both relative to the GDP are statistically significant.

In column [5], we investigate the extent to which the geographical location may determine the likelihood that a given country follows the growth regime for which an increase in remittances boosts the growth rate. We simultaneously control for a Sub-Saharan African dummy, a Latin and Caribbean dummy and a dummy landlock that indicates whether a country is landlocked or not. We find that being a Sub-Saharan African country increases the probability of being in the remittances growth-enhancing regime but neither being a Latin American and Caribbean country nor being landlocked affect this probability.

In the next table 13 we re-estimate the determinants of the probability of being in the second growth regime in which remittances affect growth positively using the full sample of developing countries, which includes all the countries for which data on remittances are available for at least one time period. In this table, we control for the variables that were significant in the

previous table 12. We find that the coefficients on the indicators of financial development have the same sign as in the previous table 12 but they are not significant. However, the coefficient on the dummy Sub-Saharan Africa is positive and significant with a sign indicating that being a SSA country increases the probability of being in the remittances growth-enhancing regime.

5 Concluding Remarks

This paper seeks to understand why it has been so difficult to find a positive impact of remittances on growth despite the growing amount of remittances in many developing countries and the different studies that have emphasized the positive effect of remittances on poverty and inequality. We take into account endogenously the possible unobserved heterogeneity that may exist in data using a flexible approach, and test whether the impact of remittances on the growth rate depends on the growth regime to which an economy belongs. We relax the hypothesis that all countries follow a single, unique growth regime in favor of multiple growth regimes such that remittances may affect growth differently across the different growth regimes detected . Our approach consists of applying a bias-adjusted three-step finite-mixture-of-regressions method, a semi-parametric method suitable for taking into account endogenously the possible heterogeneity that may exist in the data. In the first step, we define the latent class model and study the remittances' growth effect across the different regimes; in the second step, we predict the growth regime membership posterior probabilities for all the countries; and in the third step, we use these estimated probabilities to assess the relationship between growth regime membership and external variables also known as concomitant variables.

Our results show that the data are best generated by a model of two growth regimes. In one regime, remittances do not have a significant impact on growth while in the second regime, remittances have a positive and significant impact on growth. The classification of the countries in the second step shows substantial heterogeneity of the countries within growth regimes, in terms of the level of development and the level of remittances, as well as in terms of geographical location, indicating that our classification does not coincide with the ones obtained by ad hoc ex ante classifications. SSA countries represent 21% of the countries in the first group, while they are more likely to be in the remittances growth-enhancing group, in which they account for almost half of the components. The analysis of the determinants of the probability of being in the second regime shows, with some reservation about the robustness of the results, that an increase in the level of financial development decreases the probability of a country being in the remittances growth-enhancing regime, while being a Sub-Saharan African country increases this

probability.

References

Abduh, Y., R. Chami, J. Dagher, and P. Montiel (2012). Remittances and Institutions: Are remittances a curse?. *World Development 40*, 657–666.

Acemoglu, D., S. Johnson, and J. A. Robinson (2005). Institutions as the fundamental cause of long-run economic growth. In P. Aghion and S. Durlauf (Eds.), *Handbook of Economic Growth*, pp. 385–472. North Holland.

Acosta, P., C. Calderon, P. Fajnzylber, and H. Lopez (2008). What is th Impact of International Remittances on Poverty and Inequality in Latin America?. *World Development. 36*, 89–114.

Acosta, P. A., E. K. K. Lartey, and F. S. Mandelman (2009). Remittances and the dutch disease. *Journal of International Economics. 79*, 102–116.

Adams, R. H. and J. Page (2005). Do International Migration and Remittances Reduce Poverty in Developing Countries?. *World Development. 33*, 1645–1669.

Aggarwal, R., A. Demirgüc-Kunt, and M. S. M. Pería (2011). Do remittances promote financial development?. *Journal of Development Economics. 96*, 255–264.

Ahamada, I. and D. Coulibaly (2013). Remittances and growth in Sub-Saharan African countries: Evidence from a panel causality test. *Journal of International Development. 25*, 310–324.

Aidt, T., J. Dutta, and V. Sena (2008). Governance regimes, corruption and growth: theory and evidence. *Journal of Comparative Economics. 36*, 195–220.

Alfo, M., G. Trovato, and R. Waldmann (2008). Testing for country heterogeneity in growth models using a finite mixture approach. *Journal of Applied Econometrics 23*, 487–514.

Amuedo-Dorantes, C. and S. Pozo (2006a). Migration, remittances and male and female employment patterns. *American Economic Review 96*, 222–226.

Amuedo-Dorantes, C. and S. Pozo (2006b). Workers's remittances and business ownership in the Dominican Republic. *The World Economy 29*, 939–956.

Bakk, Z., F. B. Tekle, and J. K. Vermunt (2013). Estimating the association between latent class membership and external variables using bias-adjusted three-step approaches. *Sociological Methodology. 43*, 272–311.

Barajas, A., R. Chami, C. Fullenkam, M. Gapen, and P. Montiel (2009). Do Workers Remittances Promote Economic Growth. IMF Working Paper WP 09/153.

Barro, R. and J.-W. Lee (2013). A new data set of educational attainment in the world, 1950-2010. *Journal of Development Economics. 104*, 184–198.

Bettin, G. and A. Zazzaro (2011). Remittances and Financial Development: Substitutes or Complements in Economic Growth?. *Bulletin of Economic Research. 64*, 509–536.

Binzel, C. and R. Assaad (2011). Egyptian men working abroad: Labour supply responses bu the women left behind. *Labour Economic 18*, 98–114.

Bolck, A., M. A. Croon, and J. A. Hagenaars (2004). Estimating latent structure models with categorical variables: One-step versus three-step estimations. *Political Analysis. 12*, 3–27.

Bos, J., C. Economidou, M. Koetter, and J. Kolari (2010). Do all countries grow alike? *Journal of Development Economics 91*, 113–127.

Bourdet, Y. and H. Falck (2006). Emigrants' remittances and Dutch disease in Cape Verde. *International Economic Journal 20*, 267–284.

Breiman, L., J. H. Friedman, R. A. Olshen, and C. I. Stone (1984). *Classification and regression trees*. Belmont, Calif: Wadsworth.

Brock, W. and S. Durlauf (2001). Growth economics and reality. *The World Bank Economic Review 15*, 229–72.

C., R. P. and D. A. Ahlburg (1999). Remittances in the South Pacific. *International Journal of Social Economics 26*, 325–44.

Catrinescu, N., M. Leon-Ledesma, and M. Piracha (2009). Remittances, Institutions, and Economic Growth. *World Development 37*, 81–92.

Chami, R., C. Fullenkam, and S. Jajah (2003). Are Immigrant Remittance Flows a Source for Developmet? IMF Working Paper 03/189.

Clemens, M. A. and D. mckenzie (2014). Why don't remittances appear to affect growth?. World Bank Policy Research Working Paper 6856.

Cox-Edwards, A. and E. Rodríguez-Oreggia (2009). Remittances and labor force participation in Mexico: an analysis using propensity score matching. *World Development 37*, 1004–1014.

Durlauf, S. and P. A. Johnson (1995). Multiple regimes and cross-country behavior. *Journal of Applied Econometrics 10*, 365–384.

Durlauf, S. N., P. A. Johnson, and J. R. Temple (2005). Growth econometrics. In P. Aghion and S. Durlauf (Eds.), *Handbook of Economic Growth*. Elsevier.

Ebeke, C. H. (2012). Do Remittances Lead to a Public Moral Hazard in Developing Countries? An Empirical Investigation. *Journal of Development Studies 48*, 1009–1025.

Edwards, A. C. and M. Ureta (2003). International migration, remittances, and schooling: evidence fron El Salvador. *Journal of Development Economics 72*, 429–461.

Feeny, S., S. Iamsiraroj, and M. McGillivray (2014). Remittances and Economic Growth: Larger Impacts in Smaller Countries. *Journal of Development Studies 50*, 1055–1066.

Flachaire, E., C. García-Peñalosa, and M. Konte (2014). Political versus Economic Institutions in the Growth Process. *Journal of Comparative Economics 42*, 212–229.

Frühwirth-Schnatter (2006). *Finite Mixture of Markov Switching Models*. New York: Spring-Verlag Series in Statistics. Springer-Nerlag.

Giuliano, P. and M. Ruiz-Arranz (2009). Remittances, financial development, and growth. *Journal of Development Economics 90*, 144–152.

Glytos, N. P. (2002). The role of migrant remittances in development: Evidence from Mediterranean countries. *International Migration 40*, 5–26.

G:olich, D., T. O. Mahmoud, and C. Trebech (2007). Explaining Labour Market Inactivity in Migrant-Sending Families: Housework, Hammock, or Higher Education. Kiel Working Paper 1391.

Gupta, S., C. A. Pattillo, and S. Wagh (2009). Effect of Remittances on Poverty and Financial Development in Sub-Saharan africa. *World Development. 37*, 104–115.

Konte, M. (2013). A Curse or a Blessing? Natural Resources in a Multiple Growth Regimes analysis. *Applied Economics 45*, 3760–3769.

Leon-Ledesma, M. and M. Piracha (2004). International migration and the role of remittances in eastern europe. *International Migration 42*, 65–83.

Lokshin, M. and E. Glinskaya (2009). The effect of male migration on employment patterns of women in nepal. *World Bank Economic Review 23*, 481–507.

Lucas, R. E. B. (2005). International migration and economic development. Swedish Ministry for Foreign Affairs.

Nyamongo, E. M., R. N. Misati, L. Kipyegon, and L. ndirangu (2012). Remittances, financial development and economic growth. *Journal of Economics and Business. 64*, 240–260.

Owen, A. L. and J. Temesvary (2014). Heterogeneity in the growth and finance relationship: How does the impact of bank finance vary by country and type of lendig?. *International*

Review of Economics and Finance. 31, 275–288.

Owen, A. L., J. Videras, and L. Davis (2009). Do all countries follow the same growth process. *Journal of Economic Growth 14*, 265–286.

Paap, C. (2002). Trade as a threshold variable for multiple regimes. *Economics Letters 77*, 85–91.

Paap, R., P. Franses, and D. Dijk (2005). Does africa grow slower than asia, latin america and middle east? *Journal of Development Economics 77*, 553–570.

Posso, A. (2012). Remittances and Aggregate Labor Supply. *The Developing Economies 50*, 25–39.

Rao, B. B. and G. M. Hassan (2011). A panel data analysis of the growth effects of remittances. *Economic Modelling. 28*, 701–709.

Rao, B. B. and G. M. Hassan (2012). Are the Direct and Indirect Growth Effects of Remittances Significant?. *The World Economy. 35*, 351–342.

Riccardo, F. (2007). Migration and Remittances: The Impact on the Countries of Origin. In . 4th AFD-EUDN Conference (Ed.), *In Migration and Development: Mutual Benefits?*

Ruiz, I., E. Shukralla, and C. Vargas-Silva (2009). Remittances, Institutions and Growth: A Semiparametric Study . *International Economic Journal. 23*, 111–119.

Sala-I-Martin, X., G. Doppelhofer, and R. Miller (2004). Determinants of long-term growth. *American Economic Review. 94*, 813–835.

Senbeta, A. (2012). Remittances and the sources of growth. *Applied Economics Letters. 20:6*, 572–580.

Singh, R. J., M. Haacker, K. Lee, and M. L. Goff (2011). Determinants and Macroeconomic Impact of Remittances in Sub-Saharan africa. *Journal of African Economies. 20*, 312–340.

Stark, O. (1995). *Altruism and Beyond.* Oxford and Cambridge: Basil Blackwell.

Tan, C. M. (2010). No One True Path: Uncovering The Interplay Between Geography, Institutions, And Fractionalization In Economic Development. *Journal of Applied Econometrics. 25*, 1100–1127.

Vaio, G. D. and K. Enflo (2011). Did globalization drive convergence? Identifying cross-country growth regimes in the long-run. *European Economic Review*, forthcoming.

Vermunt, J. K. (2010). Latent class modelling with covariates: Two improved three-step approaches. *Political Analysis. 18*, 450–469.

World Bank (1991). Towards Higher Growth in the 1990s. In Washington DC: The World Bank (Ed.), *Pacific Island Economies.*, Washington DC: The World Bank.

World Bank (1993). Toward Efficient and Sustainable Growth. In Washington DC: The World Bank (Ed.), *Pacific Island Economies.*

World Bank (2006a). The development impact of workers' remittances in latin america. *Washington, DC: World Bank 2*.

World Bank (2006b). Global economic prospects 2006: Economic implications of remittances and migration. *Washington, DC: World Bank 2*.

Yang, D. (2011). Migrant Remittances. *Journal of Economic Perspectives 25*, 129–152.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
growth	951	1.48	3.94	-23.14	24.14	Penn World Table 7.1
remit	674	.05	.09	0	.89	World Development Indicators
ln(findev)	707	3.35	.65	.54	5.38	World Development Indicators
ln(pop+0.05)	1040	1.92	.24	-2.52	2.61	Penn World Table 7.1
ln(gdp)	951	7.74	.95	5.08	10.17	Penn World Table 7.1
ln(invest)	970	2.98	.57	.43	4.29	Penn World Table 7.1
ln(open)	970	4.08	.67	.64	5.53	Penn World Table 7.1
ln(inflation)	847	2.39	1.31	-3.73	8.68	World Development Indicators

The indicator of financial development reported here, (findev), is the liquid liabilities relative to the GDP. For robustness purpose we will also used additional measures of financial development.

Table 2: Coefficients of correlation

	growth	remit	ln(pop+0.05)	ln(gdp)	ln(invest)	ln(open)	ln(findev)	ln(inflation)
growth	1							
remit	0.0754	1						
ln(pop+0.05)	-0.1517	-0.1220	1					
ln(gdp)	0.0415	-0.0457	-0.2575	1				
ln(invest)	0.2228	0.1821	-0.0347	0.3433	1			
ln(open)	0.1694	0.2569	-0.1377	0.2325	0.3675	1		
ln(findev)	0.0921	0.1656	-0.0709	0.3489	0.3563	0.3762	1	
ln(inflation)	-0.0926	-0.1038	-0.0348	0.0089	-0.1246	-0.3348	-0.3522	1

The indicator of financial development reported here, (findev), is the liquid liabilities relative to the GDP.

Table 3: Parametric results

	OLS	FE	RE	OLS	FE	RE	OLS-IV	FE-IV	RE-IV
remit	-0.0548	-4.199	0.138	0.328	-2.842	0.433	0.924	-4.656	0.746
	(1.509)	(2.884)	(2.007)	(1.530)	(2.929)	(1.955)	(1.648)	(4.513)	(2.272)
ln(gdp)	-0.285*	-5.931***	-0.624***	-0.320**	-5.284***	-0.641***	-0.258	-5.507***	-0.505**
	(0.152)	(0.557)	(0.219)	(0.159)	(0.564)	(0.220)	(0.167)	(0.707)	(0.230)
ln(pop+0.05)	-1.567***	0.347	-0.600	-1.060**	0.484	-0.328	-0.952*	0.667	-0.148
	(0.501)	(0.481)	(0.492)	(0.503)	(0.473)	(0.490)	(0.499)	(0.467)	(0.479)
ln(invest)	1.323***	1.635***	1.468***	1.423***	1.634***	1.572***	1.383***	1.535***	1.476***
	(0.282)	(0.389)	(0.329)	(0.283)	(0.389)	(0.330)	(0.303)	(0.418)	(0.347)
ln(open)	0.237	1.357***	0.779**	-0.0564	1.347***	0.394	-0.188	1.522***	0.293
	(0.246)	(0.455)	(0.332)	(0.261)	(0.464)	(0.335)	(0.278)	(0.514)	(0.358)
ln(inflation)	0.00616	-0.352***	-0.162	-0.150	-0.433***	-0.303**	-0.0329	-0.274*	-0.168
	(0.120)	(0.128)	(0.125)	(0.134)	(0.147)	(0.142)	(0.137)	(0.156)	(0.146)
ln(findev)	-0.0141	-0.286	-0.491	0.213	-0.468	-0.292	0.0181	-0.388	-0.419
	(0.230)	(0.410)	(0.299)	(0.234)	(0.424)	(0.298)	(0.243)	(0.493)	(0.312)
Constant	3.263*	41.06***	3.369	2.574	36.11***	3.457	3.031	36.57***	2.965
	(1.876)	(4.798)	(2.341)	(1.872)	(4.840)	(2.286)	(1.889)	(5.702)	(2.318)
time dummies	..	..	..	..	..	..			
R-squared	0.154	0.344		0.160	0.335		0.167		
Nb obs	579	579	579	517	517	517	450	450	450
Nb country	121	121	121	92	92	92	92	92	92

Standard regression models with time fixed-effects. For IV estimation, the first lag of remittance as instrument for the variables remit. The indicator of financial development reported here, (findev), is the liquid liabilities relative to the GDP. The last 4 columns contain only countries for which we have data available for at least 4 different time periods. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4: Goodness of fit

Number of regimes	BIC	CAIC
K=1	2558.37	2574.37
K=2	**2524.42**	**2557.42**
K=3	2530.48	2580.48
K=4	2535	2602

The table presents the goodness of fit of the mixture of regression using our preferred sample which is restricted to countries for which data on remittances are available for at least 4 out of the 8 time periods. Selected model in bold.

Table 5: Mixture of regression model estimations

growth	Class1 π_1=0.47	Class2 π_2=0.53	Wald(=)	p-value
Constant	15.7128***	3.1418	6.0098	0.014
	(4.6014)	(1.928)		
remit	-4.4505	3.7368***	4.4422	0.035
	(3.6469)	(1.2785)		
ln(gdp)	-1.4347***	-0.0783	10.2808	0.0013
	(0.3876)	(0.1523)		
ln(pop+0.05)	-5.883***	0.1233	0.21	$<\infty$
	(1.2528)	(0.364)		
ln(invest)	2.1665***	0.7229***	5.7537	0.016
	(0.5374)	(0.2529)		
ln(open)	1.6858***	-1.3009***	0.217	$<\infty$
	(0.6209)	(0.2766)		
ln(inflation)	-0.511**	-0.0587	2.0336	0.15
	(0.2569)	(0.1439)		
ln(findev)	-0.7735	0.6868**	7.9524	0.0048
	(0.4166)	(0.324)		
time dummies	....	.....		
R-squared	0.2685	0.3808		
Nb country	43	49		
Nb obs	235	282		

This table reports the estimation results of the selected model with 2 components. *** significant at 1%, ** significant at 5%, * significant at 10%. The indicator of financial development reported here, (findev), is the liquid liabilities relative to the GDP.

Table 6: Goodness of fit-large sample

Number of regimes	BIC	CAIC
K=1	2906.51	2922.51
K=2	**2870.92**	**2903.92**
K=3	2884.82	2934.82
K=4	2918.99	2985.99

The table presents the goodness of fit of the mixture of regression using the full sample which includes all the countries for which we have data for at least one period. Selected model in bold.

Table 7: Mixture of regression model estimations-large sample

growth	Class1 $\pi_1 = 0.57$	Class2 $\pi_2 = 0.43$	Wald(=)	p-value
Intercept	17.4467***	2.7083	12.6578	0.00037
	(3.7304)	(1.8094)		
remit	-3.2866	3.2792***	3.3991	0.065
	(3.2666)	(1.233)		
ln(gdp)	-1.3972***	0.0585	18.5975	0.00001
	(0.3109)	(0.1487)		
ln(pop+0.05)	-7.3234***	0.1178	38.5551	$<\infty$
	(1.1429)	(0.3618)		
ln(invest)	1.7439***	0.8615***	2.4246	0.12
	(0.4648)	(0.2796)		
ln(openk)	1.8758***	-1.1455***	27.3679	$<\infty$
	(0.554)	(0.2443)		
ln(inflation)	-0.2016	-0.0958	0.2152	0.64
	(0.1882)	(0.1242)		
ln(findev)	-0.6075*	0.3279	4.6317	0.031
	(0.3502)	(0.2505)		
time dummies	....	.....		
R-squared	0.2595	0.3935		
Nb country	69	52		
Nb obs	287	292		

This table reports the estimation results of the selected model with 2 components. *** significant at 1%, ** significant at 5%, * significant at 10%. The indicator of financial development reported here, (findev), is the liquid liabilities relative to the GDP.

Table 8: Goodness of Fit

	BIC	CAIC
K=1	1936.98	1954.98
K=2	**1928.18**	**1965.18**
K=3	1932.51	1988.51
K=4	1954.17	2029.17

The table presents the goodness of fit of the mixture of regression using our preferred sample and include education and institutions in the model. Note that results with K=3 and K=4 are not very stable due to the decrease of the number of observations. Selected model in bold.

Table 9: Mixture of regression model estimations

growth	Class1	Class2
	π_1=0.56	π_2=0.44
Intercept	13.5033***	5.1124**
	(3.8899)	(2.1496)
remit	-6.2575	2.7329**
	(4.4404)	(1.1585)
ln(gdp)	-1.8818***	-0.1573
	(0.4058)	(0.2002)
ln(pop+0.05)	-4.4889***	0.3258
	(1.4865)	(0.3233)
ln(invest)	1.7189***	1.1011***
	(0.5104)	(0.3091)
ln(open)	0.7249	-1.3242***
	(0.4899)	(0.3577)
ln(inflation)	-0.1501	-0.1589
	(0.2258)	(0.1545)
ln(findev)	0.5871	0.0507
	(0.4467)	(0.2519)
ln(educ)	1.7647***	-0.341
	(0.4659)	(0.2648)
dem	0.0202	0.0798*
	(0.0661)	(0.0408)
R-squared	0.3238	0.4681
Nb country	39	31
Nb Obs	216	187

This table reports the estimation results of the selected model with 2 components. *** significant at 1%, ** significant at 5%, * significant at 10%. The indicator of financial development reported here, (findev), is the liquid liabilities relative to the GDP.

Table 10: Classification

Group 1		Group 2	
Country	Prob	Country	Prob
Albania	0.974	Algeria	0.9352
Armenia	1	Bangladesh	0.8359
Azerbaijan	1	Benin	0.8353
Belize	0.9987	Bolivia	0.9615
Botswana	1	Brazil	0.9586
Cambodia	1	Burkina Faso	0.9987
Cameroon	0.9991	Central African Republic	0.6027
Cape Verde	0.9873	Colombia	0.9804
Dominica	0.9993	Congo, Republic of	0.9966
Dominican Republic	0.9994	Costa Rica	0.8558
Egypt	1	Cote d'Ivoire	0.8728
El Salvador	0.7057	Djibouti	0.7814
Gambia, The	0.9824	Ecuador	0.5203
Grenada	1	Ethiopia	0.6344
Guinea-Bissau	0.9961	Fiji	0.9654
Guyana	0.9984	Gabon	0.9169
Indonesia	0.9998	Ghana	0.852
Jamaica	0.9912	Guatemala	0.8259
Jordan	1	Guinea	0.9469
Kazakhstan	1	Honduras	0.5792
Kyrgyzstan	0.9349	India	0.9401
Laos	1	Iran	0.8516
Malaysia	1	Kenya	0.9802
Mauritius	0.8909	Lesotho	0.9826
Moldova	0.9173	Madagascar	0.9993
Mozambique	0.9987	Malawi	0.6168
Panama	1	Maldives	0.7975
Papua New Guinea	0.9849	Mali	0.8993
Paraguay	0.9864	Mauritania	0.801
Peru	0.9274	Mexico	0.9937
Romania	0.9624	Morocco	0.9419
Seychelles	0.9993	Namibia	0.7
Sierra Leone	0.6926	Nepal	0.8158
Sri Lanka	0.9994	Nicaragua	0.8975
St, Lucia	0.9994	Niger	1
St,Vincent Grenadines	0.9984	Nigeria	0.8896
Suriname	1	Pakistan	0.8398
Swaziland	1	Philippines	0.9422
Syria	0.8748	Rwanda	1
Tanzania	0.6594	Samoa	0.9704
Thailand	1	Senegal	0.9949
Tonga	0.8723	South Africa	0.9791
Vanuatu	0.9998	Sudan	1
		Togo	0.9999
		Tunisia	0.8887
		Turkey	0.9999
		Venezuela	0.5178
		Yemen	0.8055
		Zimbabwe	0.8952

Classification of countries from the model in table 4 and 5.

Table 11: Classification-Full sample

Group 1		Group 2	
country	Prob 1	Country	Prob 2
Afghanistan	0.925	Algeria	0.8693
Albania	0.9701	Argentina	0.6737
Angola	1	Bangladesh	0.8231
Armenia	1	Benin	0.7446
Azerbaijan	1	Bolivia	0.9713
Belarus	1	Brazil	0.984
Belize	0.9964	Burkina Faso	0.994
Bhutan	0.8289	Colombia	0.9854
Bosnia and Herzegovina	0.5671	Congo, Dem, Rep,	0.5493
Botswana	1	Congo, Republic of	0.9688
Bulgaria	0.8443	Costa Rica	0.9656
Burundi	0.785	Cote d'Ivoire	0.6398
Cambodia	1	Djibouti	0.5186
Cameroon	1	Ecuador	0.7806
Cape Verde	0.9955	El Salvador*	0.5628
Central African Republic*	0.8895	Ethiopia	0.5694
Chad	1	Fiji	0.966
Comoros	0.9965	Ghana	0.8983
Dominica	0.9995	Guatemala	0.8902
Dominican Republic	0.9944	Guinea	0.8673
Egypt	1	Honduras	0.7431
Gabon	0.9619	India	0.9553
Gambia, The	0.9929	Iran	0.856
Georgia	1	Kenya	0.9847
Grenada	1	Lebanon	0.7181
Guinea-Bissau	0.9989	Lesotho	0.9959
Guyana	0.9984	Libya	0.7971
Haiti	0.7528	Macedonia	0.7797
Indonesia	0.9996	Madagascar	0.9968
Iraq	0.7376	Malawi	0.5005
Jamaica	0.9969	Mali	0.782
Jordan	1	Mauritania	0.723
Kazakhstan	1	Mexico	0.9881
Kyrgyzstan	0.8933	Morocco	0.9213
Laos	0.9998	Namibia	0.6795
Liberia	0.9991	Nepal	0.7854
Malaysia	1	Nicaragua	0.853
Maldives	0.888	Niger	0.997
Mauritius	0.8284	Nigeria	0.6678
Moldova	0.9352	Pakistan	0.8326
Mongolia	0.7385	Philippines	0.9604
Montenegro	0.712	Rwanda	1
Mozambique	0.999	Samoa	0.9785
Panama	1	Senegal	0.9845
Papua New Guinea	0.9961	South Africa	0.9848
Paraguay	0.965	Sudan	1
Peru	0.9331	Togo	0.9987
Romania	0.9549	Tunisia	0.8786
Sao Tome and Principe	0.7422	Turkey	0.9997
Serbia	0.5117	Uganda	0.8111
Seychelles	0.9978	Yemen	0.7823
Sierra Leone	0.6827	Zimbabwe	0.7701
Solomon Islands	0.999		
Sri Lanka	0.9993		
St, Lucia	0.9992		
St,Vincent Grenadines	0.9986		
Suriname	1		
Swaziland	1		
Syria	0.83		
Tajikistan	0.9999		
Tanzania	0.7104		
Thailand	1		
Timor-Leste	0.9996		
Tonga	0.886		
Ukraine	0.9999		
Vanuatu	0.9999		
Venezuela*	0.6208		
Vietnam	0.9986		
Zambia	0.899		

Classification of countries from the model in tables 6 and 7.

Table 12: Determinants of class membership

	[1]	[2]	[3]	[4]	[5]
Intercept	1.7239	2.9646	5.1256***	-0.5652	3.6206*
	(1.6748)	(1.8858)	(1.7936)	(0.4196)	(2.0428)
ln(credit/gdp)	-0.4981				
	(0.4692)				
ln(liquid liab/gdp)		-0.8635*			
		(0.5222)			
ln(broadmoney/gdp)			-1.4595***		-1.1209**
			(0.4917)		(0.5314)
SSA				1.2965**	0.8166
				(0.6287)	(0.6055)
latincar				0.1587	
				(0.6625)	
landlock				0.0448	
				(0.6809)	
Nb obs	91	92	92	92	92

This table reports results in step 3 using the classification in table 10. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 13: Determinants of class membership-Full sample

	[1]	[2]	[3]
Intercept	0.5435	-0.0947	-0.684**
	(1.2778)	(1.272)	(0.3004)
ln(liquid liab)	-0.2742		
	(0.3705)		
ln(broadmoney/gdp)		-0.0879	
		(0.3632)	
SSA			0.7864*
			(0.4702)
Nb obs	120	120	121

This table reports results in step 3 using the classification in table 11. *** significant at 1%, ** significant at 5%, * significant at 10%.