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Remittances, finance and growth: does financial development foster remittances and their impact on economic growth?*

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Abstract

In this paper, I measure the importance of remittances and financial development for developing countries. I estimate an index of overall financial conditions and use it to determine the relevance of the financial sector as a transmission channel for remittances to affect economic growth. The index brings together information from existing measures, reflecting size, depth and efficiency of the financial sector. It is created by means of an unobserved components model. I show that the more financial development in a country, the smaller becomes the impact of remittances on economic growth and it can even turn negative. For countries with weaker financial markets there is a positive effect, but significant only at the earliest stages of financial development. The effect becomes negative in the third quartile of financial development. These results hold irrespective of the measure of financial development included, but are most profound in case of the created index. This means that estimates based on proxies might be slightly biased. I also show that countries with both low levels of remittances and financial development should first focus on developing the latter, while migrants' transfers become important for growth if the country has a moderate level of financial development.

JEL: F24, O11, O15 and O16
Keywords: remittances, economic growth, financial development, unobserved components model, dynamic panel data analysis

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In this paper, I measure the importance of remittances and financial development for developing countries. I estimate an index of overall financial conditions and use it to determine the relevance of the financial sector as a transmission channel for remittances to affect economic growth. The index brings together information from existing measures, reflecting size, depth and efficiency of the financial sector. It is created by means of an unobserved components model. I show that the more financial development in a country, the smaller becomes the impact of remittances on economic growth and it can even turn negative. For countries with weaker financial markets there is a positive effect, but significant only at the earliest stages of financial development. The effect becomes negative in the third quartile of financial development. These results hold irrespective of the measure of financial development included, but are most profound in case of the created index. This means that estimates based on proxies might be slightly biased. I also show that countries with both low levels of remittances and financial development should first focus on developing the latter, while migrants' transfers become important for growth if the country has a moderate level of financial development.

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1 Introduction

Remittances are migrants' transfers in money and kind sent to relatives in their home countries. According to the World Bank Migration and Remittances Team, in 2012-2014 75% of the value of all such transfers were received by developing countries, either from industrial economies (North-South, ca. 53%) or from other developing countries (South-South, for example from Russia to Ukraine or India to Bangladesh). In the last 15 years these flows have been increasing rapidly, exceeding official development assistance (ODA), and more steadily than foreign direct investment flows (FDI) (cf. Fig. 1). Economists have become interested in these international money flows, as an important source of development financing.

Remittances have been recently debated in the context of the post-2015 Sustainable Development Agenda of the United Nations Development Programme (UNDP, Agenda to be adopted in September 2015). There are 17 newly proposed Sustainable Development Goals (SDGs) and their achievement relies on public as well as private financing from industrial countries. Remittances have been recognized as one of potential sources of funding for the SDGs during the UN Third International Conference on Financing for Development in Addis Ababa in July 2015:[1]

> "40. We recognize the positive contribution of migrants for inclusive growth and sustainable development in countries of origin [...]. Remittances from migrant workers, [...], are typically wages transferred to families, primarily to meet part of the needs of the recipient households. They cannot be equated to other international financial flows, such as foreign direct investment, ODA or other public sources of financing for development. We will work to ensure that adequate and affordable financial services are available to migrants and their families in both home and host countries.[...] We will support national authorities to address the most significant obstacles to the continued flow of remittances, such as the trend of banks withdrawing services, to work towards access to remittance transfer services across borders. [...] including by promoting competitive and transparent market conditions. We will exploit new technologies, promote financial literacy and inclusion, and improve data collection."

This paragraph from the Addis Ababa conference Action Agenda recognized the role of remittances in supporting families in developing countries and emphasizes that financial sector development is necessary to boost migrants' transfers through lower costs and better service availability. Fostering remittances and the financial/banking sector as a transmission channel can therefore have short-run and long-run effects on economic development of receiving countries.

In this paper I evaluate the impact of remittances on economic growth, taking into account financial sector development measured with a newly constructed index. There

[1] Resolution adopted by the General Assembly on 27 July 2015, Sixty-ninth session, Agenda item 18, UN. $http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/69/313$ accessed August 27, 2015.

are several challenges associated with answering this question, in particular with respect to capturing financial sector development in a comprehensive way, considering its size, depth and efficiency at the same time. For many developing countries (according to World Bank's classification of countries) data on financial indicators[2] are generally available only for short time periods or with gaps. There is also no consensus as for an adequate measure of financial development – in a related study Giuliano and Ruiz-Arranz (2009) used four different proxies: deposit to GDP ratio, loan to GDP ratio, credit to GDP ratio and M2 to GDP ratio to provide some insight about different aspects of financial sector development.[3] All of them refer only to the size of the financial sector, therefore Bettin and Zazzaro (2012) used also a measure of bank inefficiency, but due to data availability their sample is limited to the time period from 1991 to 2005, not capturing long-run trends.

For these reasons it is worthwhile to create a measure of financial development which would capture more aspects of the financial sector, helping to evaluate the impact of remittances on growth and the role of the financial intermediaries in this process. In this paper I tackle this problem by using an unobserved components model in which a financial development indicator is extracted from available information stemming from existing measures describing the size, depth and efficiency of the financial sector, combined into one number.

The measure proposed in this paper can provide information about the overall impact of financial sector development on the remittance-growth relationship. By combining elements of size and efficiency of the financial sector, it takes into account the fact that availability of credit in the economy is determined both by bank efficiency (bureaucracy related to the application and decision process) and by availability of financial resources. The proposed measure assigns lower values of financial development to countries who have high deposits or credit to GDP ratio but inefficient banks and non-banking institutions. Similarly in the opposite situation, the score of countries with very high efficiency but low size proxies is also adjusted downwards. The first case allows to control for loans which were not given out for the most productive use, and the second case accounts for the fact that even if procedures related to obtaining a loan are simple, applicants may not be able to receive financial support due to unavailability of financial resources.

The main purpose of this paper is therefore to verify whether size or efficiency matter more – does the "overall financial development" strengthen the effect of remittances on economic growth in transfer-receiving developing countries (positive coefficient on the remttance-finance interaction term) or is it a substitute to remittances, removing credit constraints, providing financial resources for productive activities and allowing transfer recipients to spend remittances in a different, non-growth enhancing way (negative impact of the remittance-finance interaction term on GDP per capita growth)?

[2]for example in the Financial Structure Dataset.

[3]In his study for Ghana, Adenutsi (2011) provides a broader list with potential measures of financial development, including additionally: stock price index or market capitalization index, level of nominal interest rates, real interest rate growth, bank credit to the private sector to private deposits ratio, spread between deposit and lending rate, and others.

Another issue pertaining to this research question, and to growth regressions in general, is the potential endogeneity of financial development measures and remittances (and other potential determinants of long-run economic growth). In this paper I rely on the assumption of weak exogeneity of the variables of interest. I account for it by lagging the regressors by one year with respect to the dependent variable when forming 5-year averages. Then I use two estimation methods, consistent under this assumption. The quasi-maximum likelihood for dynamic panel data with fixed effects (QML-FE) is the first method applied and I discuss the results of it in more detail, as the preferred ones. The advantage of QML-FE is that, in contrary to GMM methods, it is not necessary to use any instruments and weak instrument problems described by Roodman (2009) and Bazzi and Clemens (2013) are avoided. Taking these disadvantages into account, I also apply system GMM estimation where I use lagged values as internal instruments for all regressors. The second method is more popular in the literature and can also be seen as a robustness check if my explanatory variables do not fulfill the exogeneity requirement. Moreover, to remove most common sources of cross-sectional dependence, time dummies are included in all regressions.

The results of this paper show that the impact of remittances on economic growth indeed depends on the level of financial development. For countries with the least advanced financial sectors there is evidence for positive correlation between remittances and growth, but the effect turns negative with increasing financial development and migrants' transfers can become irrelevant. A country could also experience long-run output losses if it achieved very high levels of financial development. This means, that remittances and financial development can be seen as substitutes. Nonetheless, some initial financial development is an important prerequisite to induce economic development and to foster remittances. The results do not change significantly when years 2007-2010 (global financial crisis and following economic slowdown in industrial countries) are excluded from the sample, preserving the negative sign of the remittance-finance interaction term in my growth regressions.

The structure of the paper is following: after a brief literature review in Section 2, Section 3 gives a detailed description of the data used for the creation of the index and for estimation, Section 4 includes a brief overview of the methodology applied, both for the index formation and for growth regressions. In Section 5 I present the results concerning the financial development index and in Section 6 the results of the growth model for a large cross-section of countries over the time period 1970-2010. All regressions are repeated for four different measures of financial development, first the overall financial conditions index and then for some of the variables which were used for its formulation. I control for measures of investment, government expenditure and human capital. Section 6 includes also two counterfactual scenarios, firstly of the impact on economic growth if remittances or financial development remained constant at their initial level for each country, and secondly if they grew more than in reality – by 20% for each country. Section 7 shows that no strong structural shifts took place during the financial crisis so that the role of the financial sector as a substitute for remittances has remained unchanged. Section 8 concludes.

2 Related literature

There is a vast literature on the importance of remittances for development and poverty alleviation, especially for small countries where the ratio of remittances to GDP is high, reaching more than 30% (for example in Lesotho – with the average ratio over 50%, Moldova, Tajikistan, Tonga, Samoa[4]). Given these large numbers, sometimes even bigger than the value of foreign direct investment (FDI) or official development assistance (ODA), many researchers have examined the impact of these transfers on economic growth in receiving countries. Although no consensus has been reached until now, remittances are generally believed to enhance economic growth through indirect channels (mainly through investment and human capital formation). Yet, studies focusing on their direct impact on gross domestic product (GDP) per capita growth[5] suggest a negative or at best insignificant relationship (Chami, Fullenkamp, and Jahjah (2003); Gapen, Chami, Montiel, Barajas, and Fullenkamp (2009); Rao and Hassan (2011)).

Rao and Hassan (2012) and Senbeta (2013) show that the direct effect of remittances on economic growth may be nil but these transfers still can affect GDP per capita through different channels: investment, financial development, output volatility, total factor productivity (TFP) and the real exchange rate. However, on aggregate the effects can cancel out. Senbeta (2013) argues additionally that the negligible remittance impact on TFP justifies the lack of significance of migrants' transfers[6] on long-run economic growth. More recently, Clemens and McKenzie (2014) have shown that the rapid increase in remittances recorded after the year 2000 is due to changes in the definition of the transfers rather than actual increases in transfers. In this context, they do not expect remittance measures based on Balance of Payments data to show significant growth-enhancing effects.

Some studies have found positive causal links between remittances and growth (The World Bank (2006); Giuliano and Ruiz-Arranz (2009); Catrinescu, Leon-Ledesma, Piracha, and Quillin (2009); Ramirez and Sharma (2009); Ramirez (2013)[7]). Giuliano and Ruiz-Arranz (2009) show that remittances can significantly improve economic growth, if the financial sector development is taken into account, hence showing that financial sector can be a channel through which remittances affect growth. They also argue that migrants' transfers and the financial sector can be substitutes – their growth model includes an interaction term between the two variables and this term has a negative coefficient, as

[4]Data sources are described in Section 3

[5]In these studies, estimation equations include measures of investment and human capital in order to partial out the indirect effects of remittances through these channels.

[6]In this paper I use the term *migrants' transfers* interchangeably with *remittances* or *remittance inflows*. Until 2009, *migrants' transfers* constituted one item in the Balance of Payments, and together with with compensation of employees added up to remittances. According to International Monetary Fund (2009a) the former was changed into personal transfers, therefore I treat *migrants' transfers* and *remittances* as synonyms (both including also compensation of employees.

[7]The last two studies consider only selected Latin American and Carribean countries from 1990 to 2005/7. The methodology applied therein (fully-modified OLS) was criticized by Gapen et al. (2009) for limited small sample performance.

expected by the authors. They interpret this result as follows. If the financial sector is well developed, credit constraints are removed and remittances received from relatives from abroad need not be used in a productive way. However in countries with poorly developed financial markets remittances can be an important source of financing growth-enhancing activities.

In the conclusions Giuliano and Ruiz-Arranz (2009) express their concern that the results might suffer from bias, related in particular to the omission of measures of institutional quality. Catrinescu et al. (2009) estimate dynamic panel data models including workers' remittances, various measures of institutional quality[8] and interaction terms of the two and show that better quality of institutions strengthens the impact of remittances on economic growth. The direct effect of migrants' transfers however is not robust, and only significantly positive in some of the specifications.

The substitutability found by Giuliano and Ruiz-Arranz (2009) is confirmed by studies focused on Latin American and Caribbean countries by Ramirez and Sharma (2009); Ramirez (2013) and on a larger set of countries by Gapen et al. (2009). However Nyamongo, Misati, Kipyegon, and Ndirangu (2012) and Zouheir and Sghaier (2014) provide evidence of the opposite relationship between remittances and financial development in African countries. In this region, the two variables seem to be complements with continuing financial deepening strengthening the positive impact of remittances on growth, rather than mitigating it. As remittances can be deposited in banks, they bring a larger share of the population in contact with the financial sector, expanding the availability of credit and savings products (International Monetary Fund (2005); Aggarwal, Demirgüç-Kunt, and Pería (2011)).

Moreover, countries with underdeveloped financial markets have larger transaction fees and migrants tend to use informal channels instead (e.g. hawala in parts of Asia and Africa). Freund and Spatafora (2005) estimate that official remittance data underrates their value by 35 to 75% which means that the true impact of such transfers on GDP might still be understated, and these authors also show that lowering transaction costs by 1 percentage point would lead to remittance increasing by 14-23%. This view is supported e.g. by Ratha (2003):

> "By strengthening financial-sector infrastructure and facilitating international travel, countries could increase remittance flows, thereby bringing more funds into formal channels." (p. 157).

Bettin and Zazzaro (2012) explain that the negative sign of the interaction term between remittances and financial development need not necessarily indicate that these two are substitutes and can be considered as alternative sources of financing productive investment for economic growth. They explain, following Rioja and Valev (2004) and Gapen et al.

[8]They use Corruption Perceptions Index from Transparency International and political risk indicators from the International Country Risk Guide.

(2009), that this coefficient may capture a nonlinear effect of the size of financial sector on output growth. This is in line with an alternative interpretation of the interaction term between remittances and financial sector development, focused on the marginal effect of the latter rather than that of migrants' transfers. In this case, the negative sign of the interaction term coefficient can mean that growing remittances increase bank deposits and available credit but loans are not necessarily given in an efficient way. Therefore, this remittance-driven rise in the financial sector size does not contribute to economic growth.

For this reason, Bettin and Zazzaro (2012) construct a measure of financial development related to its (in)efficiency rather than its size and provide evidence for remittances and financial sector's efficiency to act as complements for economic prosperity. The efficiency of the financial sector in a given country is measured as the weighted average of the ratio of banks' operating expenses to their net interest revenues and other income.[9] Higher outcomes are related to less efficient financial intermediation. Bettin and Zazzaro (2012) show that the combined effect of remittances on GDP per capita is lower the larger the size of the financial sector (substitutes) but it is higher the more efficient the financial sector is (complements).

3 Data issues

3.1 Remittance data

As mentioned before, the reliability of remittance data is limited. At global level, receipts of remittances exceed their payments and this discrepancy is growing over time, see International Monetary Fund (2009b). This is a problem especially in least developed countries where differences in costs between sending monies through the banking sector as compared to informal channels are large (and, moreover, transfers in-kind or carrying cash across borders is very popular). Improving the quality of the data (e.g. by estimating informal flows from transaction fees or errors and omissions post in the balance of payments) is beyond the scope of this paper.

Remittance data constitute part of the balance of payments published by the IMF. They are compiled from different positions in the current and capital account, according to Dilip Ratha's recommendation and to the latest Balance of Payments Manual (Ratha (2003), International Monetary Fund (2009a)). Personal remittances are the sum of three elements: personal current and capital transfers between resident and nonresident households and compensation of employees, less taxes and social contributions.[10]) These data are readily available in shares of current GDP values in the World Development Indicators data set of the World Bank. As it is also the most complete compilation, I used it in this paper.

Given the definition of remittances in the Balance of Payments, it is crucial to emphasize

[9]The data covers 53,820 banks in 66 developing countries over the time period 1990-2005.

[10]For a technical definition of remittances and their computation see International Monetary Fund (2009a)

what kinds of transfers are reflected in official statistics, as this can potentially translate into the direction of their impact on economic growth. Migrants transfer parts of their income back home for two main reasons: altruistic and selfish – the "portfolio motive" (see for example Schiopu and Siegfried (2006), Bouhga-Hagbe (2004)). The former is related to supporting family members who stayed in the home country, mainly in times of bad economic conditions (countercyclical behavior), while the latter is motivated by portfolio diversification reasons (procyclical). The first kind of transfers is usually part of remittances, although it depends on the amount sent – some countries set up thresholds below which transactions are not recorded. The second one should not be included in official remittance statistics (for example if the money is transferred to the migrant's own account – as bank deposits or investments – or if real estate is acquired at home) it should be booked in the financial account instead. However, this is ambiguous. If relatives in the home country can withdraw money from the migrant's account, these cash withdrawals can be viewed as remittances again. Therefore, in principle, remittances data should only reflect altruistic transfers, implying that migrants' transfers could possibly lower economic growth through real exchange rate appreciation and resource reallocation from tradable goods to non-tradable goods production – similar to the Dutch disease, cf. Acosta, Lartey, and Mandelman (2009). However, as these monies can be spent on investment in education or health care, or in starting a business, it may also generate long-run growth. This paper tries to evaluate which motive dominates by quantifying growth effects of remittances.

As the official remittance data reflect different kinds of transfers, including both consumption and investment expenditure, different models exist, explaining the direction of the impact of remittances on GDP. On one hand, Chami et al. (2003) claim that the consumption purpose dominates.[11] In their model, moral hazard problems occur and family members at home lower their labor supply. This effect more than offsets the multiplier effects from increased consumption leading to negative growth impacts of the transfers. On the other hand, Giuliano and Ruiz-Arranz (2009) provide a model where resources from migrants are spent on productive investment and growth impact is positive (also Freund and Spatafora (2008)). Some authors point out strong altruistic motives and negligible self-interest portfolio motives, cf. Bouhga-Hagbe (2004) and Schiopu and Siegfried (2006), while others show an inverted-U relationship between remittances and GDP in the home economy and positive dependence on the domestic interest rate, cf. Adams (2009).

Until now, no possibility of disentangling the transfers related to each motive has been proposed for a broad range of countries.[12] There is evidence from gravity models suggest-

[11] They motivate this claim by results of previous empirical studies and by their first-stage regression results showing that remittances are significantly correlated with GDP differentials but not with interest rate differentials between the home country and the U.S. (2SLS instrumenting remittances with the two aforementioned variables)

[12] For Sub-Saharan countries, Arezki and Brueckner (2012) use rainfall as an instrument for GDP to disentangle the altruistic motive and check whether it is a significant determinant of remittances. They also show that this motive plays an important role when financial development is low – remittances may help overcome domestic credit constraints and take advantage of unexploited investment opportunities.

ing that the two motives combined explain less than half of the transfer flows and more than 50% is generated by links between the sending and receiving countries (distance, common language, common history; see e.g. Lueth and Ruiz-Arranz (2006) or Balli, Guven, Gounder, and Ozer-Balli (2010)), which means that separating the altruistic motive from the portfolio motive, and ignoring the other factors affecting remittance flows at the macro level, would lead to a substantial underestimation of the total value of the transfers. For this reason it is also difficult to draw conclusions as for what should be the overall impact of remittances on economic growth. This is one drawback of large cross-country studies with aggregate remittance data. Nevertheless, I would expect positive effects in the longer term, as there is some evidence for such relationships in the literature, when financial sector development is controlled for (with some measure).

3.2 Data on financial development and the composition of the index

The main purpose of the financial sector can be summarized as follows:

- "The role of the financial system is to transform liquid, short-term savings into relatively illiquid, long-term investments, thus promoting capital accumulation." (The Wold Bank (2005), p.22)
- "Financial markets have an important role in channeling investment capital to its highest value use." (Huang (2011))

There is no composite measure which would perfectly gauge the ability of the financial sector to transform savings into investments. However, such an indicator can be obtained by combining information from various existing measures. Data on financial development used in this paper come mostly from the World Bank's "A Database on Financial Development and Structure" (updated in November 2013).This data set covers 203 jurisdictions over the time period 1960 - 2011. Some variables come from the World Bank's World Development Indicators (WDI) database. The following variables have been chosen to form the financial indicator (classification and definitions from The Wold Bank (2005)):

1. **overall size of the financial system**:
    - financial system deposits to GDP ratio (%) - deposits in deposit money banks and other financial institutions as a share of GDP
    - liquid liabilities to GDP ratio (%) - defined as M3 to GDP ratio, used when deposits to GDP ratio not available (it is broader than M2 as it includes money deposits apart from cash, and therefore reflects better the ability of an economy to channel funds from savers to borrowers). The advantage of this measure is its broad availability, but it includes M2, therefore may be driven by factors other than financial depth and reflect more the ability of the system to merely provide transaction services, see Khan and Senhadji (2000).

2. **financial institution depth** (other than in 1): provision of credit to the economy
    - private credit by deposit money banks and other financial institutions to GDP ratio (%) - all loans offered by commercial banks and other financial institutions
    - domestic credit to the private sector to GDP ratio (%) - only domestic loans to the private sector (both measures from WDI)
3. **institutional efficiency** - ability of the financial sector to provide high-quality products and services at the lowest cost
    - interest rate spread - difference between the lending and the deposit interest rate (reflects the value of loan-loss provisions and the risk premium associated with loans to high-risk borrowers)
    - deposit interest rate (%)
    - overhead costs to total assets (%) - total costs of financial intermediation, including operating costs, taxes, loan-loss provisions, net profits, etc.

A measure created based on information from these three categories is able to combine both size and efficiency aspects of the financial sector, therefore passing the critique raised by Gapen et al. (2009) and Bettin and Zazzaro (2012) that most studies only focus on measures of size of the financial sector, ignoring its efficiency. If this measure of overall financial development is used, concerns related to the interaction term between finance and remittances reflecting non-linear effects of the size of financial sector increasing with growing migrants' transfers are limited. As a measure of "overall financial conditions", this index also accounts for the fact that high bank efficiency may not be enough for a liquid financial sector, if availability of financial resources is limited (small size of the financial sector).

There is one aspect that is not considered by the constructed index. This measure captures the ability of the financial sector to transform liquid deposits into illiquid investments, but it does not capture advantages in terms of risk sharing, allowing for consumption and output smoothing. This is a feature of all proxies of financial development commonly used in the remittance-growth relationship literature. Remittances can serve to buffer economic fluctuations, therefore substituting for this role of the financial sector. However, in this paper I focus on growth effects, rather than on smoothing, related to second moments, which constitutes a different research question.

The financial development index (and some of the other proxies listed above) enter my growth regressions, together with remittance inflows to GDP ratio, an interaction term between the two, and other determinants of long-run economic development.

3.3 Other determinants of economic growth

Other variables included in the estimations are standard in the growth literature and include measures of: investment, government expenditure, trade openness, population growth

and human capital. Most data come from the World Development Indicators (version 2014) database of the World Bank: gross fixed capital formation to GDP ratio, government expenditure to GDP ratio, population size and trade openness (exports+imports to GDP ratio). Human capital is measured by the average years of secondary schooling attained by the population aged 25 and over (from the Barro and Lee (2013) database, updated in June 2014).

3.4 Estimation sample

The estimation sample consists of developing countries based on the classification used by the IMF.[13] The maximum time period is 1970-2010, non-overlapping 5-year time averages for each country are used in the estimations. This means that up to 8 observations are available per country. Given that remittance to GDP ratios are particularly high in smaller countries, I did not exclude them from the sample, hence not following the study of Mankiw, Romer, and Weil (1992). I also keep oil-producers. This should not affect the results to a large extent, since I identified only 5 countries as small (with average population below 1 million): Barbados, Belize, Cyprus, Fiji, Malta and Swaziland and 2 as oil-producing: Gabon and Iran, in the set of 61 developing countries. In principle, potential differences in the structure of these economies should be captured by the individual effects.[14] For former communist countries (Central and Eastern European countries, as well as former USSR republics) only data from 1990 onward are considered (allowing for a maximum of 4 observations per country, from 1995 to 2010). The list of countries and years for which data is available is provided in appendix A.1.

4 Methodology

4.1 Dynamic factor model – construction of the financial development index

The variables described in Section 3.2 have been grouped into three categories in order to extract the overall, unobserved financial sector indicator (in what follows also referred to as overall financial development or overall financial conditions index) from them. I only include a given country in the sample if data from at least two out of the three categories are available for at least 20 time periods (not necessarily consecutive). The model is formalized as follows, following Stock and Watson (1991):

[13] All developing countries are assigned to one of the following regions: Central and Eastern Europe, Commonwealth of Independent States, developing Asia, Latin America and the Caribbean, Middle East and North Africa and Sub-Saharan Africa)

[14] Mankiw et al. (1992) did not use panel data techniques, therefore were not able to account for potential structural differences between oil-producers and other countries. Individual effects included in my fixed effects regressions do capture these particularities under the assumption that they are time invariant.

$$\boldsymbol{z_{it}} = \boldsymbol{\alpha} + \boldsymbol{\beta\iota}\text{findev}_{it} + \boldsymbol{w_{it}} \quad (1)$$

$$\text{findev}_{it} = \gamma\text{findev}_{i,t-1} + v_{it} \quad (2)$$

with

$\mathbb{E}(\boldsymbol{w_{it}}) = \mathbf{0}\ \forall i, t$

$\mathbb{E}(\boldsymbol{w_{it}}\boldsymbol{w_{is}}') = \begin{cases} \boldsymbol{\Sigma} \text{ if t=s} \\ \mathbf{0} \text{ otherwise} \end{cases}$

$\mathbb{E}(v_{it}) = 0,\ \mathbb{E}(v_{it}^2) = 1\ \forall i, t$

where $\boldsymbol{z_{it}}$ is a $k_i \times 1$ vector consisting of measures of financial development from the three categories described in Section 3.2 ($k_i = 3$ if all three measures are available for a country i at time t, otherwise $k_i \in \{0, 1, 2\}$); $findev_{it}$ is a scalar representing the unobserved financial sector development measure for country i at time period t and $\boldsymbol{w_{it}}$ is the idiosyncratic error. $\boldsymbol{\iota}$ is a vector of ones with the same dimension as the data in $\boldsymbol{z_{it}}$ ($k_i \times 1$). t in this setup refers to a 1-year time period (in the latter growth regressions it will stand for 5-year time averages). $\boldsymbol{\alpha}$ is a $k_i \times 1$ vector of constants, and $\boldsymbol{\beta}$ is a $k_i \times k_i$ matrix with off-diagonal elements equal to zero. Only elements (1,1), (2,2) and (3,3) are estimated and referred to as $\beta(1)$, $\beta(2)$ and $\beta(3)$.

Equation (1) is referred to as the "measurement equation" (or observation equation). For each country it is a system of k_i equations relating the unobserved overall financial conditions index to existing proxies of financial development (from the available categories). Equation (2) is the "state equation", describing the data generating process which the created index is assumed to have. In this case both groups of equations (referring to measured and unobserved variables) are estimated jointly for all countries (parameters are not country-specific) by maximum likelihood (MLE) and the Kalman Filter.[15] This specification is based on the assumption that existing measures of financial development are determined by the overall state of the financial development which is unobserved and that the relationship is the same in all countries. The unobserved variable is estimated jointly with the vector of unknown parameters: $\boldsymbol{\theta} = \{\boldsymbol{\alpha}, \boldsymbol{\beta}, \gamma, \text{vech}(\boldsymbol{\Sigma})\}$.

findev_{it} combines information about the size (category 1), depth (category 2) and *inefficiency*[16] (category 3) of the financial sector. Higher values of the unobserved variable should translate into greater values of the first two measures, therefore $\beta(1)$ and $\beta(2)$ are expected to be positive. At the same time they should decrease inefficiency of the financial sector, translating into a negative value of $\beta(3)$.

The methodology builds on the idea of Stock and Watson (1991) ("Single-Index" Model,

[15]The Kalman filter is the best linear unbiased predictor of unobserved states even if the normality assumption on errors from equations (1) and (2) does not hold. If it holds, and the initial states are also normally distributed, the Kalman filter gives the best prediction among all possible functional forms, not only among the linear ones (Harvey (1989); Ho, Shumway, and Ombao (2006)).

[16]Higher values of deposit interest rates, interest rate spreads or overhead costs are signs of inefficiency.

for one country), Kaufmann, Kraay, and Mastruzzi (2008) (extended to panel data) and Binder, Georgiadis, and Sharma (2009).[17] In contrast to the previous literature, the data generating process of the unobserved component (the financial sector development index) is assumed to be autoregressive (with one relevant lag). In this way, I allow for persistence in the development of the index. It accounts for two special cases: a random walk and a process with no memory (identical and independent draws from a given distribution). The latter was the specification chosen in other studies. The Kalman Filter accommodates AR(1) processes (see for example Hamilton (1995)).

This specification of the model accounts for random effects (which are included in the composite error terms $\boldsymbol{w_{it}}$ and v_{it}). It does not allow for fixed effects in the state equation since information about the level of the unobserved financial conditions index would be lost after taking the first difference or within transformation of this equation, and therefore it would preclude making international comparisons of the financial development index (which is necessary to ensure reliability of the obtained overall financial conditions values). Fixed effects in the measurement equation are possible to implement but it would lead to inconsistency between the two equations, if correlation between the unobserved effects and regressors was allowed in the measurement but not in the state equation.

Another advantage of this methodology is the fact that it accounts for missing values. Countries for which not all observations for each time period are available can be included in the sample, since the estimation-maximization (EM) algorithm applied estimates the value of the unobserved component consistently even in the presence of missing values (Durbin and Koopman (2001)). More details on the estimation procedure are provided in appendix **??**.

4.2 Dynamic panel data models for growth regressions

The estimation equation looks as follows:

$$y_{it} = \alpha + \gamma y_{i,t-1} + \delta_1 \text{Rem}_{it} + \delta_2 \text{FinDev}_{it} + \delta_3 \text{Rem}_{it}\text{FinDev}_{it} + \boldsymbol{\beta X_{it}} + \mu_i + \eta_t + \epsilon_{it} \quad (3)$$

where the left hand side variable is the 5-year average of real GDP per capita, Rem_{it} denotes the share of remittance inflows to GDP of the transfer-receiving country, FinDev_{it} is a measure of financial development (estimations were repeated for four different measures, all variables expressed in log-modulus transformation) and the vector $\boldsymbol{X_{it}}$ includes all other regressors from Section 3.3. η_t refers to common unobserved shocks and is approximated by time dummy variables (referring to each 5-year period). In this way, potential cross-sectional correlation is limited. To ensure that no such dependence among countries prevails in the

[17] Stock and Watson (1991) have used a single-index model to estimate the overall state of the American economy, Kaufmann et al. (2008) have estimated various dimensions of governance in 212 countries over 1996-2007, while Binder et al. (2009) used this kind of model to obtain a financial development index and a institutions development index for 60 countries in 1970-2006, but only a small subset of them are developing countries. Given that developing countries are the ones studies in this paper, existing measures of financial development cannot be used, due to their low time or spatial coverage.

model I perform the SYR test (results available from the author on request), developed by Sarafidis, Yamagata, and Robertson (2009).[18] The error term ϵ_{it} contains all other unobserved time-varying sources of variation in GDP per capita.

The dependent variable is expressed as the natural logarithm of GDP per capita in constant 2005 US dollars, others are expressed in percentages as shares in the country's GDP, apart from years of schooling (not transformed), population growth (percentage changes) and financial development measures. I apply a log-modulus transformation to the data related to the financial sector which were used for the index construction.[19] The reason for using this transformation rather than just taking the natural logarithm is that it preserves negative values in the original data. Negative values can occur in the third category of financial sector development measures (for example for the interest rate spread, but cannot be excluded in case of the deposit interest rate either). Following Mankiw et al. (1992), I add 5 percentage points to the population growth, to account for the capital depreciation rate and long-run GDP growth rate. Tab. 1 shows summary statistics for the transformed data (after obtaining 5-year time averages) and appendix A.3 provides information about pairwise correlation between the regressors.

Given the dynamic structure of the model and a "short T, large N" specification of the panel data, one of the methods which I use is system GMM (Arellano and Bover (1995); Blundell and Bond (1997)). The advantage of this approach is that it allows for endogenous regressors and takes account of the endogeneity of the lagged dependent variable at the same time. Moreover, it models initial observations for the sake of including the first time period. Given that the equation is being estimated also in levels, apart from differences, the model can include time-invariant regressors. To include as many observations for unbalanced models as possible, forward orthogonalization can be used instead of first differences. There are disadvantages too, though. This method has been criticized for low robustness against the instrument choice, in particular in large models weak instruments may cause the estimates to be biased.[20]

For these reasons, the second method which I use in this paper is the quasi maximum likelihood estimator for fixed effects dynamic panel data developed by Hsiao, Pesaran, and Tahmiscioglu (2002) (denoted later as QML-FE[21]), and I treat coefficients obtained by this method as the main results. This method also takes account of initial conditions to correct for short-T bias but does not rely on instrument use.

Both methods are suitable for short dynamic panels with a persistent (close to unit root,

[18] A simple way to perform this test was proposed by De Hoyos and Sarafidis (2006) and consists of computing the difference in Sargan's statistics for overidentifying restrictions from two GMM regressions - one with the full set of instruments and one without instruments with respect to the lagged dependent variable. A large discrepancy between the two values indicates presence of cross-sectional correlation.

[19] The transformation, denoted as lm(x), takes the following form: lm(x)=sign(x)*ln(abs(x)+1). It preserves the sign of the original data (values below zero get a negative sign, values above get a positive sign).

[20] For comprehensive critique of GMM estimators refer to Roodman (2009) and Bazzi and Clemens (2013).

[21] For this estimation method I use the xtdpdqml command for Stata developed by Kripfganz (2015).

which is the case for GDP per capita) left hand side variable. While in system GMM it is possible to use first and older lags as GMM-style instruments for potentially endogenous variables, QML-FE allows only for weakly (and strictly) exogenous regressors[22]. Due to this shortcoming, all regressors apart from the lagged dependent variable (average logarithm of GDP per capita from t-9 to t-5) are formed in a way to exclude simultaneity (averages from t-5 to t-1, while the dependent variable is an average from t-4 to t, where e.g. $t = 1990$). Formally weak (sequential) exogeneity implies:

$$\mathbb{E}(\epsilon_{it}|y_{i,t-1}, ..., y_{i,0}, \text{Rem}_{it}, ..., \text{Rem}_{i1}, \text{FinDev}_{it}..., \text{FinDev}_{i1}, \boldsymbol{X_{it}}, ..., \boldsymbol{X_{i1}}, \mu_i, \eta_t) = 0 \qquad (4)$$

This identification assumption together with a first-differenced version of (3) implies that the following moment conditions are valid (and used in my system GMM regressions):

$$\mathbb{E}((\epsilon_{it} - \epsilon_{i,t-1})(\text{Rem}_{i,t-s+1}, \text{FinDev}_{i,t-s+1}, \boldsymbol{X_{i,t-s+1}})') = 0 \text{ for all } s \leq t-2 \qquad (5)$$

This means that the second lag of the dependent variable and first lag of the other regressors (and all further lags of all variables) can be used as instruments. However, if serial correlation is present in the error term, the most recent lags have to be excluded, depending on the order of autocorrelation.[23]

Following the economic growth literature, lagged values of the dependent variable and of the regressors which are assumed to be weakly exogenous are used as "GMM style" instruments. I use the second to fourth lags of investment, trade openness, government expenditure and years of secondary education, second to fifth lags of remittance inflows, financial development measure and their interaction term[24]. Exogenous variables (time dummies and population growth) serve as instruments for themselves ("IV style"). I use the 'collapse" option in Stata to keep the overall number of instruments at a reasonable level (following the rule-of-thumb that the number of instruments should be lower than the number of panel data units). Third to fifth lag of the dependent variable are also included as "GMM style" instruments. Estimation tables include Hansen's test statistics for overidentifying restrictions which can help evaluate the quality of the instruments (the fulfillment of (5)). Also, I include pooled OLS and simple fixed effects within estimation results, both for the estimation sample as for the truncated sample for robustness check. According to Roodman (2009), if the coefficient on the lagged dependent variable lies

[22]In system GMM internal instruments are only valid under weak exogeneity assumption too. However the regressors can be correlated with current and a given number of future values of the error term. This implies using further lags as instruments. If a regressor is correlated with all future values of the error term, its lags cannot be used as regressors at all. External regressors are necessary in such case.

[23]The Arellano-Bond test for serial correlation in first-differenced error terms can detect autocorrelation of different order. Condition (5) only holds if no second order serial correlation is present (indicating no first-order autocorrelation in the original error term from (3)). If this assumption does not hold, but no third order autocorrelation is indicated, one lag of the instruments has to be skipped, $s \leq t-3$, analogously for all additional orders of serial correlation. Of course, this lowers the strength of the instruments.

[24]One lag of all variables was omitted when forming the instrument set since second order serial correlation in the differenced error terms was detected.

between the FE and pooled OLS estimates, GMM results can be trusted. I provide this information in Tab. 13 and Tab. 14 in appendix A.9.

Such a formulation of the model including an interaction term between remittances and financial development allows for a nonlinear impact of remittances on economic growth, depending on the level of financial development of the transfer-receiving country. This means that remittances might be particularly important only for a subgroup of countries, for example those with lowest levels of financial development which is the main hypothesis of this paper. For countries with more developed financial markets I expect the impact of remittances on economic growth to be reduced.

4.3 Generated regressor problem

The inclusion of the estimated overall financial conditions index in the regressions brings about advantages as well as challenges. The former have been already discussed and refer to measuring better the different aspects of financial sector in one indicator, as well as imputing information for countries with missing values. Problems, however, are related to the additional uncertainty added to the model if an estimated variable is included instead of its observed value.

The problem was first pointed out by Pagan (1984) and then by Murphy and Topel (2002). They propose different two-step maximum likelihood procedures in order to account for the bias in the standard errors of the coefficients. Alternatively, if analytical solutions are cumbersome to obtain, bootstrap can be used to correct the standard errors, as was done by Ashraf and Galor (2013). In this paper I follow their approach.

The procedure is as follows. First, countries are drawn with replacement from the set of all available countries (not only developing). For the chosen set of countries I run the Kalman filter to estimate the unobserved financial development indicator. The values of the indicator are stored, and the sample is then limited to include only developing countries. System GMM and QML-FE regressions are then run on this sample with possibly repeating countries. I store coefficient estimates from each regression. This procedure is repeated K times ($K = 1200$), however for the QML-FE the repetition of observations can create problems and leads to the log-likelihood function not being concave, therefore parameter values are only stored for ca. 95% of the runs. This is still a reasonably large number of repetitions. Standard errors which are displayed in the following tables for all QML-FE estimates and in the first column of system GMM estimates (in which I used the generated index as a regressor) are computed as standard deviations of the parameter estimates from the 1200 (or fewer, if not all converged) runs of the bootstrap procedure outlined in this section.[25] This procedure closely follows the one of Ashraf and Galor (2013), who generate (1000 times) a variable measuring migratory distance from East Africa to

[25] I do not use bootstrapped standard errors in the remaining system GMM estimations, as the robust standard errors obtained in two-step estimation are already large, and bootstrapping is a time-consuming procedure.

destination country in order to predict ethnic diversity (a variable which was originally only available for 21 countries) and use this diversity (as a regressor) to explain population density in year 1500 in 145 countries. This is analogous to my generating an index of overall financial conditions and then plugging it into growth regressions.

5 The financial development index - results

The index of financial development was estimated for 151 countries for the time period from 1970 to 2010 (or other longest available time span). The resulting relationship between the underlying variables and the constructed index can be summarized by the following equations (standard errors in brackets):

$$\begin{pmatrix} z_{it}^1 \\ z_{it}^2 \\ z_{it}^3 \end{pmatrix} = \begin{pmatrix} 3.46[0.057] \\ 3.40[0.061] \\ 1.97[0.048] \end{pmatrix} + \begin{pmatrix} 0.11[0.005] \\ 0.13[0.007] \\ -0.04[0.006] \end{pmatrix} \times \text{FinDev}_{it} \tag{6}$$

$$\text{FinDev}_{it} = 0.99[0.001] \times \text{FinDev}_{i,t-1} \tag{7}$$

All coefficients in equations (6) and (7) are statistically significant at 1% significance level. The first vector in equation (6) ($\boldsymbol{\alpha}$ in equation (1)) refers to the estimated means of the variables from each of the three categories used for extracting the overall financial conditions index, abstracting from the index values. The second vector ($\boldsymbol{\beta}$ in equation (1)) reflects the strength of the dependence of the observable measures on the unobserved overall financial conditions indicator. The coefficients can be interpreted as follows – the higher financial development in general, the higher financial deposits to GDP ratio and credit to GDP ratio ($\beta(1)$ and $\beta(2)$). A higher level of financial development leads to higher institutional efficiency, represented by decreasing interest rate spreads – hence the negative sign of $\beta(3)$.

Appendix A.4 provides a ranking of financial development, based on the time mean of the estimated index for each country. As expected, advanced economies take the highest positions, with East Asian, European countries and the United States forming the top 10. The location of small countries can be surprising but it is due to large financial deposits to GDP ratios. The index corrects this information by including data from other measures, but is unable to remove this effect completely (for comparison of financial development ranking columns denoted as (1) to (3) include rank positions based on measures from each category from which the index was extracted).

The leaders in the group of developing countries are Hong Kong (1), Cyprus (5), Macao (8), Malta (11), Malaysia (15), St. Kitts and Nevis (19), South Africa (21), Lebanon (22) and Thailand (23). As for European countries (which belong to developing countries according to IMF) included in the ranking are: Cyprus, Malta, Israel (34), Czech Republic (38)

and Bulgaria (58). The leaders for developing Asia are Hong Kong, Macao, Malaysia, Thailand, Vanuatu (27), China (28) and Fiji (63), while in Latin America and the Caribbean the best positions are taken by small states: St. Kitts and Nevis (19), St. Lucia (26), Antigua and Barbuda (30), Grenada (31) and Panama (32). As for larger and more important (in terms of economic power) countries from this region, Chile (50) is followed by Brazil (59), Uruguay (73), Venezuela (78) and Colombia (87). South Africa, Lebanon, Jordan (29), Bahrain (41) and Tunisia (42) obtained highest results among countries from the Middle East and Africa.

For the sake of brevity I do not provide information about the estimation results of the financial development index for each particular country. Such data, including graphs of historical evolution and tables with mean values of the index and the underlying variables, is available on request.

6 Estimation results from growth regressions

In the tables and graphs in the remainder of this paper I present results of quasi-maximum likelihood and system GMM estimations. All estimations where performed in Stata and Mata. I use GMM for my work to be comparable to the previous studies and the QML-FE given its advantages in bias correction for processes close to unit roots and lack of problems related to instrument choice. For both methods, I repeat each estimation four times: first for the generated index of financial conditions and then for three other measures which were used for its construction. The three other variables referring to financial sector development and used in the estimations are following. First, financial system deposits to GDP ratio which is, apart from M3 to GDP ratio, the broadest readily available measure of the financial sector. Second, as I am not only interested in domestic loan providers, I use private credit by banks and other financial institutions to GDP ratio to account for all sources of credit offered to the private sector by financial institutions. Thirdly, I use the interest rate spread to include a measure covering the cost efficiency aspect of financial development. Results based on the three other measures of financial development are included to verify the reliability of the constructed indicator and for comparison with other studies.

6.1 Look at correlations

Fig. 2 shows the correlation between remittances share in GDP and GDP per capita growth (before excluding the impact of other factors) for different levels of financial development (left versus right hand side panels: low versus high financial development) and for four different measures of financial development. Fig. 2 (a) shows correlations split based on the overall financial conditions index, extracted by use of the methodology in 2.2.1. Panels (b) - (d) refer to other measures frequently used in the literature: financial system deposits

to GDP ratio, private credit by banks and other financial institutions to GDP ratio and interest rate spread (values of these variables are not shown in these figures, they are only used as thresholds to determine sample splits). The threshold level of financial development is determined arbitrary (for illustrative purposes) by its median for the whole estimation sample. For each country I have computed the mean of remittance inflows to GDP ratio and of GDP per capita growth separately for the time periods for which the country was in each of the two possible regimes.[26] These are presented in the subsequent plots.

The solid line in Fig. 2 corresponds to the correlation between the two measures and its 95% confidence interval which would be obtained by bivariate OLS regressions. A horizontal dashed line indicates that remittances and GDP per capita growth are not correlated, while a positively sloped line indicates that remittance inflows to GDP ratio growth is positively correlated with GDP per capita growth, and vice versa. All four presented sample splits indicate that countries which have higher remittance inflows to GDP ratio tend to have a higher GDP per capita growth rate in the low financial development regime, while there is no evidence for this relationship to hold in the other regime. This suggests that when the transfer-receiving country reaches a certain level of financial development (here arbitrary fixed at the median for all developing countries), additional monies obtained from relatives abroad are not being spent on productive purposes anymore. This means that remittances help overcome liquidity constraints if these might be binding (which is likely in countries with low financial development), but once other sources of financing become available for productive activity (startups, investment in education or health of children) transfers from migrants are more likely to be used for consumption and do not contribute to economic growth. This result is robust to the choice of the measure of development.

A word of caution is necessary for understanding plots and tables referring to the interest rate spread. As its interpretation is opposite to the other measures, with lower difference between the lending and deposit rates reflecting higher levels of development, also the marginal effects of remittances on economic growth will have the opposite slope than for the other measures of financial development. For instance, in Fig. 2 (d) the positive relationship between remittance inflows to GDP ratio and GDP per capita growth for interest rate spreads above median reflects the same relationship as the positive relationship for the lower regime in panels (a)-(c) of the same figure. They all refer to the fact that countries with low financial development who have higher remittance to GDP ratios also have higher GDP per capita growth rates.

Before turning to the estimation results, I briefly describe pairwise correlations between the logarithm of GDP per capita (dependent variable) and all the explanatory variables considered (cf. appendix A.3), starting with the standard control variables usually con-

[26] In this paper the threshold level of financial development has been fixed arbitrarily. It would be possible to determine its existence by a dynamic threshold model based on Hansen (1999) but the threshold is unlikely to be unique for all countries and constant over time. Regime switches would only be possible with radical policies, including sharp interest rate changes or changes in regulations of the financial markets (e.g. limiting the presence of foreign credit providers on the domestic market).

sidered in the growth literature. These variables are: investment to GDP ratio (proxy for the savings rate), population growth (accounting also for capital depreciation and long-run GDP per capita growth, in sum reflecting the rate of capital accumulation necessary to preserve the standard of living), years of secondary education (proxy for investment in human capital, as in the augmented Solow model of Mankiw et al. (1992)), government expenditure (measure of government effectiveness) and trade openness (the ratio of exports and imports to GDP). All the correlations have the expected sign (positive correlation with y_{it} of all variables other than population growth, for which it is negative), apart from government expenditure. However the main estimation results discussed below correct for this.

The inclusion of a measure of human capital is driven not only by relevance of investment into having a well educated population for long-run economic growth but also due to its relation with migration and consequences of international movements of people (other than cross-border money transfers). Higher remittances can be associated with larger diasporas (larger aggregate transfers resulting from higher overall migration from one country, not from higher amounts sent by individual migrants, extensive margin rather than intensive). One frequently mentioned negative effect of large emigration is brain drain, the loss of economic potential due to lack of highly educated workers in the home country. By including a measure of human capital in the migrant-sending economy in the growth regressions I limit the risk of my remittance measure reflecting potential brain drain associated with international migration (a negative sign of the coefficient reflecting the impact of remittances on GDP per capita could indicate, among other things, brain drain effects, if no human capital measure was included in the model). In my sample the correlation between remittance inflows to GDP ratio and the human capital variable is virtually zero (cf. appendix A.3, row 7, column 4), but a regression omitting years of secondary education shows that the coefficients of remittances and of the interaction term with financial develoment would be lower and with larger standard errors in this case. This means that remittances could indeed be picking up brain drain effects.[27]

Concerning the variables of interest – remittance inflows to GDP ratio and measures of financial development – not all of them are statistically significantly correlated with the dependent variable. The correlation of migrant transfers and of the interest rate spread (measure of efficiency of the financial sector, used to generate the index of overall financial conditions) with log(real GDP per capita) is nil. In case of interest rate spread it might be related to lower data availability but for remittance inflows to GDP it indicates that a simple regression of log(real GDP per capita) on the value of migrants' transfers would lead to insignificant results and suggest that these transfers have zero or even negative impact on economic growth (correlation of -0.077).[28]

[27]Regression results omitting the years of secondary education variable not shown.

[28]Indeed, a 'naïve' static regression of log(real GDP per capita) on remittance to GDP ratio suggests a negative relationship, statistically significant if time dummies are also includes. Results available from the author upon request.

6.2 Main regression results and marginal effects of remittances

The main estimation results are presented in Tab. 2, Tab. 4 and in Fig. 3. Each column of the tables includes the coefficients obtained from regressions using different measures of financial development. The first column refers to the index of overall financial development, constructed in the way described in Section 2.2.1, while in the other columns the commonly used measures of financial development were considered (instead of the generated index). Both estimation methods, system GMM and QML-FE, indicate a positive impact of remittance inflows to GDP ratio on economic growth for countries with low financial development but decreasing with further financial deepening. The coefficient on remittances inflows share in GDP (δ_1) refers to its influence on GDP per capita growth for countries with financial development equal to 0 (which is possible given the log-modulus transformation applied to measures of financial conditions, cf. Tab. 1 and appendix A.5).[29] Yet, this value does not contain all the information about the relationship between remittances, growth and finance. To fully assess it, also δ_3, the coefficient on the interaction term between remittance inflows and measures of financial development, needs to be taken into account, since:

$$\frac{\partial y_{it}}{\partial \text{Rem}_{it}} = \delta_1 + \delta_3 \text{FinDev}_{it} \equiv \delta_{it} \tag{8}$$

$$\text{Var}(\delta_{it}) = \text{Var}(\delta_1) + \text{Var}(\delta_3)\text{FinDev}_{it}^2 + 2\text{FinDev}_{it} Cov(\delta_1, \delta_3) \tag{9}$$

Equation (8) captures the complete relationship between remittances and GDP per capita growth for different levels of financial development. δ_{it} and its 90% confidence interval has been depicted in Fig. 3. The partial derivative of y_{it} with respect to remittance inflows to GDP ratio has been computed for all observed values of the four considered measures of financial development and the standard error of δ_{it} was obtained from equation (9). The graphs reinforce the inference based on estimation tables. There is a positive effect of remittances on economic growth in countries with lowest financial development, but it becomes insignificant with improvements of financial conditions. The effect turns negative for moderate values of financial development and can become statistically significantly negative for the most financially developed countries (when system GMM results are considered). This indicates that remittances and financial development can be seen as substitutes on the way to achieve economic prosperity, assuming that the impact of financial development on growth for low levels of remittances is also positive – which is the case, at least when estimation results based on the generated index are considered. However, once one of these inputs becomes large, the other one can become redundant.

[29] Actually, in practice financial development exactly equal to zero is only possible for the generated index, but much less likely for the variables which were used for its generation – as the log-modulus transformation preserves zero, this would imply nil financial deposits to GDP ratio, credit to GDP ratio or interest rate spread. However, a nil nominal deposit interest rate is not that unlikely.

δ_{it} can be interpreted as follows: given the level of financial development, if the share of remittance inflows to GDP in country i at time t increases by 1 percentage point, real GDP per capita will change by $100 * \delta_{it}\%$. Therefore, given the coefficient estimates for different levels of financial development presented in Tab. 3, a 1 percentage point increase in remittance inflows to GDP ratio for a country with an average financial development would lead to a positive but insignificant increase in real GDP per capita over the next 5 years of 0.5% (when concerning the overall financial conditions index). If, on the other hand, we considered a country with much higher financial development, for example at the 95th percentile in the sample, a 1 percentage point increase in remittance share in GDP would lead to a decrease of real GDP per capita by up to 0.26% but this result is not be significant at the 5% level (when considering column (1), the index of overall financial development).

Tab. 3 also reveals that the impact of remittances on economic growth remains positive and statistically significant even for financial development around the 25th percentile of the sample. This is true for the generated index as well as for the variables from the first and second category (reflecting the size and depth of the financial sector). Results related to the interest rate spread are not statistically significant for any of the percentiles considered, which is related to the fact that this estimation sample includes only 227 observations, while the other three have 326-332. Migrants' transfers can be particularly important in countries with lowest financial development (up to the 10th percentile in the sample), where an increase of the remittance inflows to GDP ratio by 1 percentage point can lead to almost a proportional gain GDP per capita (rising by roughly 1% over the next 5 years).

The positive (even though not always statistically significant) marginal effect of remittances on economic growth for countries with low financial development can indicate that there are binding liquidity constraints in these countries. As the financial sector is not well developed, the supply of loans for productive activities can be insufficient. Transfers from family members abroad can help overcome these constraints. On the other end of the financial development distribution there are countries with well functioning markets – on levels similar to industrial countries (e.g. in Malaysia, South Africa). In these places, moral hazard problems can appear, as indicated by Chami et al. (2003). If remittances are spent on consumption and labor supply is lowered, there will be negative long-run effects on economic growth. This could be one explanation of the negative impact of remittances on GDP per capita for countries with highest financial development. Another reason could be that, given that these monies are registered as remittances, they are not invested in the financial market by the sender but sent to their family, who spends them in a different way. This means that, again, they are not used in the most productive way in order to contribute to economic prosperity.

The negative impact of remittances on economic development for countries with highest levels of financial development in the sample (indicated by system GMM results) could also be a purely statistical outcome due to the method applied. By including an interaction term

in the regression model I impose a monotonic linear structure of dependence of the marginal effect of remittance inflows (on GDP per capita levels) on level of financial development. In my model, δ_3 defines the negative slope of this relationship. This means, that if in fact the positive effects of remittance for growth are diminishing with increasing levels of financial development but nil (or only slightly negative, but independent of financial development) for higher levels of this measure (as suggested by Fig. 2), the model will wrongly assign strong negative values to δ_{it} in this region. As this study is targeted more at finding policy implications for countries with lower rather than higher values of financial development, I decided to keep the structure of the model unchanged. Moreover, this problem is only indicated by the system GMM results, for the QML-FE results even the effect at the 95th percentile of the distribution of the overall financial conditions index is negative but not statistically significant (see Tab. 3).

6.3 How does the generated index affect the results?

A comparison of results between the first and the other columns in Tab. 2 and Tab. 4 shows that the inclusion of the generated overall financial conditions index improves the estimated outcomes and provides information about which aspects of financial development are related (as substitutes or complements) to the impact of remittances on economic growth.

The third row of Tab. 2 and Tab. 4 shows the impact of the financial sector on the logarithm of GDP per capita, with each element referring to the effect for different measures of financial development. This coefficient, δ_2 in (3), reflects the direct impact of the discussed variable, abstracting from remittance inflows. In my model the remittance variable is defined as a share in GDP (in percent), which means that it cannot achieve negative values.[30] This means that δ_2 is the highest or lowest impact of financial development on economic growth (depending on the sign of the interaction term, negative or positive respectively).

While there is consensus in the literature about the positive impact of financial development on economic growth,[31] when considering the QML-FE results, only the coefficients in column (1) and (4), where the generated financial development index and interest rate spread are used respectively, have the expected sign.[32] The system GMM results presented in Tab. 4 all have the expected sign, but they depend on the instruments choice.[33] This means that for the QML-FE estimations the generated index seems to reflect better the

[30]Negative values would be possible if I included net remittances, but I consider only transfer inflows, which are the relevant monies for developing countries.

[31]For a review of theoretical and empirical research concerning the finance-growth nexus see Levine (2005).

[32]The sign of the findev coefficient in column (4) is negative, as a higher interest rate spread reflects lower financial development.

[33]Not shown here, all variables apart from financial development measures and remittances inflows have the expected sign irrespective of the choice of number of lags included in the GMM-style instrument set (considering instruments which pass Sargan/Hansen tests of overidentifying restrictions). The remittance-finance interaction term prevails with a negative sign (as for the overall financial conditions index).

relevance of the financial sector for economic growth. If financial deposits to GDP ratio or private credit by banks (and other financial institutions) were considered instead of the generated index, one would draw the conclusion about financial development being detrimental for economic growth (on average, but not necessarily statistically significant).

Also when considering the interaction term δ_3, the generated index provides additional information when compared to results obtained by using proxies of various aspects of financial development separately. The individual results in columns (2) and (3) of Tab. 2 and Tab. 4 show that the size and depth aspect of financial development can be substitutes to remittances (negative sign of interaction term). However, the alternative interpretation related to nonlinear effects of finance on growth, driven by remittances, discussed by Bettin and Zazzaro (2012), cannot be excluded. Moreover, no clear inference can be made about the relationship between financial sector efficiency (measured by interest rate spread) and migrants' transfers – the interaction term sign is positive (as expected) when QML-FE results are considered, but negative for system GMM estimation (both not statistically significant though). Given that for the QML-FE results, only the coefficients in column (1) and (3) are statistically significant, it can be said that there is evidence for remittance and financial development to be substitutes, mostly driven by credit availability, confirming the theoretical considerations related to binding liquidity constraints and potential moral hazard problems if both remittances and loan availability are high (as in Chami et al. (2003)) and potential over-supply of credit driven by migrants' transfers. However, the marginal effects presented in column (1) of Tab. 3 related to the generated index of financial development are corrected upwards which means that when considering the overall financial conditions one can find a stronger impact of remittance inflows on economic growth, higher than we when only measures of size or depth of the financial sector are considered. This is due to the fact, that the index accounts also for efficiency, which cannot be analyzed separately given the lower data availability.

As discussed in Section 4.3, the use of the generated index comes also with disadvantages. It introduces additional uncertainty into the model, which can be seen when comparing the statistical significance of the coefficients associated with control variables usually considered in the economic growth literature, other that the savings rate (investment to GDP ratio) in column (1) in Tab. 2 with those in the other three columns. Trade openness and years of secondary education (human capital measure) have a positive impact of similar magnitude in all cases, but not statistically significant if my generated measure of overall financial conditions is considered. These coefficients are significant before the bootstrapping and for this reason I am not concerned with the lack of their significance in the main estimation results. In this paper, I am not focused on inference about these variables.

The generated index is estimated efficiently if variables from all three categories are available in a given time period. However, when a variable is missing (for example a measure of financial sector efficiency, as the deposit interest rate or interest rate spread), the precision of the Kalman filter worsens and the confidence bound around the estimated fi-

nancial development index increases. This is one of the reasons why I use 5-year averaged quinquennial data – annual changes of the index may not always be statistically significant.[34] Kaufmann et al. (2008), the authors of the World Governance Indicators measures of institutional quality, point out a similar drawback of their indices and even suggest analyzing their evolution over decades.

Fig. 4 shows some examples of countries for which the index was estimated with more precision (upper panel, (a)) and also countries where the uncertainty related to the filtered value is larger (lower panel, (b)). The upper panel includes countries for which only the final values of the overall financial conditions index are estimated with some uncertainty. In case of the countries from the lower panel, especially in Colombia in the late 1980s and in South Africa around 1990-1992 (where variables from one or two categories were missing in a given year), annual changes of the index are not necessarily statistically significant. Also when considering the development of the index in Cyprus or India you can notice that sometimes its variation is very low. It can actually remain stable, even over a decade.

For these reasons I use quinquennial data of 5-year averages instead of annual observations. Of course, I cannot assure that all erroneous variation of the generated index is excluded. Windows of different length (5 to 10 years) could be used, but increasing the number of years in the window would translate in fewer observations for growth regressions.

6.4 How important are remittances and financial development for economic growth?

When looking at Fig. 3 you can see that only for low levels of financial development (below the mean) remittances can have a significantly positive impact on economic growth. Even though for some observations in the sample the effect would also be of economic relevance (an increase of GDP per capita of up to 1 roughly percent, cf. Tab. 3), for countries with moderate and higher levels of financial development the role of remittances can be considered rather low. To illustrate that remittances can nevertheless be beneficial for developing countries, I provide some counterfactual scenarios. I have computed GDP per capita values in the final time period for each country in which both remittance inflows to GDP ratio and financial development have grown over the time period 1970-2010 (or other maximum time period available, there are 30 countries fulfilling this requirement in the estimation sample, cf. Fig. 5 – countries from the upper right-hand side quadrant) for two counterfactual scenarios: one if there was no remittance or no financial development change (*ceteris paribus*) over the same time period and a second one with an overall increase of remittances or financial development higher by 20% than what was observed in reality.

[34] In this case, the use of every fifth observation is additionally driven by the inclusion of the human capital measure (years of secondary education), which for older years was only available on quinquennial basis. 5-year averaging is usually justified by smoothing out business cycle variations and obtaining long-run relationship, however there is no guarantee that the chosen time span for averaging will cover the cycles exactly, from peak to through.

Details on the computation of the growth gains/losses are provided in appendix A.7.

I have compared these values with the actual ones in order to capture the change in output per capita triggered by growth of each of the two aforementioned factors. In other words, I have compared the overall change of GDP per capita which would have been achieved given each of the two scenarios with the actual recorded change. A positive value indicates that the counterfactual scenario would lead to economic gains, while negative values suggest growth losses in comparison to the realized values. For the computation of the counterfactual growth rates I have used the coefficient estimates implied by QML-FE estimation with my generated index included as a regressor.

The results of the exercise in which either remittances or financial development were held constant at their initial level are presented in Fig. 6. In panel (a) one can see that the overall growth of GDP per capita would be significantly lower for almost all countries if there was no increase in the remittance inflows to GDP ratio and that growth loss is the largest for countries with medium initial financial development and lowest remittances. The left hand side graph in this panel confirms the negative relationship between remittances and financial development (the higher financial development, the lower the impact of remittances on GDP per capita, even nil in countries with highest initial financial development – Trinidad & Tobago, Barbados, South Africa), while the right hand side graph indicates that the difference in growth rates could become insignificant for initial remittance to GDP ratios above ca. 3%. This means that countries who benefited most from remittance inflows are those who started with low to moderate financial development and those with very low initial transfer inflows (in particular Senegal, Sudan, Sri Lanka and Dominican Republic).

Panel (b) of Fig. 6 shows counterfactual scenarios with financial development being kept at its initial level. This picture looks quite differently, suggesting that actual financial development has lead to output losses in developing countries (the counterfactual scenario would have resulted in growth gains), stronger for larger initial remittance inflows to GDP ratios (indicating that remittances and financial development are substitutes). In this case, the substituability of financial development with remittances is much less marked – indicated clearly for Morocco and Bangladesh, but for other countries not present at all, as in Sri Lanka or Honduras.[35] The right hand side graph shows that especially countries with financial development close to mean would have gained the most if its level remained constant. The only clear "winner" from financial development is Sudan who has gained ca. 3.5 percent of GDP per capita. For both counterfactual scenarios, the loss/gain in GDP per capita would be in the range of -15 to 15 percentage points which can be considered relatively low, given the average overall economic growth from 1970 to 2010 of 52% (and a maximum of 170% in Botswana), but yet statistically significant.

Results of the first counterfactual scenario suggest that developing countries are able to

[35]As initial levels of remittance inflows share in GDP have very low variation, with most values between 0 and 2% in most countries, it is hard to make conclusions about how the counterfactual scenarios relate to initial migrants' transfer levels. The substituability is indicated by the positively sloped fitted line and its confidence interval differentiating it from nil relationship (flat line).

benefit economically from remittances, but only as long as financial development remains low. On the other hand, very high level of financial sector growth is necessary in order to counteract the negative interaction term with remittances and affect GDP per capita positively. This is confirmed by the results of the second counterfactual scenario, where remittances or overall financial development were assumed to have grown by 20% more in total as compared to what was observed in the data.

In this scenario I allow either the transfer inflows or the financial sector (levels) to grow by 20% more in total as compared to their actual growth between 1970 and 2010 ($1.2 \times (x_T - x_1)$). I compare the GDP per capita which would have been achieved if such growth rates were true with its actual level (see Fig. 7). Again, the plots only include countries in which the overall change in remittances and financial development between the first and the last period was positive (the same 30 countries as in the first counterfactual scenario). The assumption about 20% higher overall growth rate assures additionally that in all countries the counterfactual scenario would lead to higher than observed remittance inflows/financial development at the end of the time period considered. All of this additional growth happens in the final period – I do not change the growth path of remittances and financial development between period 0 and T-1 (more details in appendix A.7).

Panel (a) of Fig. 7 shows the growth rate differential if remittance inflows to GDP grew by 20% more in total. This scenario would lead to growth gains of up to ca. 1 percentage point in Senegal, Guatemala and Dominican Republic. The left hand side graph of this panel indicates that overall remittance increases higher by 20% would be most growth enhancing in countries with moderate initial financial development. This suggests that some initial financial development is necessary to attract remittance inflows into the official records and at the very beginning it might pay off more if the financial sector is being developed instead of encouraging transfer inflows. It can be related to the costs of sending and receiving remittances which can be higher if the financial sector is poorly developed. Countries with moderate initial financial development would profit the most from higher remittance inflows. Yet, the effect falls with rising financial development.

The right-hand side of panel (a) of Fig. 7 indicates that higher than observed remittance growth would be the most beneficial for countries with low initial migrants' transfers, but this effect is not very strong – there are also many countries who have started with a very low remittance inflows level and the additional 20% increase would not be enough to observe large or any output benefits.[36]

Panel (b) of Fig. 7 shows the growth rate differential if overall financial conditions grew by 20% more in total. This would lead to growth losses in terms of GDP per capita between 0 and 6 percentage points. Only countries with very high initial financial development could be able to profit from its even higher growth, which is indicated by the fitted line and its confidence interval, but no developing country at the higher end has actually denoted growth. Despite the negative interaction term between remittance and financial development, the

[36] Again, these weak results are related to low variation in initial remittance inflows to GDP ratios.

initial level of migrants' transfers does not seem to affect the outcome of this counterfactual scenario. This is due to the fact that I consider 20% higher overall growth of the *level*, not *log-modulus* (which enters the growth regressions) of financial development. If instead I assumed that the latter recorded 20% higher overall growth, output losses would go from 0 to 2 percentage points and would be highest for countries with largest remittances inflows, as indicated by the negative sign of δ_3 (results not shown).

Fig. 8 shows the difference between the growth gains/losses from higher increase in financial development versus higher increase of remittance inflows. This graph shows, that countries who start with higher initial financial development can gain from its further evolution. Countries who start with very low initial remittance to GDP ratio could also benefit more from focusing first on the development of the financial sector. But in principle almost all countries can benefit from further encouraging remittance inflows growth, irrespective of initial levels of migrants' transfers.

These two scenarios confirm the fact that it is sufficient to focus on developing either the financial sector or increasing remittance inflows to GDP ratio, depending on the current level of both variables. Growth gains from remittance inflows can be significant and higher than from financial sector development, but if the financial sector is sufficiently large and efficient, attracting more remittances will not have further benefits for GDP per capita.

6.5 Long-run effects

Is it advantageous to encourage remittance inflows given the constant development of the financial sector which diminishes the growth effects of migrants' transfers? The estimation results presented above can be considered long-run relationships if the choice of 5-year time periods matches exactly the business cycle in all countries and the data used in the growth regressions reflect long-run trends. This is hard to verify, therefore I also include steady-state outcomes. This means that I compute the long-run impact of remittances on economic growth, when GDP per capita reaches its steady state ($y_{it} = y_{i,t-1}$ in (3)). I divide the coefficients δ_1 and δ_3 by $(1 - \gamma)$ (implying convergence of real GDP per capita to its country specific steady-state value).

I also need an assumption on the financial development level in steady state, to plug into the long-run version of (8). First, I use the average value of the estimated index for South Africa over the years 1990-2010. I choose this country, as it is one of the larger countries among developing economies scoring high in the financial development ranking based on my generated index (appendix A.4). The 20-year average is taken in order to smooth out recent booms and busts on the global financial market, which also affected the South African market (see Fig. 4). The chosen long-run financial development level is 7.84 and it is higher than during the financial slowdown of 2002-2004 but lower than the peaks in 1999 and 2007.

I also use the average value of the estimated index for Switzerland over the time period

1990-2010. I choose this country as it has the 4th most developed financial market (according to the mean of the index, cf. appendix A.4 and it is not driven that much by deposits to GDP ratio as in Luxembourg. The index value I consider is 12.58 and it is lower than the peaks of 1999 and 2006, but higher than the minimum of 2001. Steady-state values of the other three financial development measures are computed in the same way (for both countries).

The estimated long-run effects are presented in Tab. 6. In the upper panel I use Swiss values of the four financial development measures. The first three columns refer to the generated index and to long-run effects based on regressions coefficients obtained by different estimation methods. Firstly, I use QML-FE coefficients, which can be seen as the most conservative, related to the smallest impact. The third column refers to system GMM results, which can be seen as the strongest one. I also provide a combination of both – the autoregressive term γ from QML-FE estimation and δ_1, δ_3 from system GMM. This is the second column, label as 'mixed'. The reason for that is as follows. While γ and the corresponding speed of convergence of 3% *per annum* for the overall financial development index seem to be more reliable when QML-FE estimation is considered, system GMM estimation provides stronger elasticities than QML-FE and that affects long-run effects the most. I consider this the intermediate case, closest to the true long-run impact of remittance inflows on economic growth given financial development.

Tab. 6 shows that if a country reaches high financial development levels, encouraging more inflows of migrants' transfers can at best have no impact of GDP per capita in the long run. However, the 'mixed' effects even suggest that such money influx could lead to significant output losses of ca. -10 to -15.65%, depending on financial development. The effect is again the strongest for the generated index. When other measures are considered in the last three columns, long-run impacts are between 0 and -5 percent and are not statistically significant.

7 Robustness

7.1 Did the financial crisis affect the role of the financial sector as a transmission channel?

The global financial crisis of 2007-2008[37] may have changed the role of the financial sector as a transmission channel or substitute for remittances since less developed financial markets could have to lower credit availability and increase the costs of financing in case of private capital reversals and of higher bond spreads. However, only more financially

[37]I consider 2007 as the starting point of the crisis, even though it is one year before the bankruptcy of Lehman Brothers. However trust into the financial sector in the US began to dissolve already in 2007, and the housing bubble burst even one year earlier (cf. The Economist, "The origins of the financial crisis Crash course" available at http://www.economist.com/news/schoolsbrief/21584534-effects-financial-crisis-are-still-being-felt-five-years-article, accessed on 15.09.2015.

integrated (emerging) economies should have been affected strongly by this phenomenon, therefore the aggregate effect on all developing countries in the sample is not clear.[38]

The role of migrants' transfers could also have changed – Fig. 1 shows that these flows remained relatively stable (with a decline only in 2009, followed again by growth) after 2007, while other kinds of flows to developing countries have overturned (apart from development assistance, but these flows are much lower in general). The strong reversal in private capital flows has made such countries as Bangladesh and the Philippines even more dependent on remittance flows as their sovereign ratings were based on these transfers (cf. Sirkeci, Cohen, and Ratha (2012)).[39]

Sirkeci et al. (2012) list six reasons for remittance to remain resilient to the crisis. The most relevant for the current study is the one related to unexpected exchange rate movements. During the crisis developing countries' currencies have depreciated against the dollar and migrants' purchasing power increased. Investment-related remittances increased in South and East Asia. This should translate into a stronger positive direct impact of remittances on long-run growth, as discussed before.

To see whether the financial crisis has changed the role of remittances and financial development for economic growth in developing countries, I have removed the years 2007-2010 from the estimation sample. This means that the last observation for the explanatory variables is for the year 2005 (not a 5-year average); and the dependent variable is the logarithm of real GDP per capita in 2006. Estimation results for this truncated sample are presented in Fig. 9, Tab. 7 and Tab. 12, Tab. 11 (appendix A.8).

The fastest way to compare the results is by checking the coefficient on the interaction term between remittances and financial development in Tab. 7. This parameter reflects the strength of dependence of marginal effects of remittances on economic growth on the level of financial development in the receiving country. The main results remain unchanged – the remittance-finance interaction term is of similar magnitude and significance for both estimation methods.

Average marginal effects of remittances on economic growth (see Tab. 7, last two columns of each panel) are slightly higher when considering the truncated sample and QML-FE estimates, but lower for system GMM. The latter result is intuitive, since average financial development in the time period 2005-2009 was higher than in 2005-2006, affecting the average marginal effect of remittances on growth.

QML-FE and system GMM estimations show the same interpretation of the remittance-finance interaction term for three cases: when the generated index is used or when measures of financial system size or depth are used. However, when considering the last category – efficiency of the financial sector – system GMM results under various specifications of instruments sets fail to indicate feedback effects of a more efficient financial sector strength-

[38]For an analysis of channels of impact of the global financial crisis on developing economies see for example Griffith-Jones and Ocampo (2009) and World Bank and International Monetary Fund (2009)

[39]Putting remittance inflows as collateral was not uncommon even before the crisis, however this practice was used more by banks than countries (for example Banco do Brasil in 2002).

ening the impact of remittances on economic growth. In a case of a small sample (258 observations) with many explanatory variables the QML-FE estimator seems to perform better, presenting still quite uncertain but more reliable interaction effect (see the bottom right-hand side pictures of panels (a) and (b) in Fig. 9).

These results indicate that inclusion of the time period of the global financial crisis in the main estimation sample does not affect the results to a large extent. The confidence into and role of the financial sector to provide alternative sources of financing to migrants' transfers were not perturbed in the developing countries included in this study.

7.2 Exclusion of potential outliers

I performed the statistical test for detecting outliers in multivariate data called *bacon* in Stata (*blocked adaptive computationally efficient outlier nominators*, see Weber (2010)). This test chooses a subset m of observations from the multivariate dataset and consecutively adds more observations based on their Mahalanobis distance from the basic subset, if this distance is not larger than a chosen percentile of a χ^2 distribution (usually 85th percentile). This procedure continues until the subset of nonoutliers stops changing and the remaining observations are marked as outliers. Even though the test did not point out any irregular observations, when looking at Fig. 2 you can notice that there are two countries which have much higher remittance inflows to GDP ratios than the rest. These are Albania (which additionally recorded high GDP per capita growth) and Jordan. I excluded these two countries from the estimation sample to see if the main results (negative remittance-finance interaction term, positive but decreasing influence of remittances on economic growth) prevail. While the direct impact of migrants' transfers diminishes, the effect is still dependent on the level of financial development, as suggested by the main results (cf. Tab. 15 and Fig. 11).

8 Concluding remarks

The impact of remittances on economic growth is a relatively new topic in the literature. It arose in the last two decades, as migrants' transfers reached the highest levels in history and governments of developing countries and international organizations realized their importance. However, until now, there is no consensus in the literature concerning the impact of remittances on economic growth stemming from cross-country analysis.

Recently, researchers have started studying the role of the financial sector as a channel for remittances to affect growth, or, on the contrary, as a substitute for remittances (as means of overcoming credit constraints). Since not many composite measures of financial development exist, especially for developing countries over a long time span, it is challenging to establish the direction of relationship between migrants' transfers and financial development.

In this paper I use an unobserved components model to construct an a priori unknown index of financial development from observable measures (which are commonly used as proxies for financial development). This overall financial conditions index reflects the size, depth and efficiency of the financial sector. It can be used for creating international comparisons of financial development or for studying its historical evolution in a particular country. It can also be used to reconcile contradictory or ambiguous results of studies which used proxies instead of one composite index.

I provide a ranking comparing average overall financial conditions for a large group of advanced and developing economies using a newly constructed measure. Also, this new index is used as a control variable in growth regressions measuring the impact of remittances on GDP per capita changes, with special focus on the financial sector as a possible catalyst or obstacle in this process.

My QML-FE and system GMM estimations show that, independently of the measure of financial development used, there is substitution between remittances and financial development as factors enhancing economic growth measured by GDP per capita. The negative sign of the interaction term between remittances and financial development indicates that if the financial sector is sufficiently large, additional transfers from migrants are not used in an efficient way in the domestic economy. Given that the generated index accounts also for efficiency of the financial sector, apart from its size and depth, and the negative sign of the interaction term preserves if this measure is used, it is less likely that this coefficient reflects nonlinear effects of financial development on growth rather than the nonlinear impact of migrants' transfers on economic performance.

There is evidence for remittances having negative growth effects, which can can become large in the long run, in developing countries with a well functioning financial sector. However, in economies with less advanced financial markets there are positive effects. The recent global financial crisis did not affect this relationship strongly.

If a government were to choose whether to focus on encouraging more remittance inflows or more financial development, the decision would depend on the initial levels of both factors. For countries with very poor financial conditions it would be more profitable to first develop this sector. For other countries it would be more advantageous to foster money transfers from migrants. Therefore, policy implications depend on the particular country's situation. However, even if remittance inflows grew by 20% more over the years 1970-2010, growth gains in the next 5-year period would only be of the magnitude of 1 percentage point.

These results show that it is not enough for a government to attract more remittance inflows, but additional incentives are necessary in order for these transfers to be spent in a productive way and contribute to economic growth. Maimbo and Ratha (2005) suggest that one way to encourage migrants and remittance recipients to make investments in their home countries by introducing clear regulations and limiting corruption. Unfortunately my dataset includes countries for which measures of such institutional qualities are not

available for a long time horizon and conditioning the impact of remittances on economic growth on measures of political and institutional qualities is left for future research.

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Tables

Table 1: Summary statistics of 5-year averaged data (1970-2010)

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Real GDP per capita (log)	7.46	1.12	5.14	10.07	393
Remittance inflows/GDP (%)	3.01	4.08	0	22.89	393
Overal fin.dev.	-1.12	5.38	-16.38	16.11	393
Financial systems deposits/GDP	3.32	0.65	1.43	5.28	388
Liquid liabilities (M3)/GDP	3.57	0.61	1.6	5.32	387
Private credit by deposit money banks and other fin.inst./GDP	3.2	0.77	0.99	5.43	387
Domestic credit to the private sector/GDP	3.27	0.74	1.07	5.48	392
Interest rate spread	1.95	0.72	-1.97	5.42	289
Deposit interest rate	2.28	0.77	0.84	7.99	331
Overhead costs	1.58	0.44	0.09	2.73	174
Investment/GDP (%)	21.09	5.8	4.99	47.68	393
Population growth (%)	7.08	1.09	0.5	11.6	393
Years of secondary education	1.36	0.97	0.05	4.89	393
Government expenditure/GDP (%)	14.26	5.15	4.08	38.68	393
Trade Openness (Exports+Imports)/GDP (%)	70.82	35.43	8.42	187.15	393

Notes: Population growth includes also the depreciation and GDP growth rates (assumed to be 5% in total) Variables referring to the financial sector from "Overall fin. dev." to "Overhead costs" after log-modulus transformation: lm(x)=sign(x)*ln(abs(x)+1) – smoothing the data and preserving the original sign.

Table 2: Main QML-FE results (1970-2010)

	(1) Overall fin.cond. b/se	(2) Financial systems deposits/GDP b/se	(3) Priv. credit/GDP b/se	(4) Interest rate spread b/se
L.Real GDP per capita (log)	0.863***	0.860***	0.861***	0.814***
	(0.044)	(0.048)	(0.046)	(0.054)
Remittance inflows/GDP	0.004	0.019	0.020**	-0.007
	(0.003)	(0.013)	(0.009)	(0.013)
Financial development (findev)	0.001	-0.006	-0.000	-0.011
	(0.003)	(0.030)	(0.018)	(0.026)
Remittance-findev interaction term	-0.001*	-0.004	-0.005**	0.004
	(0.000)	(0.003)	(0.002)	(0.006)
Investment/GDP	0.008***	0.008***	0.007***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Population growth	-0.000	0.001	0.001	0.008
	(0.015)	(0.017)	(0.017)	(0.015)
Years of secondary education	0.039	0.046*	0.043*	0.069**
	(0.026)	(0.026)	(0.025)	(0.034)
Government expenditure/GDP	-0.005*	-0.004	-0.004*	-0.006
	(0.003)	(0.003)	(0.003)	(0.004)
Trade Openness	0.001	0.001*	0.001*	0.001**
	(0.001)	(0.000)	(0.000)	(0.001)
Observations	332	327	326	227
Countries	61	61	61	53
no. of obs. per country	5.443	5.361	5.344	4.283

Notes: The dependent variable in all columns is the natural logarithm of real GDP per capita. More explanatory notes are below Tab. 4.
Bootstrapped standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
All regressions include country fixed effects, time dummies (for the 5-year periods) and a constant.

Table 3: The estimated effects of remittance inflows to GDP changes on GDP per capita growth for different measures of financial development (QML-FE results)

	effect given the following measure of financial development:			
	(1)	(2)	(3)	(4)
effect at:	overall fin.dev.	fin. sys. deposits/GDP	priv. cred. by banks and fin.inst./GDP	interest rate spread
mean	0.486	0.449	0.394	0.083
p-value	0.119	0.137	0.155	0.817
median	0.523	0.479	0.387	0.066
p-value	0.101	0.124	0.162	0.855
other percentiles:				
10th	0.986	0.766	0.875	-0.180
p-value	0.036	0.098	0.025	0.758
25th	0.785	0.629	0.622	-0.063
p-value	0.045	0.099	0.047	0.888
75th	0.180	0.267	0.149	0.214
p-value	0.564	0.344	0.600	0.587
95th	-0.260	-0.016	-0.222	0.543
p-value	0.559	0.967	0.556	0.488
average marginal effect	0.459	0.430	0.373	0.091
p-value	0.298	0.124	0.341	0.714

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The values in the table can be directly interpreted as semi-elasticities: for the country with overall fin. dev. at the sample mean, if remittances share in GDP changes by 1 percentage point real GDP per capita will change by 0.486% over 5 years (significant at 12%, all effects already multiplied by 100)

Table 4: Main System GMM results (1970-2010)

	(1) Overall fin.cond. b/se	(2) Financial systems deposits/GDP b/se	(3) Priv. credit/GDP b/se	(4) Interest rate spread b/se
L.Real GDP per capita (log)	0.927***	0.904***	0.936***	0.891***
	(0.039)	(0.053)	(0.042)	(0.051)
Remittance inflows/GDP	0.001	0.035*	0.052**	0.001
	(0.005)	(0.018)	(0.021)	(0.041)
Financial development (findev)	0.006	0.015	0.020	-0.000
	(0.004)	(0.036)	(0.022)	(0.051)
Remittance-findev interaction term	-0.003***	-0.010**	-0.016***	-0.001
	(0.001)	(0.005)	(0.006)	(0.018)
Investment/GDP	0.008**	0.009**	0.010***	0.012**
	(0.003)	(0.004)	(0.004)	(0.005)
Population growth	-0.013	-0.012	-0.006	-0.012
	(0.016)	(0.015)	(0.013)	(0.015)
Years of secondary education	0.075**	0.077*	0.058	0.082*
	(0.032)	(0.045)	(0.040)	(0.048)
Government expenditure/GDP	-0.002	0.003	0.001	0.002
	(0.003)	(0.005)	(0.003)	(0.006)
Trade Openness	0.002**	0.002	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	332	332	332	258
Countries	61	61	61	57
no. of obs. per country	5.443	5.443	5.443	4.526
Number of instruments	43	43	43	43
p-value for Hansen's test	0.379	0.394	0.625	0.655
p-value for AR(1) in residuals test	0.013	0.027	0.012	0.147
p-value for AR(2) in residuals test	0.064	0.101	0.077	0.235
p-value for AR(3) in residuals test	0.177	0.148	0.165	0.282
p-value $H_0 : \gamma = 1$ (one-sided)	0.032	0.038	0.067	0.019

Notes: The dependent variable in all columns is the natural logarithm of real GDP per capita. 5-year averages of all variables. Each column presents results using different measures of financial development (findev), (1) referring to the generated index
All coefficients except for γ and δ_2 (for findev) can be interpreted as semi-elasticities: for example if the investment share in GDP increases by 1 percentage point, GDP per capita increases by 0.8%.
Coefficients in the first row (γ in (3), for L.Real GDP per capita (log)) can be used to calculate annual speed of convergence (λ) following Mankiw et al. (1992) and Caselli, Esquivel, and Lefort (1996). Following the calculations of the latter, $\lambda = -\frac{\ln(\gamma)}{5}$.
If $\gamma = 0.863$ (QMLE-FE result), then $\lambda \approx 3\%$, All values of λ in the two tables above are between 1.3% and 4.1%, which are reasonable numbers, slightly higher than the original Mankiw et al. (1992) results but lower than those of Caselli et al. (1996).
The interpretation of δ_2 (for findev, a log-modulus transformed variable) is similar to a regular elasticity (for large values of financial development level). In particular: $\delta_2 \equiv \frac{\partial ln(Y_{it})}{\partial lm(x_{it})} = \frac{\frac{\partial Y_{it}}{Y_{it}}}{\frac{\partial x_{it}}{|x_{it}|+1}}$, where $ln(Y_{it}) = y_{it}$ (the natural logarithm of real GDP per capita) and x_{it} is the level of financial development underlying the log-modulus transformed values used in the above estimations.
Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, bootstrapped in column (1), robust with Windmeijer's correction in (2)-(4). All regressions include country fixed effects, time dummies (for the 5-year periods) and a constant.

Table 5: Average percentage growth of remittances and financial development (over 5-year periods)

Country	Remittance growth	Fin.dev. growth
Albania	-13.8	403.0
Algeria	6.7	-58.7
Bangladesh	36.5	191.9
Barbados	10.3	77.9
Belize	-1.1	128.9
Benin	-12.0	64.0
Bolivia	227.2	151.1
Botswana	-27.8	73.1
Brazil	328.4	92.9
Cameroon	98.0	-49.2
China	68.1	91.6
Colombia	62.3	30.7
Congo, Rep.	34.5	-255.0
Costa Rica	114.0	20.4
Cote d'Ivoire	22.7	-32.3
Cyprus	-22.8	149.6
Czech Republic	49.7	-53.2
Dominican Republic	38.9	9.7
Ecuador	1138.3	109.8
Egypt	-3.2	134.6
El Salvador	50.2	-5.5
Fiji	86.9	155.0
Gabon	165.5	-35.1
Ghana	74.4	90.8
Guatemala	140.5	93.5
Honduras	227.0	92.4
India	39.1	151.1
Indonesia	124.8	120.4
Iran, Islamic Rep.	-39.3	39.7
Israel	-15.7	125.2
Jordan	1.5	138.0
Kenya	35.6	41.1
Malawi	239.9	-29.5
Mali	1.7	50.4
Malta	-22.8	69.9
Mauritius	-26.0	162.6
Mexico	101.6	-14.9
Morocco	5.7	149.3
Mozambique	-13.7	18.5
Nepal	216.3	242.7
Niger	40.7	-42.2
Pakistan	2.3	35.6
Panama	-0.8	94.5
Papua New Guinea	-8.9	33.2
Paraguay	57.3	-4.4
Peru	45.6	196.7
Philippines	37.4	65.0
Poland	67.9	160.6
Romania	684.4	155.5
Rwanda	66.2	106.6
Senegal	67.7	76.8
South Africa	27.9	36.3
Sri Lanka	117.8	96.4
Sudan	81.1	8.7
Swaziland	35.3	-4.8
Syrian Arab Republic	-6.9	147.0
Thailand	76.2	173.1
Togo	99.3	-18.1
Trinidad and Tobago	81.3	54.8
Tunisia	2.0	-4.1
Turkey	-24.0	56.5
Total	73.6	67.9

Notes: Remittances and financial development grow on average by 73.6% and 67.9% respectively each 5 years.
Marked in bold are countries where both remittances and financial development were increasing on average.

Table 6: Long-run effects

	Overall fin.cond. (QML-FE)	Overall fin.cond. (mixed)	Overall fin.cond. (system GMM)	Fin.syst.deposits/GDP (QML-FE)	Priv.credit/GDP (QML-FE)	Int.rate spread (QML-FE)
Financial development at Swiss level						
LR effect	-6.90	-15.65	-45.24	-2.14	-4.22	-1.88
std.error	4.99	8.19	377.98	3.40	3.76	3.88
p-value	0.17	0.06	0.90	0.53	0.26	0.63
Financial development at South African level						
LR effect	-3.78	-9.87	-29.62	0.39	-3.20	-1.57
std.error	3.27	5.11	225.56	2.10	3.27	2.69
p-value	0.25	0.05	0.90	0.85	0.33	0.56

Notes: long-run effects given different steady-state values of financial development measures (first Swiss 1990-2010 average, then the same for South Africa).
Mixed refers to long-run effects measured with γ obtained from QML-FE estimation and δ_1, δ_3 from system GMM regression.
Bootstrapped standard errors.

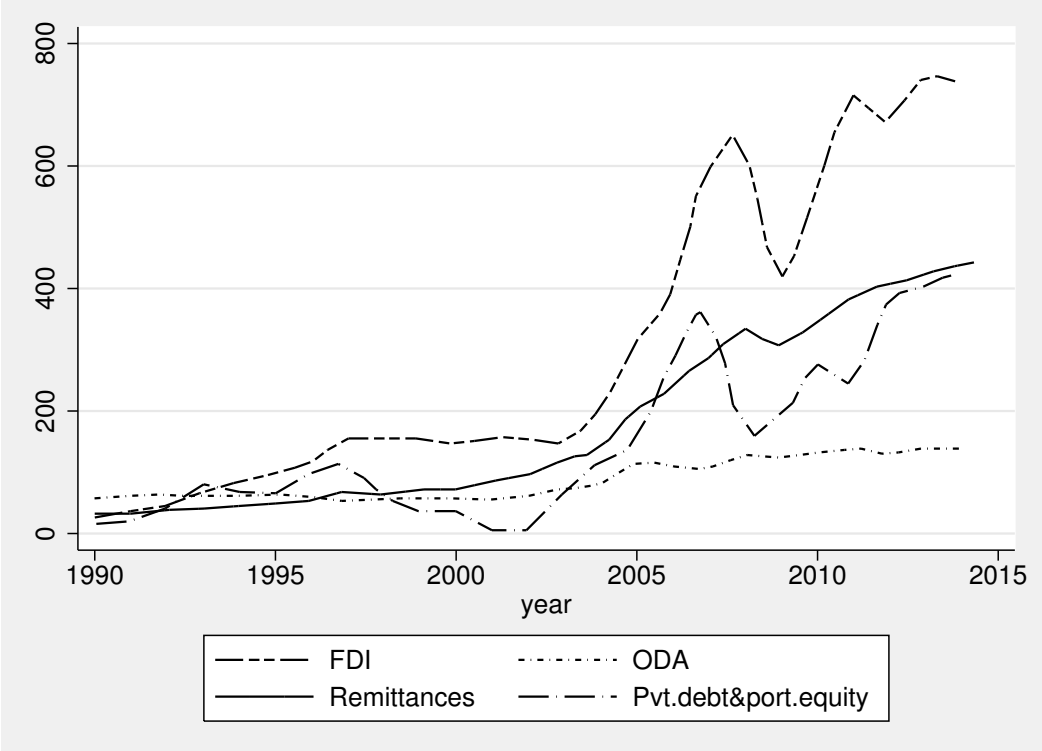
Table 7: Coefficient estimates for the whole sample and for the sample limited to 2006

QML-FE results								
Coefficient:	Remittance inflows/GDP		Financial development		Remittance-finance interaction term		Average marginal effect	
Measure of financial development used:	whole sample	before fin.crisis	whole sample	before fin.crisis	whole sample	before fin.crisis	whole sample	before fin.crisis
Overall financial development	0.004	0.004	0.001	0.001	-0.001*	-0.001*	0.459	0.467
s.e.	(0.003)	(0.003)	(0.003)	(0.003)	(0.000)	(0.000)	(0.441)	(0.442)
Financial system deposits to GDP ratio	0.019	0.019	-0.006	-0.003	-0.004	-0.004	0.43	0.431
s.e.	(0.013)	(0.012)	(0.030)	(0.029)	(0.003)	(0.003)	(0.279)	(0.290)
Private credit by fin. inst. to GDP ratio	0.020**	0.021**	-0.000	0.001	-0.005**	-0.005**	0.373	0.385
s.e.	(0.009)	(0.010)	(0.018)	(0.018)	(0.002)	(0.003)	(0.393)	(0.407)
Interest rate spread	-0.007	-0.008	-0.011	-0.015	0.004	0.004	0.091	0.053
s.e.	(0.013)	(0.012)	(0.026)	(0.022)	(0.006)	(0.005)	(0.247)	(0.285)
System GMM results								
Coefficient:	Remittance inflows/GDP		Financial development		Remittance-finance interaction term		Average marginal effect	
Measure of financial development used:	whole sample	before fin.crisis	whole sample	before fin.crisis	whole sample	before fin.crisis	whole sample	before fin.crisis
Overall financial development	0.001	-0.000	0.006	0.003	-0.003***	-0.002***	0.333	0.169
s.e.	(0.005)	(0.004)	(0.004)	(0.003)	(0.001)	(0.001)	(1.443)	(1.136)
Financial system deposits to GDP ratio	0.035**	0.007	0.015	-0.027	-0.010**	-0.003	0.073	-0.161
s.e.	(0.018)	(0.016)	(0.036)	(0.034)	(0.005)	(0.004)	(0.68)	(0.173)
Private credit by fin. inst. to GDP ratio	0.052**	0.037	0.020	0.007	-0.016***	-0.012*	-0.026	-0.16
s.e.	(0.021)	(0.023)	(0.022)	(0.026)	(0.006)	(0.006)	(1.274)	(0.942)
Interest rate spread	0.001	0.017	-0.000	- 0.003	-0.001	-0.009	-0.084	-0.002
s.e.	(0.041)	(0.030)	(0.051)	(0.030)	(0.018)	(0.013)	(0.059)	(0.571)

Notes: The values in the table can be interpreted as semi-elasticities (need to be multiplied by 100): the average marginal effect of remittances given financial development values observed in the sample is 0.005, hence if the remittances share in GDP changes by 1 percentage point real GDP per capita will change by $0.5\% = 0.005 * 100\%$ over 5 years (not statistically significant).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

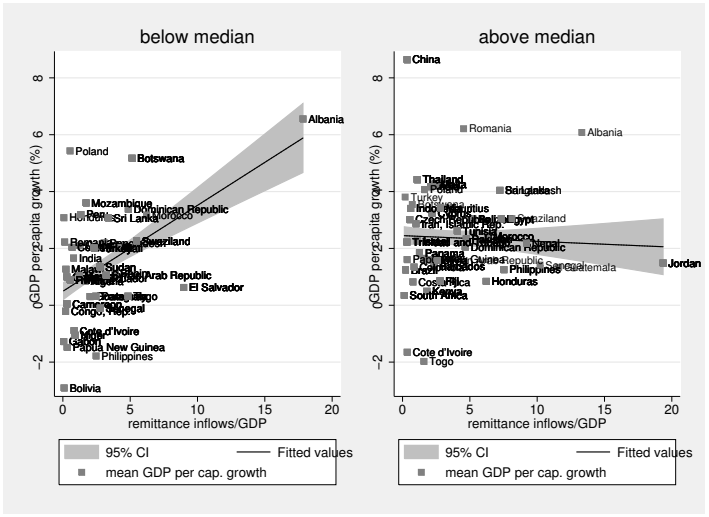
Figures

Figure 1: Foreign flows to developing countries – remittances larger than official development assistance (ODA) and more stable than foreign direct investment flows (FDI)

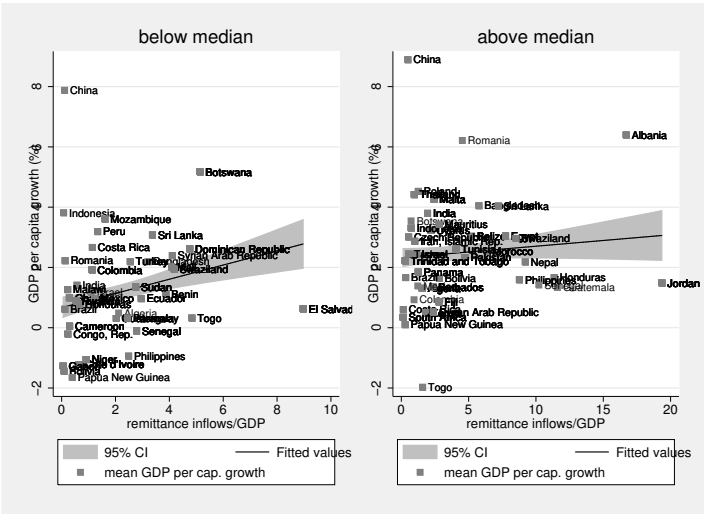


Source: World Bank Migration and Development Brief from April 13, 2015

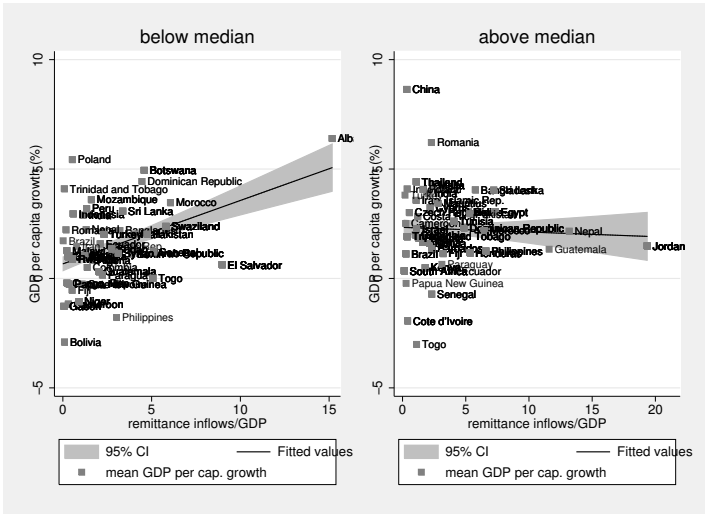
Figure 2: Remittances-growth relationship for different levels of financial development



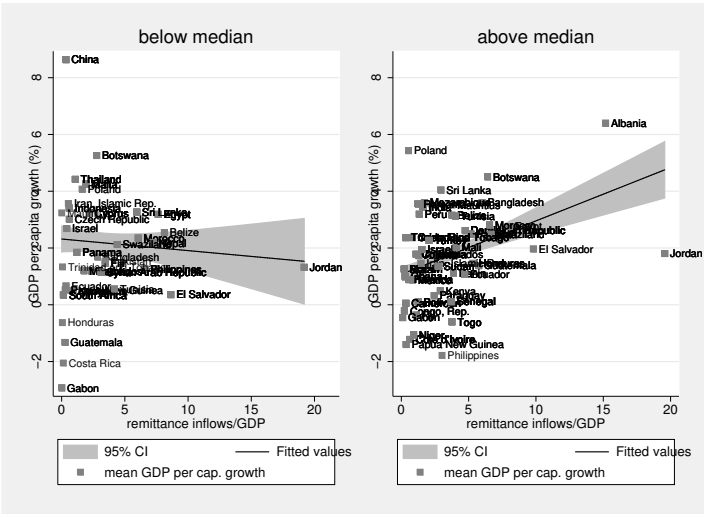
(a) Overall financial development



(b) Financial system deposits to GDP ratio

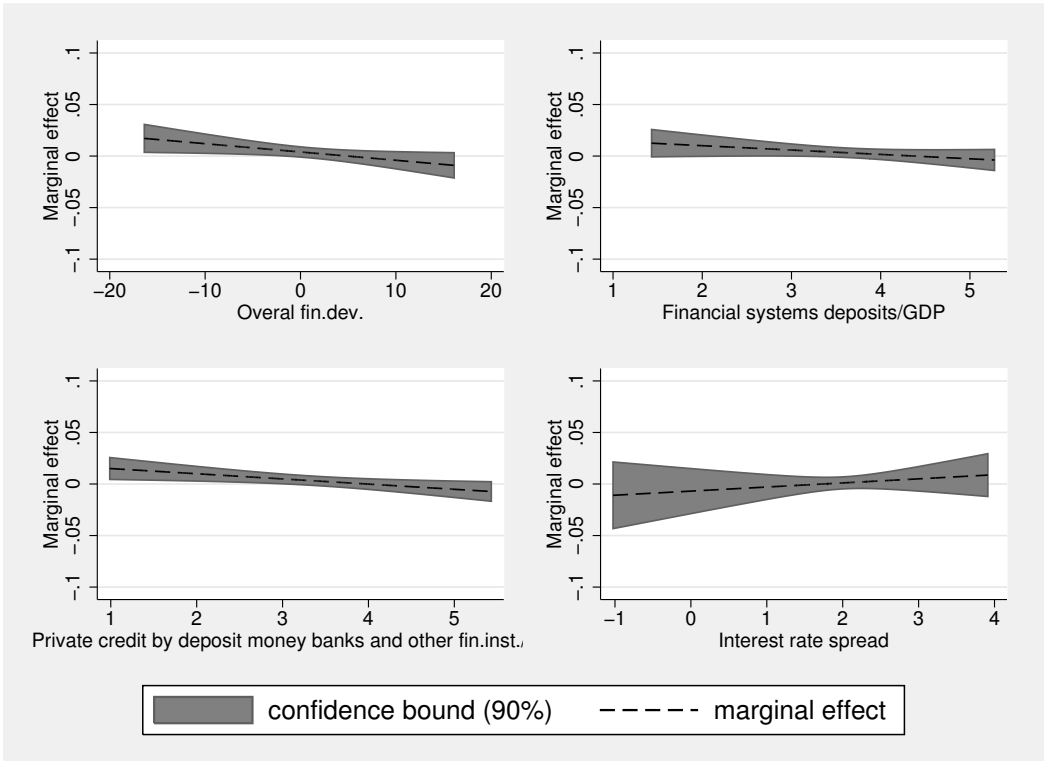


(c) Private credit by fin. inst. to GDP ratio

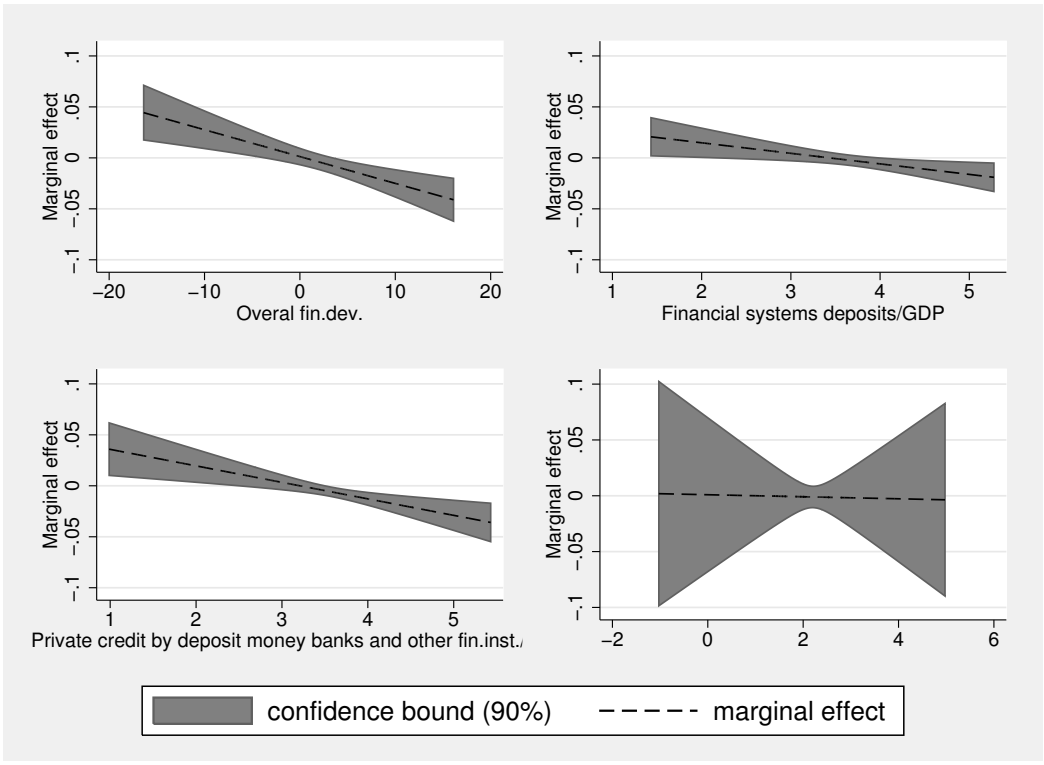


(d) Interest rate spread

Figure 3: Marginal effects of remittances on economic growth for different levels of financial development - system GMM and QML-FE results

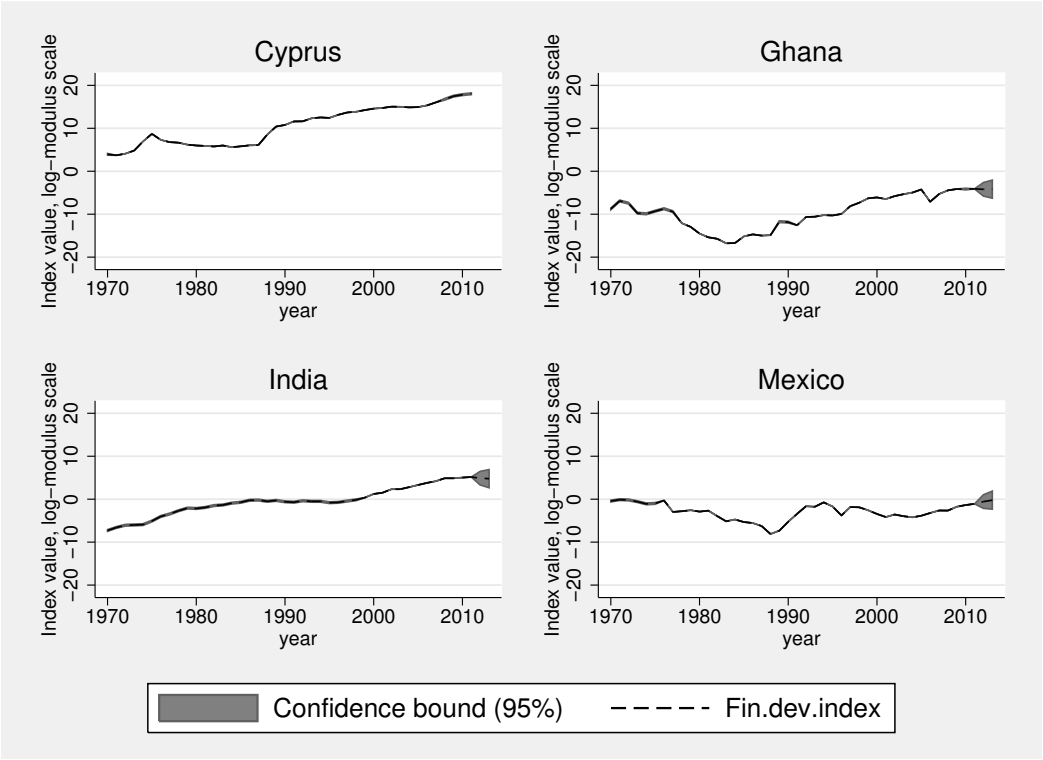


(a) QML-FE

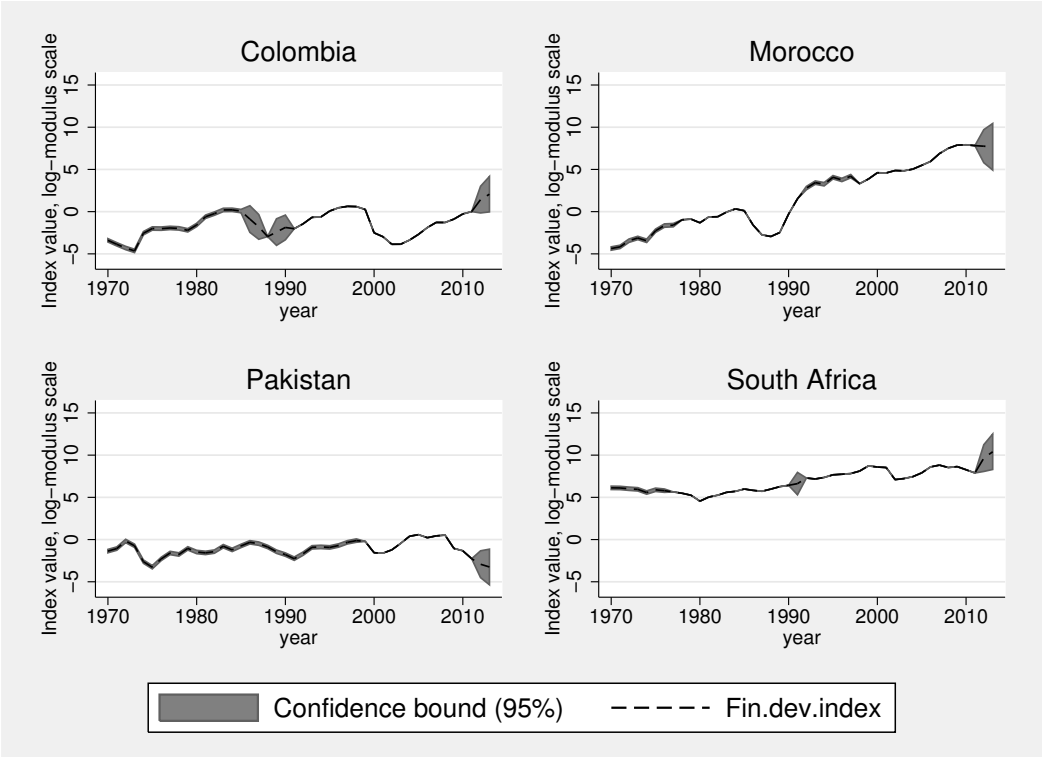


(b) system GMM

Figure 4: Financial development in some countries with more and and less estimation precision.

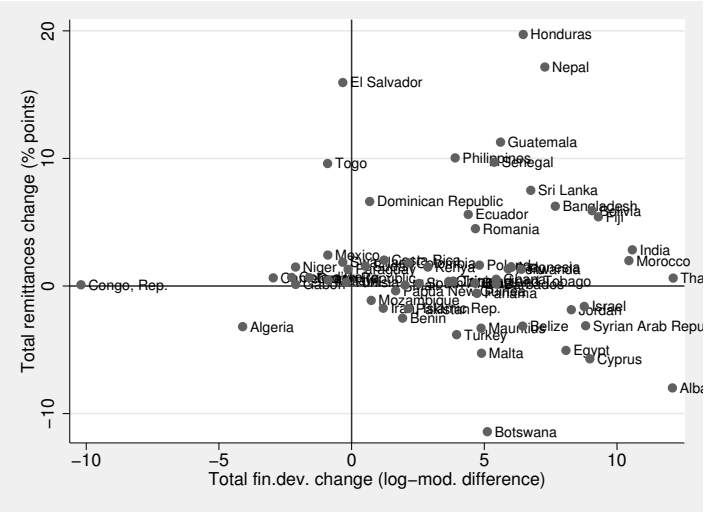


(a) Smaller confidence bounds



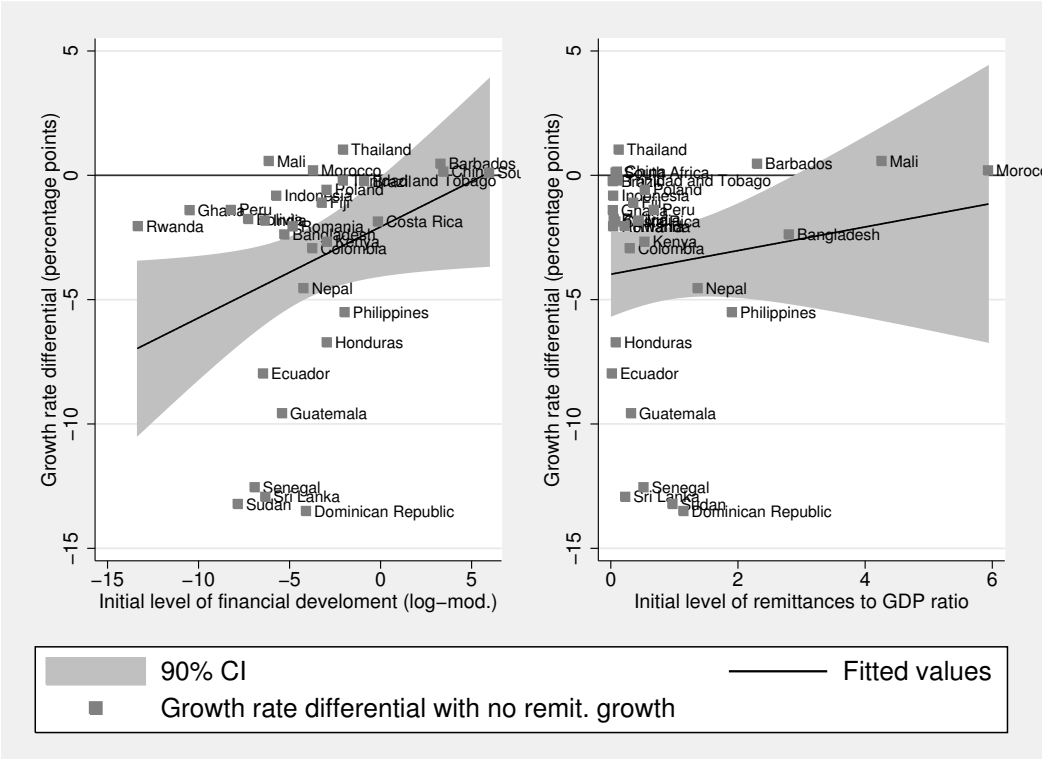
(b) Larger confidence bounds

Figure 5: Total changes of remittance inflows to GDP ratio and financial development for each country

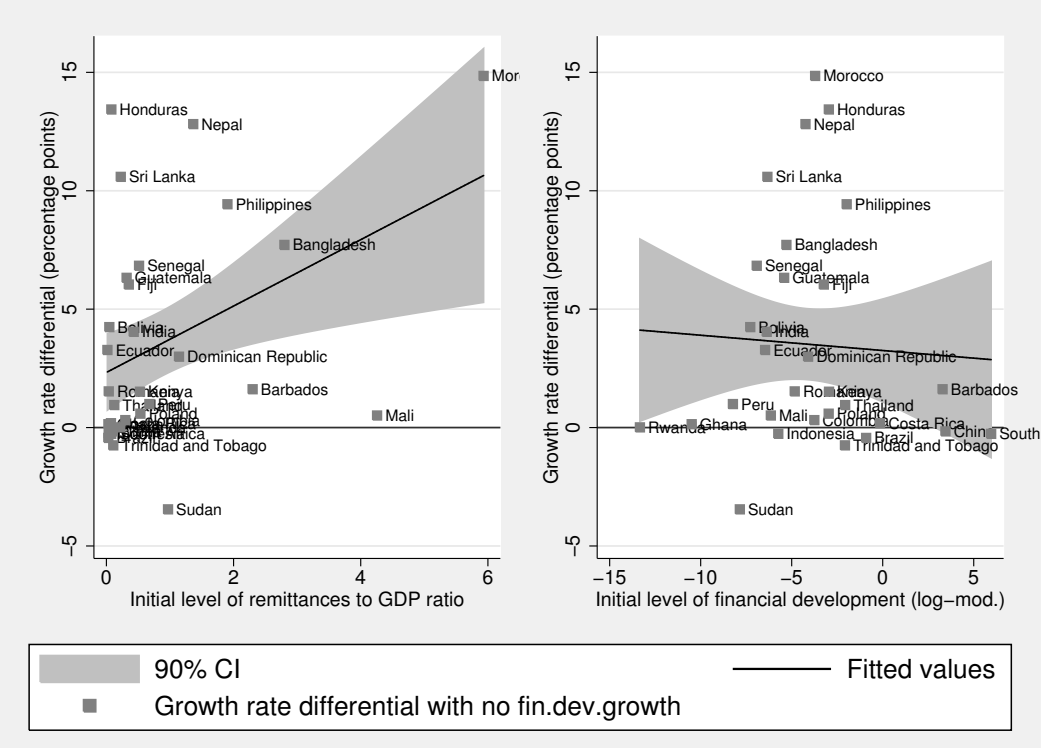


The total changes for each country are computed as differences of remittance inflows to GDP ratio and financial development.

Figure 6: Difference in total growth of GDP per capita if remittances or fin. dev. were held constant at their initial level.



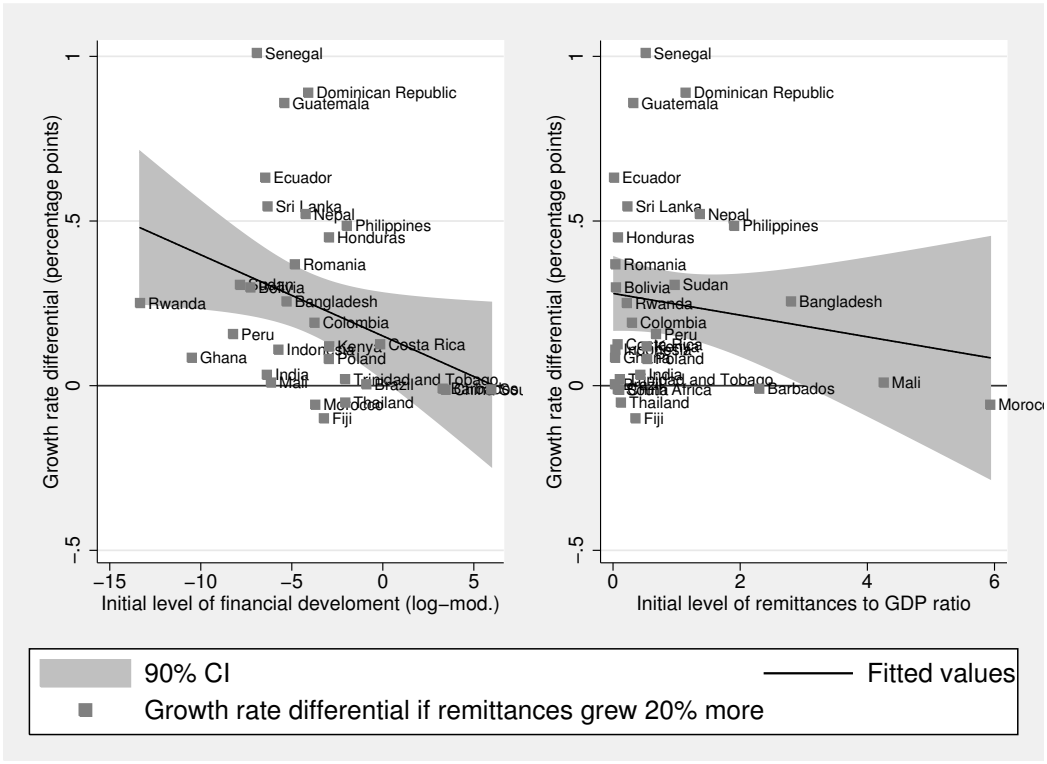
(a) No remittance change



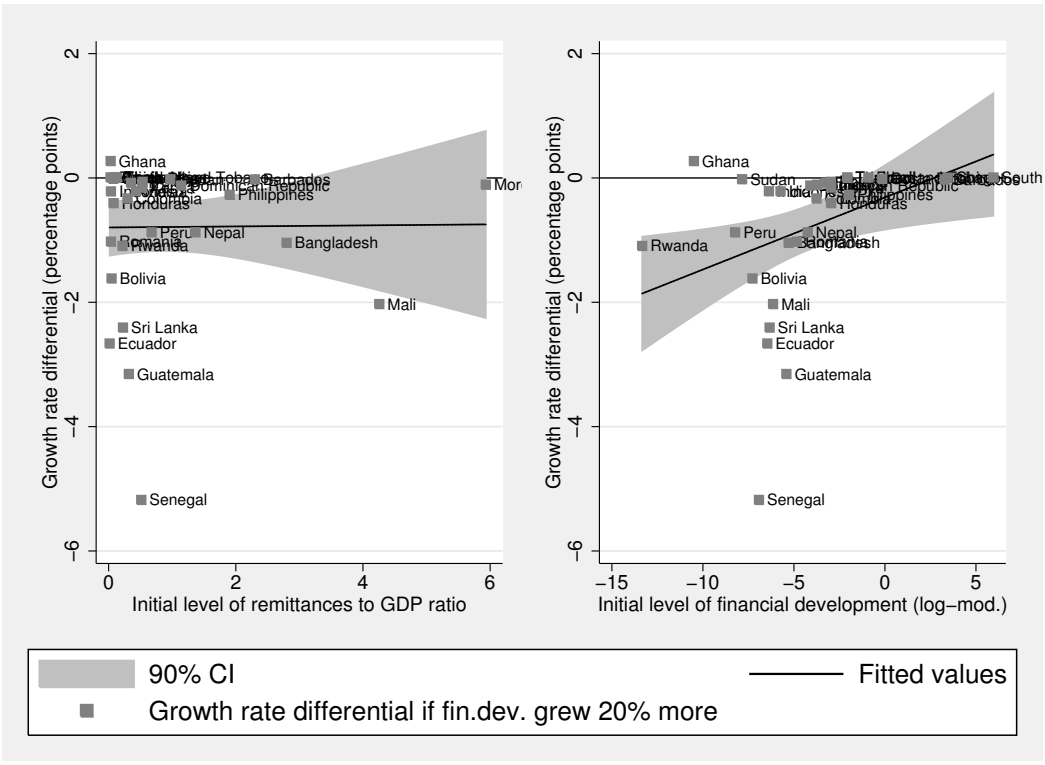
(b) No fin. dev. change

Note: The graphs show the difference between the counterfactual and real total growth of GDP per capita (in percentage points). Positive numbers indicate output gains from the counterfactual scenario.

Figure 7: Difference in total growth of GDP per capita if remittances or fin. dev. grew 20% more in total.



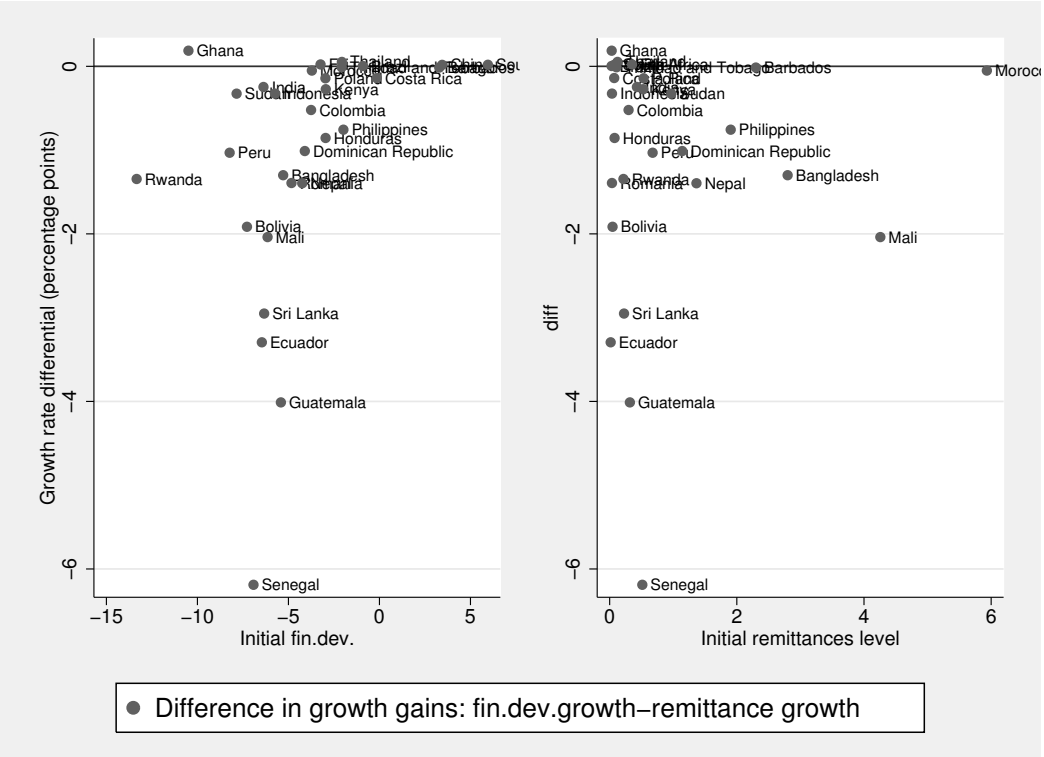
(a) 20% higher overall remittances inflows



(b) 20% higher overall fin.development

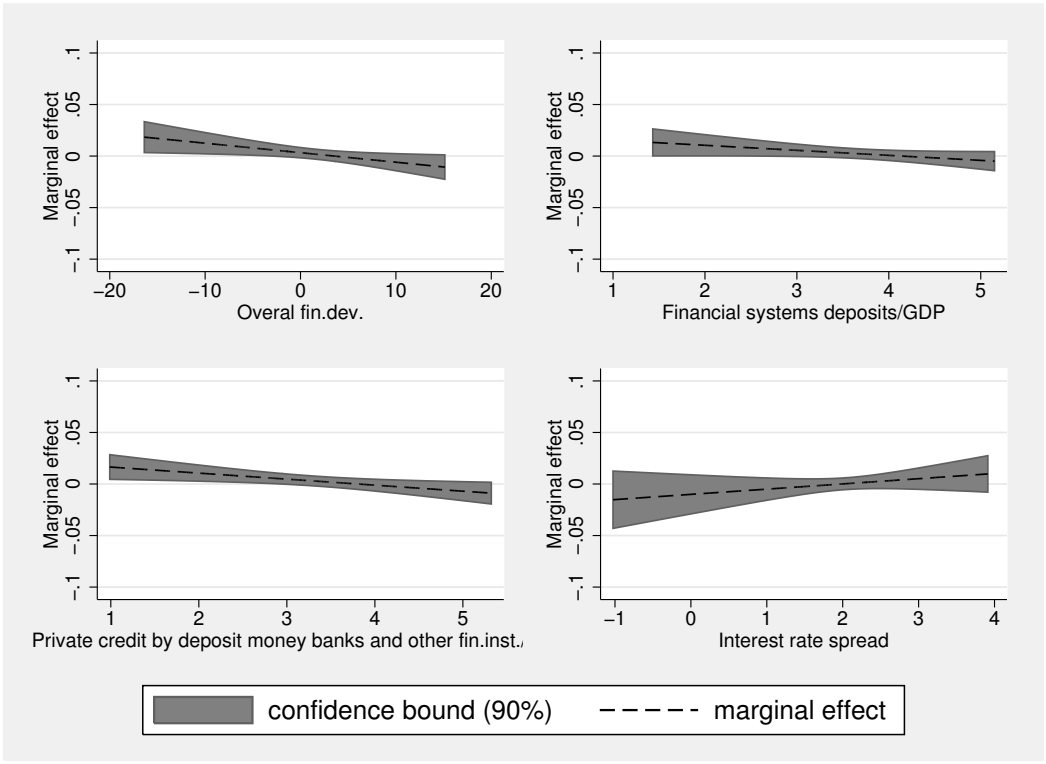
Note: The graphs show the difference between the counterfactual and real total growth of GDP per capita (in percentage points).

Figure 8: Difference in potential growth gains from higher financial development vs. higher remittance inflows

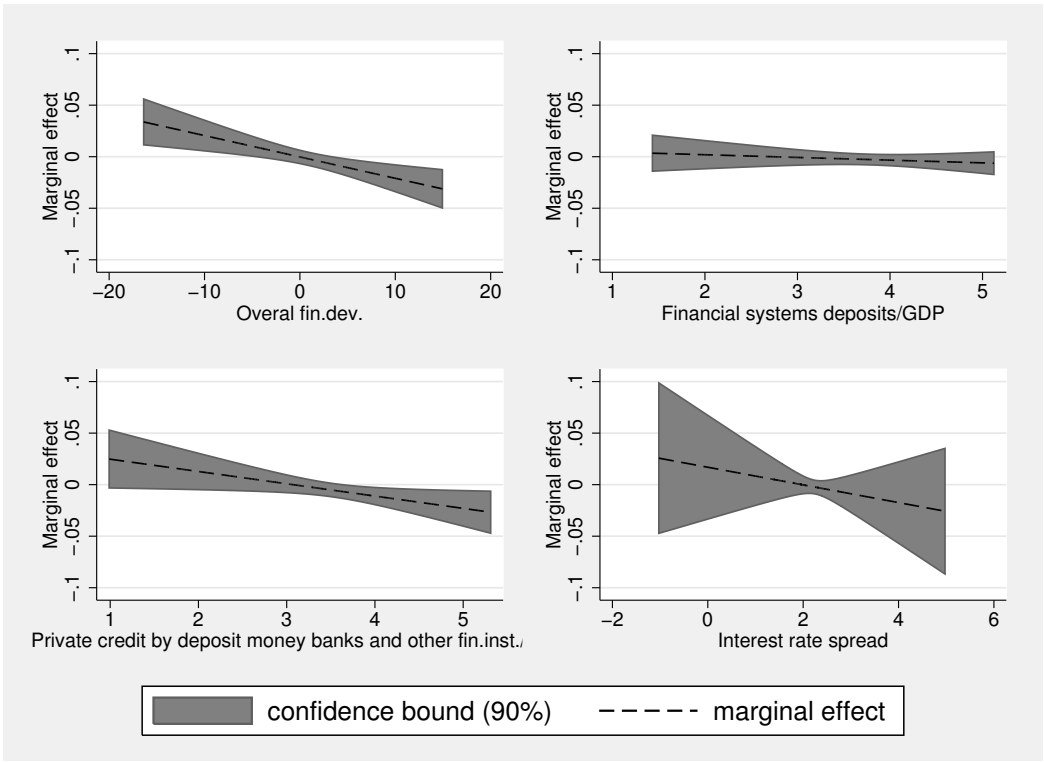


Note: The graph shows the difference between the counterfactual growth gains from increasing financial development and from increasing remittances (in percentage points).

Figure 9: Marginal effects of remittances on economic growth for different levels of financial development – before the financial crisis – system GMM and QML-FE results



(a) QML-FE



(b) system GMM

A Appendices

A.1 Estimation sample - country list

Country	No.	N	From	To
Albania	1	4	1995	2010
Algeria	2	8	1975	2010
Bangladesh	3	5	1990	2010
Barbados	4	8	1975	2010
Belize	5	6	1985	2010
Benin	6	4	1995	2010
Bolivia	7	7	1980	2010
Botswana	8	8	1975	2010
Brazil	9	6	1985	2010
Cameroon	10	7	1980	2010
China	11	5	1990	2010
Colombia	12	8	1975	2010
Congo, Rep.	13	5	1990	2010
Costa Rica	14	7	1980	2010
Cote d'Ivoire	15	8	1975	2010
Cyprus	16	7	1980	2010
Czech Republic	17	4	1995	2010
Dominican Republ	18	8	1975	2010
Ecuador	19	5	1990	2010
Egypt	20	7	1980	2010
El Salvador	21	7	1980	2010
Fiji	22	7	1980	2010
Gabon	23	7	1980	2010
Ghana	24	7	1980	2010
Guatemala	25	7	1980	2010
Honduras	26	8	1975	2010
India	27	8	1975	2010
Indonesia	28	6	1985	2010
Iran, Islamic Re	29	4	1995	2010
Israel	30	8	1975	2010
Jordan	31	7	1980	2010
Kenya	32	8	1975	2010
Malawi	33	4	1995	2010
Mali	34	5	1990	2010
Malta	35	8	1975	2010
Mauritius	36	4	1995	2010
Mexico	37	7	1980	2010
Morocco	38	8	1975	2010
Mozambique	39	5	1990	2010
Nepal	40	4	1995	2010
Niger	41	6	1985	2010
Pakistan	42	7	1980	2010
Panama	43	6	1985	2010
Papua New Guinea	44	6	1980	2005
Paraguay	45	4	1995	2010
Peru	46	4	1995	2010
Philippines	47	7	1980	2010
Poland	48	4	1995	2010
Romania	49	4	1995	2010
Rwanda	50	7	1980	2010
Senegal	51	8	1975	2010
South Africa	52	8	1975	2010
Sri Lanka	53	8	1975	2010
Sudan	54	7	1980	2010
Swaziland	55	8	1975	2010
Syrian Arab Repu	56	7	1980	2010
Thailand	57	8	1975	2010
Togo	58	6	1985	2010
Trinidad and Tob	59	8	1975	2010
Tunisia	60	6	1985	2010
Turkey	61	8	1975	2010
Total	393	Av. per country	6.44	

A.2 Kalman filter and MLE

The overall financial development index has been obtained by applying the Kalman filter to panel data. The procedure can be summarized as follows (with the country index i dropped for simplicity). The estimation has been done in Stata/Mata.

1. Initialization: $s_{0|0} = 0$ (for a stationary process) or other arbitrary or estimated initialization (from a normal distribution) for a nonstationary process, $P_{0|0} = \frac{1}{1-\gamma^2}$, initial guess for $\boldsymbol{\theta} = (\boldsymbol{\alpha}, \boldsymbol{\beta}, \text{vech}(\boldsymbol{\Sigma}))$

2. Kalman forecasting and updating

   - $s_{t+1|t} = \hat{\gamma} s_{t|t}$ (forecasted financial development index)
   - $P_{t+1|t} = \hat{\gamma}^2 + 1$ (variance of the index forecast)
   - $\boldsymbol{\eta_t} = \boldsymbol{z_{t+1}} - \boldsymbol{z_{t+1|t}} = \boldsymbol{z_{t+1}} - \hat{\boldsymbol{\alpha}} - \hat{\boldsymbol{\beta}} \boldsymbol{\iota} s_{t+1|t} = \hat{\boldsymbol{\beta}} \boldsymbol{\iota} (s_{t+1} - s_{t+1|t}) + w_{t+1}$
   - $\boldsymbol{F_t} \equiv \mathbb{E}(\boldsymbol{\eta_t} \boldsymbol{\eta_t}') = \hat{\boldsymbol{\beta}} \boldsymbol{\iota} P_{t+1|t} \boldsymbol{\iota}' \hat{\boldsymbol{\beta}}' + \boldsymbol{\Sigma}$
   - $s_{t+1|t+1} = s_{t+1|t} + P_{t+1|t} \boldsymbol{\iota}' \hat{\boldsymbol{\beta}}' \boldsymbol{F_t}^{-1} \boldsymbol{\eta_t}$ (updated financial development index forecast)
   - $P_{t+1|t+1} = P_{t+1|t} - P_{t+1|t} \boldsymbol{\iota}' \hat{\boldsymbol{\beta}}' \boldsymbol{F_t}^{-1} \boldsymbol{\iota} \hat{\boldsymbol{\beta}} P_{t+1|t}$ (updated index forecast variance)

3. Maximum likelihood estimation:
   $\max_{\boldsymbol{\theta}} \sum_{t=1}^{T} \boldsymbol{l}(Z_t | \mathbf{I}_{t-1}) = \sum_{t=1}^{T} [-\frac{1}{2} (\log(2\pi) + \log |\boldsymbol{F_t}| + \boldsymbol{\eta_t'} \boldsymbol{F_t}^{-1} \boldsymbol{\eta_t})]$
   $\Leftrightarrow \min_{\boldsymbol{\theta}} \sum_{t=1}^{T} [\log |\boldsymbol{F_t}| + \boldsymbol{\eta_t'} \boldsymbol{F_t^{-1}} \boldsymbol{\eta_t}]$

4. State smoothing:
   $s_{t|T} = s_{t|t} + \boldsymbol{J_t} (s_{t+1|T} - s_{t+1|t})$
   $P_{t|T} = P_{t|t} + \boldsymbol{J_t} (P_{t+1|T} - P_{t+1|t}) \boldsymbol{J_t}'$
   where $\boldsymbol{J_t} = P_{t|t} \gamma P_{t+1|t}^{-1}$

The last step of the procedure – state smoothing – is of high importance as it should help eliminate potential jumps related to some variable becoming available later than others and included only is some years when estimating the financial development index. To understand this, let us consider the following hypothetical example. If a country had relatively moderate values of deposits to GDP and credit to GDP ratios from 1970, but the interest rate spread (or other measure of financial sector efficiency described in Section 3.2) becomes available only in 1990 and reflects high inefficiency, Kalman forecasting and updating will estimate a jump in the financial development index value in 1990. Starting at time T and smoothing the the updated forecasts of $s_{t|t}$ should flatten this jump.

Tab. 8 gives some empirical examples for the relevance of the backward smoothing. Columns (1) - (3) include the values of the variables from the 3 categories considered for the generation of index of overall financial conditions. The value of the index labeled

as 'findev updated' is the index level after steps 1 - 3 of the procedure described above. 'Findev smoothed' is the final value of the financial development index, after smoothing (step 4). This is the value which enters the growth regressions. Fig. 10 additionally shows the evolution of both indices (before and after smoothing) as well as the underlying variables in both countries chosen as examples – Lebanon and Brazil.

When considering the first country presented, Lebanon (cf. panel (a) of Fig. 10), it can be seen that the index generation initially rests only on the efficiency measure (column (3) – deposit interest rate, long-dashed line). The variable measuring the depth of the financial sector (domestic credit, column (2), long-dashed-short-dashed line) becomes available in 1988. This leads to a jump in the estimated index value from -7.51 in 1987 to 3.38 in 1988. However, the backward smoothing, replaces both values with estimates much closer to each other: 4.37 and 4.70 (column (5)). Another big change in the index value happens in 2009 when a measure of financial system size (column (1), financial system deposits to GDP ratio, dash-dotted line) becomes available.

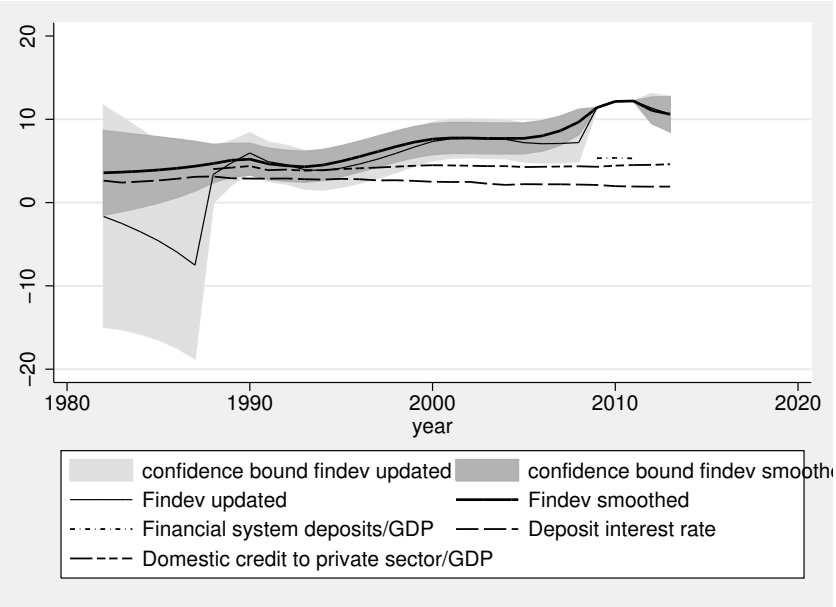
Brazil in 1987-88 is a similar example. However, the smoothing procedure only removes sharp changes in the estimated index value if a variable is missing, but not if there are larger changes in some (or all) of the 3 variables underlying the generated index, as shown in the last panel of Tab. 8 and the lower panel of Fig. 10 for the case of Brazil in 1989-90. There, all relevant information is already available at time t (the variance of the updated value of the index, denoted as $P_{t|t}$ is very small, 'P updated' column (6)), the backward smoothing barely affects the updated index value.

Table 8: The role of Kalman smoothing – some examples

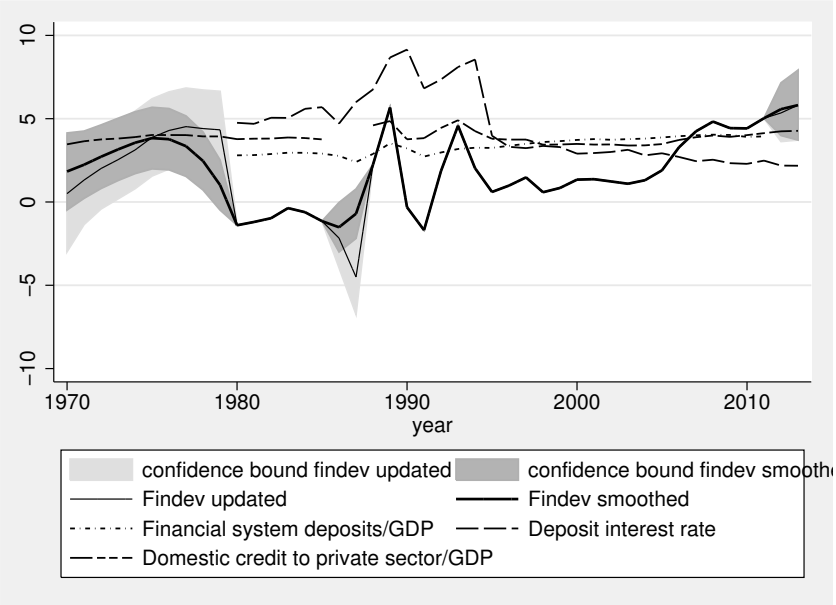
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
country	year	Fin.sys.deposits/GDP	Dom.credit to priv.sector/GDP	Deposit int.rate	findev updated	findev smoothed	P updated	P smoothed
Lebanon	1987			3.09908	-7.50883	4.36639	32.63180	2.28389
Lebanon	1988		4.01730	3.13368	3.38270	4.69034	2.99467	1.34929
Lebanon	2008		4.35722	2.16380	7.20763	9.67671	1.36849	0.58452
Lebanon	2009	5.33266	4.29834	2.11836	11.40232	11.40232	4.08E-11	4.08E-11
Brazil	1987	2.39913		5.99651	-4.50449	-0.70244	1.30457	0.57254
Brazil	1988	2.88843	4.59868	6.75743	2.24845	2.24845	1.98E-07	1.98E-07
Brazil	1989	3.52218	4.85785	8.67351	5.67035	5.67034	1.98E-07	1.98E-07
Brazil	1990	3.21650	3.76312	9.14796	-0.31500	-0.31500	1.98E-07	1.98E-07

Columns (1) - (3) show values of the variables from which the index was calculated (if empty – missing). Column (4) presents the estimated index value after step 3, and column (5) – final index value, after step 4 (smoothing).

Figure 10: The role of smoothing after using Kalman filter and MLE



(a) Lebanon



(b) Brazil

The different dashed lines on the legend are the variables which were used extract the financial development index for each country (could differ across countries, depending on data availability). The thinner solid line denotes the generated index of overall financial conditions before smoothing and the thicker line are after smoothing (final values of the index entering growth regressions). Different time periods are considered, vertical axis corresponds to the log-modulus scale of the variables.

A.3 Estimated pairwise correlations for the 5-year averaged data (1970-2010)

		1	2	3	4	5	6
1	Real GDP per capita (log)	1					
2	Investment/GDP	0.245***	1				
3	Population growth	-0.425***	-0.082	1			
4	Years of secondary education	0.652***	0.081	-0.478***	1		
5	Government expenditure/GDP	0.326***	0.246***	0.099*	0.251***	1	
6	Trade Openness	0.418***	0.255***	-0.133**	0.345***	0.394***	1
7	Remittance inflows/GDP	-0.077	0.139**	-0.028	0.054	0.087	0.202***
8	Overal fin.dev.	0.536***	0.339***	-0.309***	0.469***	0.294***	0.390***
9	Financial systems deposits/GDP	0.490***	0.311***	-0.321***	0.514***	0.310***	0.408***
10	Private credit by deposit money banks and other fin.inst./GDP	0.484***	0.316***	-0.235***	0.411***	0.282***	0.333***
11	Interest rate spread	-0.035	-0.306***	0.006	0.088	-0.007	-0.097

		7	8	9	10	11
1	Real GDP per capita (log)					
2	Investment/GDP					
3	Population growth					
4	Years of secondary education					
5	Government expenditure/GDP					
6	Trade Openness					
7	Remittance inflows/GDP	1				
8	Overal fin.dev.	0.100*	1			
9	Financial systems deposits/GDP	0.157**	0.915***	1		
10	Private credit by deposit money banks and other fin.inst./GDP	0.035	0.954***	0.825***	1	
11	Interest rate spread	-0.105	-0.235***	-0.225***	-0.212***	1

Notes: Significance levels: * 10%, ** 5%, *** 1%
This table presents pairwise correlation coefficients for the data used in growth regressions in this paper.

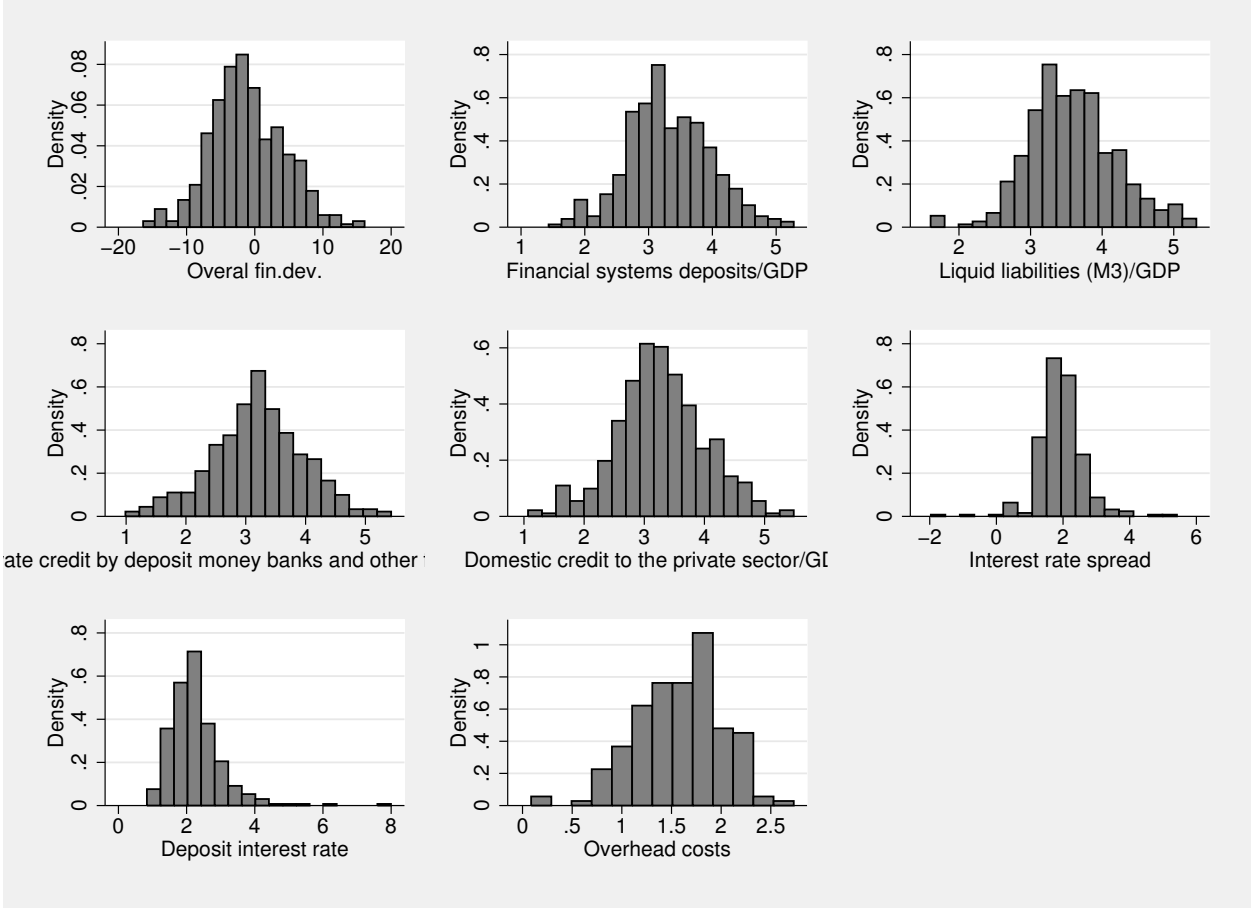
A.4 Ranking of countries by financial development

Rank	Country	Fin.dev.	Ranks - other measures			Rank	Country	Fin.dev.	Ranks - other measures		
			(1)	(2)	(3)				(1)	(2)	(3)
1	Hong Kong SAR, C	14.64	1	2	48	77	Seychelles	-0.57	58	118	101
2	Japan	14.05	4	1	17	78	Venezuela, RB	-0.70	97	111	27
3	Luxembourg	12.94	3	8	13	79	Macedonia, FYR	-0.97	111	89	106
4	Switzerland	11.43	6	4	6	80	Suriname	-1.00	85	106	127
5	Cyprus	10.53	8	6	20	81	Iran, Islamic Re	-1.08	80	82	1
6	United States	9.45	22	5	171	82	Zimbabwe	-1.10	71	112	91
7	Netherlands	8.88	18	18	16	83	Pakistan	-1.13	91	97	82
8	Macao SAR, China	8.66	5	31	53	84	Samoa	-1.35	93	108	107
9	Portugal	8.60	12	16	14	85	Nicaragua	-1.35	79	85	125
10	Spain	8.47	17	10	29	86	Costa Rica	-1.37	108	102	144
11	Malta	8.32	7	26	26	87	Colombia	-1.48	120	88	121
12	Germany	8.25	13	7	76	88	Oman	-1.51	87	68	21
13	Singapore	8.22	15	14	34	89	Indonesia	-1.71	101	91	38
14	Canada	8.16	20	17	23	90	Maldives	-2.04	36	23	99
15	Malaysia	7.97	14	20	28	91	Papua New Guinea	-2.09	96	116	90
16	Austria	7.91	19	19	36	92	Mauritania	-2.24	127	90	136
17	France	7.64	23	13	47	93	Sri Lanka	-2.37	105	115	8
18	United Kingdom	7.34	181	3	4	94	Turkey	-2.39	103	117	171
19	St. Kitts and Ne	7.00	10	40	69	95	Dominican Republ	-2.55	121	77	142
20	Sweden	6.97	89	12	51	96	Bolivia	-2.57	134	100	162
21	South Africa	6.96	45	15	45	97	Solomon Islands	-2.75	102	101	124
22	Lebanon	6.78	2	21	80	98	Cote d'Ivoire	-2.81	128	95	114
23	Thailand	6.42	32	28	31	99	Mexico	-2.85	110	113	74
24	Italy	6.19	28	27	87	100	Togo	-2.95	113	114	118
25	Ireland	6.13	35	30	58	101	Swaziland	-3.08	107	121	77
26	St. Lucia	5.61	30	37	97	102	Senegal	-3.13	137	99	115
27	Vanuatu	5.57	9	66	108	103	Albania	-3.17	55	152	89
28	China	5.56	86	9	5	104	Lesotho	-3.21	83	146	109
29	Jordan	5.43	16	29	44	105	Romania	-3.29	115	125	146
30	Antigua and Barb	5.30	11	25	83	106	Paraguay	-3.47	131	107	160
31	Grenada	5.25	25	44	94	107	Guatemala	-3.59	119	122	95
32	Panama	5.24	53	36	54	108	Libya	-3.88	143	150	19
33	Norway	5.23	51	24	37	109	Benin	-3.88	125	140	114

34	Israel	4.87	40	39	133	110	Bangladesh	-3.91	73	86	39
35	Finland	4.79	54	34	22	111	Ethiopia	-3.92	114	124	43
36	Barbados	4.75	38	53	72	112	Botswana	-3.95	109	132	46
37	Denmark	4.74	63	55	68	113	Nepal	-4.18	116	138	24
38	Czech Republic	4.65	29	50	62	114	Peru	-4.23	136	128	169
39	Australia	4.61	48	43	9	115	Mongolia	-4.35	118	131	164
40	Bahamas, The	4.45	49	41	15	116	Ecuador	-4.53	133	104	3
41	Bahrain	4.44	39	46	65	117	Mozambique	-4.54	117	142	126
42	Tunisia	4.30	57	32	42	118	Mali	-4.56	146	133	114
43	St. Vincent and	4.27	27	62	98	119	Ukraine	-4.62	140	139	158
44	Belgium	4.20	41	59	73	120	Argentina	-4.92	139	126	40
45	Aruba	4.09	44	49	85	121	Belarus	-5.59	148	143	55
46	Dominica	4.04	37	61	81	122	El Salvador	-5.65	176	166	30
47	Korea, Rep.	3.88	70	33	2	123	Gabon	-5.71	154	141	122
48	New Zealand	3.62	56	57	7	124	Cameroon	-5.85	149	130	138
49	Kuwait	3.56	34	51	10	125	Gambia, The	-5.88	132	137	150
50	Chile	3.27	68	11	96	126	Saudi Arabia	-5.91	155	47	171
51	Greece	3.27	47	65	67	127	Comoros	-5.96	138	148	112
52	Iceland	3.23	75	42	70	128	Haiti	-6.07	126	149	161
53	Mauritius	3.22	43	67	75	129	Syrian Arab Rep.	-6.32	100	157	33
54	Namibia	2.43	60	48	93	130	Nigeria	-6.33	145	145	59
55	Bulgaria	2.22	67	83	154	131	Malawi	-6.45	135	153	153
56	Slovenia	2.11	64	64	111	132	Zambia	-6.54	144	170	117
57	Belize	2.04	59	54	88	133	Madagascar	-6.58	151	134	156
58	Trinidad and Tobago	2.00	66	69	105	134	Burkina Faso	-6.99	159	135	115
59	Brazil	1.93	90	72	170	135	Congo, Rep.	-7.32	165	172	123
60	Morocco	1.84	62	70	11	136	Liberia	-7.46	142	155	145
61	Egypt	1.79	46	75	63	137	Bhutan	-8.51	50	94	130
62	Cape Verde	1.77	31	103	104	138	Burundi	-8.70	163	144	116
63	Fiji	1.18	77	80	49	139	Ghana	-9.41	158	165	102
64	Guyana	1.01	21	45	84	140	Sudan	-9.46	162	160	171
65	Hungary	0.49	74	71	35	141	Niger	-9.47	168	151	115
66	Poland	0.41	81	78	64	142	Guinea-Bissau	-9.58	173	180	165
67	Kenya	0.12	78	87	100	143	Lao PDR	-9.68	161	164	163
68	Philippines	0.06	84	76	52	144	Tanzania	-10.34	157	167	140
69	Honduras	0.04	98	73	129	145	Central African	-10.44	178	162	128
70	Latvia	0.04	104	93	113	146	Rwanda	-10.63	169	174	120
71	Jamaica	-0.10	76	98	134	147	Equatorial Guinea	-10.89	174	163	147
72	Qatar	-0.12	61	74	32	148	Uganda	-11.23	170	178	132
73	Uruguay	-0.12	92	96	18	149	Myanmar	-11.46	167	175	66
74	Algeria	-0.20	69	109	50	150	Chad	-11.76	179	176	135
75	India	-0.28	82	92	171	151	Sierra Leone	-12.95	141	161	141
76	Tonga	-0.49	94	81	71						

Fin.dev. refers to the mean of the financial development index over the whole period for which data for the given country was available
Ranks based on other measures: (1) Deposits/GDP, (2) Private credit/GDP, (3) Interest rate spread

A.5 Distribution of the financial data



All variables after log-modulus transformation

A.6 Marginal effects of remittances for different measures of financial development – system GMM results

I focus on QML-FE results as main results, as they are more robust, not relying on instrument choice. Using system GMM coefficient estimates, more appropriate if weak exogeneity is only true for future values of the error term, but not contemporaneously, would not change the main conclusions of positive and significant impact of remittances on economic growth for countries with lowest financial development (but with a stronger marginal effect) and mean and median effects would remain at similar levels.

Table 10: The estimated effects of remittance inflows to GDP changes on GDP per capita growth for different measures of financial development (system GMM)

	effect given the following measure of financial development:			
	(1)	(2)	(3)	(4)
effect at:	overall fin.dev.	fin. sys. deposits/GDP	priv. cred. by banks and fin.inst./GDP	interest rate spread
mean	0.421	0.117	0.018	-0.083
p-value	0.422	0.735	0.960	0.912
median	0.540	0.190	-0.004	-0.079
p-value	0.322	0.601	0.990	0.921
other percentiles:				
10th	2.055	0.888	1.569	-0.023
p-value	0.027	0.148	0.063	0.990
25th	1.399	0.555	0.754	-0.050
p-value	0.060	0.250	0.182	0.970
75th	-0.581	-0.328	-0.770	-0.113
p-value	0.202	0.285	0.009	0.848
95th	-2.018	-1.017	-1.964	-0.189
p-value	0.004	0.035	0.001	0.915
average marginal effect	0.333	0.073	-0.026	-0.084
p-value	0.818	0.914	0.984	0.162

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The values in the table can be directly interpreted as semi-elasticities: for the country with overall fin. dev. at the sample mean, if remittances share in GDP changes by 1 percentage point real GDP per capita will change by 0.486% over 5 years (significant at 12%, all effects already multiplied by 100)

A.7 Computation of the counterfactual scenarios - details

This analysis has only been done for 30 countries for which both remittance inflows and financial development levels have increased between 1970-2010. Values of δ_1, δ_2 and δ_3 are taken from the main QML-FE results.

GDP per capita in the last period can be estimated as:

$$y_{iT} = \alpha + \gamma y_{i,T-1} + \delta_1 \text{Rem}_{iT} + \delta_2 \text{FinDev}_{iT} + \delta_3 \text{Rem}_{iT}\text{FinDev}_{iT} + \boldsymbol{\beta X_{iT}} + \eta_t \tag{10}$$

Iterating backward and abstracting from time effects (η_t) gives:

$$y_{iT} = \gamma^T y_{i,0} + \Sigma_{j=0}^{T-1}\gamma^j \left(\alpha + \delta_1 \text{Rem}_{i,T-j} + \delta_2 \text{FinDev}_{i,T-j} + \delta_3 \text{Rem}_{i,T-j}\text{FinDev}_{i,T-j} + \boldsymbol{\beta X_{i,T-j}}\right) \tag{11}$$

1. Scenario I - no remittances change or no financial development change

   (a) No remittance change $\Rightarrow \text{Rem}_{it} = \text{Rem}_{i0} \forall t \in [0, T]$
   In this case GDP per capita in the last period could be approximated by:

   $$\hat{y}_{iT} = \gamma^T y_{i,0} + \Sigma_{j=0}^{T-1} \gamma^j \left(\alpha + \delta_1 \text{Rem}_{i,0} + \delta_2 \text{FinDev}_{i,T-j} + \delta_3 \text{Rem}_{i,0} \text{FinDev}_{i,T-j} + \boldsymbol{\beta X_{i,T-j}}\right) \tag{12}$$

   and the growth rate differential (in percentage points is:):

   $$100 * (\hat{y}_{iT} - y_{iT})_{\text{noremitgrowth}} = 100 * \Sigma_{j=0}^{T-1} \gamma^j (\text{Rem}_{i0} - \text{Rem}_{i,T-j})(\delta_1 + \delta_3 \text{FinDev}_{i,T-j}) \tag{13}$$

   (b) No financial development change $\Rightarrow \text{FinDev}_{it} = \text{FinDev}_{i0} \forall t \in [0, T]$
   Similarly to (13):

   $$100 * (\hat{y}_{iT} - y_{iT})_{\text{nofindevgrowth}} = 100 * \Sigma_{j=0}^{T-1} \gamma^j (\text{FinDev}_{i0} - \text{FinDev}_{i,T-j})(\delta_2 + \delta_3 \text{Rem}_{i,T-j}) \tag{14}$$

2. Scenario II - Larger than observed increase of remittances or financial development between 1970 and 2010

   (a) Remittance overall growth 20% higher than observed $\Rightarrow \widehat{\text{Rem}_{iT}} = 1.2 * (\text{Rem}_{iT} - \text{Rem}_{i1}) + \text{Rem}_{i1}$
   One way to achieve the higher final level of remittances would be to affect the whole path of remittances, such that the overall growth is 20% higher than what was observed in reality. However, in this case some values of remittances can be lower in the counterfactual scenario, mitigating the effect of their higher value in the last period. For this reason, I assume that the increase of remittances took place in the last 5-year period and previous values remained unchanged. That means that GDP per capita is only affected by the marginal effect driven by the difference between counterfactual and observed remittances inflows to GDP ratio in the last period (for each country):

   $$100 * (\Delta \hat{y}_{iT})_{\text{remitgrowth20}} = 100 * (\widehat{\text{Rem}}_{i,T} - \text{Rem}_{i,T})(\delta_1 + \delta_3 \text{FinDev}_{i,T}) \tag{15}$$

   (b) Financial development overall growth 20% higher than observed
   The assumption that the whole increase took place in the final 5-year period for each country preserves. However, some adjustments need to be made to transform the increase in the level of financial development into the change of its log-modulus value.

Let x_{it} denote the level of financial development. Then the counterfactual level of financial development $\hat{x}_{iT}$, related to an increase 20% higher than in reality is computed as follows:

$$\hat{x}_{iT} - x_{i0} = 1.2(x_{iT} - x_{i0}) \tag{16}$$

the log-modulus transformed value which enters the regression equation is defined as:

$$\widehat{\text{FinDev}}_{i,T} = \text{sign}(\hat{x}_{iT})(\ln(|\hat{x}_{iT}| + 1)) \tag{17}$$

and the difference between the counterfactual and the real output per capita is:

$$100 * (\Delta\hat{y}_{iT})_{\text{findevgrowth20}} = 100 * (\widehat{\text{FinDev}}_{i,T} - \text{FinDev}_{i,T})(\delta_2 + \delta_3 \text{Rem}_{i,T}) \tag{18}$$

For the sake of simplicity, I have formulated all the equations in this section under the assumption that the panel is balanced and the final time period is the same for each country. This is not the case in my data set, therefore in the actual calculations T always has a subscript i, meaning that it is country specific.

By applying the Kalman filter and maximum likelihood estimation on log-modulus transformed financial indicators, I obtained values of the unobserved overall financial development conditions which are also on the log-modulus scale. Therefore, to compute the counterfactual level of financial development I first need to transform $\text{FinDev}_{i,T}$ into levels, according to:

$$x_{it} = \begin{cases} \exp(\text{FinDev}_{i,t}) - 1 \text{ if } \text{FinDev}_{i,t} \geq 0 \\ 1 - \exp(-\text{FinDev}_{i,t}) \text{ otherwise} \end{cases}$$

A.8 Estimation results for the sample limited to 2006 (before the financial crisis, 1970-2006)

Table 11: QML-FE results

	(1) Overall fin.cond. b/se	(2) Financial systems deposits/GDP b/se	(3) Priv. credit/GDP b/se	(4) Interest rate spread b/se
L.Real GDP per capita (log)	0.824***	0.822***	0.824***	0.758***
	(0.040)	(0.045)	(0.043)	(0.046)
Remittance inflows/GDP	0.004	0.019	0.021**	-0.008
	(0.003)	(0.012)	(0.010)	(0.012)
Financial development (findev)	0.001	-0.003	0.001	-0.015
	(0.003)	(0.029)	(0.018)	(0.022)
Remittance-findev interaction term	-0.001*	-0.004	-0.005*	0.004
	(0.000)	(0.003)	(0.003)	(0.005)
Investment/GDP	0.007***	0.007***	0.007***	0.008***
	(0.002)	(0.002)	(0.002)	(0.003)
Population growth	-0.000	0.002	0.001	0.007
	(0.014)	(0.015)	(0.015)	(0.014)
Years of secondary education	0.039*	0.044**	0.041*	0.073**
	(0.022)	(0.022)	(0.022)	(0.031)
Government expenditure/GDP	-0.005	-0.004*	-0.004*	-0.004
	(0.003)	(0.003)	(0.003)	(0.004)
Trade Openness	0.001	0.001*	0.001*	0.001**
	(0.000)	(0.000)	(0.000)	(0.001)
Observations	331	325	324	225
Countries	61	61	61	53
average no. of obs. per country	5.443	5.361	5.344	4.283

Table 12: System GMM results

	(1) Overall fin.cond. b/se	(2) Financial systems deposits/GDP b/se	(3) Priv. credit/GDP b/se	(4) Interest rate spread b/se
L.Real GDP per capita (log)	0.940***	0.962***	0.959***	0.881***
	(0.036)	(0.035)	(0.030)	(0.047)
Remittance inflows/GDP	-0.000	0.007	0.037	0.017
	(0.004)	(0.016)	(0.023)	(0.030)
Financial development (findev)	0.003	-0.027	0.007	-0.003
	(0.003)	(0.034)	(0.026)	(0.030)
Remittance-findev interaction term	-0.002***	-0.003	-0.012*	-0.009
	(0.001)	(0.004)	(0.006)	(0.013)
Investment/GDP	0.009***	0.010***	0.009**	0.013***
	(0.003)	(0.003)	(0.004)	(0.003)
Population growth	-0.017	-0.050*	-0.024	-0.023
	(0.014)	(0.027)	(0.020)	(0.022)
Years of secondary education	0.062**	0.029	0.044*	0.086**
	(0.029)	(0.033)	(0.025)	(0.038)
Government expenditure/GDP	0.003	0.006	0.005	0.005
	(0.003)	(0.004)	(0.004)	(0.004)
Trade Openness	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	331	330	330	256
Countries	61	61	61	57
average no. of obs. per country	5.443	5.443	5.443	4.526
Number of instruments	50	50	50	50
p-value for Hansen's test	0.609	0.367	0.435	0.732
p-value for AR(1) in residuals test	0.027	0.070	0.024	0.067
p-value for AR(2) in residuals test	0.069	0.078	0.057*	0.166
p-value for AR(3) in residuals test	0.207	0.360	0.240	0.360
p-value $H_0 : \gamma = 1$ (one-sided)	0.050	0.141	0.086	0.007

Notes: Bootstrapped standard errors in parentheses (in all QML-FE estimations and system GMM column (1), robust standard errors with Windmeijer's correction in (2)-(4) of system GMM. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
All regressions include country fixed effects, time dummies (for the 5-year periods) and a constant.

A.9 Pooled OLS (POLS) and fixed effects (FE) estimation results

These results are included to show that the autoregressive coefficient in the system GMM regressions lies in the confidence bound between within (FE) estimates and pooled OLS results, as suggested by Roodman (2009).

Table 13: Whole sample (1970-2010)

	Overall fin.cond.		Financial systems deposits GDP		Priv. credit GDP		Interest rate spread	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(FE)	(POLS)	(FE)	(POLS)	(FE)	(POLS)	(FE)	(POLS)
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
L.Real GDP per capita (log)	0.784***	0.967***	0.780***	0.966***	0.782***	0.968***	0.716***	0.965***
	(0.039)	(0.008)	(0.039)	(0.008)	(0.037)	(0.008)	(0.048)	(0.011)
Remittance inflows/GDP	0.003	0.004***	0.018***	0.024***	0.018***	0.021***	-0.005	-0.011
	(0.003)	(0.001)	(0.007)	(0.008)	(0.006)	(0.005)	(0.009)	(0.007)
Financial development (findev)	0.001	0.005***	0.003	0.042***	0.008	0.027***	-0.017	-0.028**
	(0.003)	(0.001)	(0.029)	(0.013)	(0.018)	(0.010)	(0.019)	(0.014)
Remittance-findev interaction term	-0.001*	-0.001***	-0.004**	-0.006***	-0.005***	-0.006***	0.005	0.007*
	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)
Investment/GDP	0.008***	0.009***	0.008***	0.009***	0.008***	0.010***	0.008***	0.009***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)
Population growth	-0.000	-0.020*	0.000	-0.021**	-0.000	-0.021*	0.000	-0.028**
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.013)
Years of secondary education	0.042*	0.033***	0.042*	0.031***	0.039*	0.031***	0.061*	0.037***
	(0.023)	(0.008)	(0.023)	(0.008)	(0.023)	(0.008)	(0.031)	(0.011)
Government expenditure/GDP	-0.005**	-0.002	-0.005**	-0.003*	-0.005**	-0.002*	-0.006*	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)
Trade Openness	0.001*	0.000	0.001*	0.000	0.001*	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
System GMM estimate	0.927***		0.904***		0.936***		0.891***	
Obs.	332	332	332	332	332	332	258	258

Table 14: Before financial crisis (1970-2006)

	Overall fin.cond.		Financial systems deposits GDP		Priv. credit GDP		Interest rate spread	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(FE)	(POLS)	(FE)	(POLS)	(FE)	(POLS)	(FE)	(POLS)
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
L.Real GDP per capita (log)	0.753***	0.973***	0.751***	0.972***	0.753***	0.974***	0.683***	0.970***
	(0.037)	(0.008)	(0.037)	(0.008)	(0.035)	(0.008)	(0.042)	(0.011)
Remittance inflows/GDP	0.003	0.004***	0.019***	0.025***	0.020***	0.021***	-0.007	-0.011
	(0.003)	(0.001)	(0.007)	(0.007)	(0.006)	(0.005)	(0.008)	(0.007)
Financial development (findev)	0.001	0.004***	0.005	0.039***	0.008	0.024**	-0.022	-0.029**
	(0.003)	(0.001)	(0.028)	(0.013)	(0.018)	(0.009)	(0.018)	(0.014)
Remittance-findev interaction term	-0.001	-0.001***	-0.005**	-0.006***	-0.005***	-0.005***	0.005	0.007*
	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.001)	(0.004)	(0.004)
Investment/GDP	0.008***	0.009***	0.008***	0.009***	0.008***	0.009***	0.008***	0.009***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)
Population growth	-0.000	-0.018*	0.001	-0.019*	0.000	-0.019*	0.000	-0.026**
	(0.009)	(0.010)	(0.008)	(0.010)	(0.008)	(0.011)	(0.008)	(0.013)
Government expenditure/GDP	0.040**	0.029***	0.041**	0.028***	0.038*	0.027***	0.066**	0.035***
	(0.020)	(0.008)	(0.019)	(0.008)	(0.019)	(0.008)	(0.025)	(0.010)
Years of secondary education	-0.005**	-0.002	-0.005**	-0.003*	-0.005**	-0.002*	-0.006*	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)
Trade Openness	0.001	0.000	0.001*	0.000	0.001*	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
System GMM estimate	0.940***		0.962***		0.959***		0.881***	
Obs.	331	331	330	330	330	330	258	258

Notes: Robust standard errors in parentheses. Variable definition as in Tab. 2, Tab. 4 Tab. 11 and Tab. 12

A.10 Robustness check - main results without Albania and Jordan

Table 15: QML-FE results - estimation sample without Albania and Jordan

	(1) Overall fin.cond. b/se	(2) Financial systems deposits/GDP b/se	(3) Priv. credit/GDP b/se	(4) Interest rate spread b/se
L.Real GDP per capita (log)	0.862***	0.857***	0.856***	0.823***
	(0.044)	(0.049)	(0.047)	(0.054)
Remittance inflows/GDP	0.003	0.018	0.023**	-0.005
	(0.003)	(0.015)	(0.011)	(0.015)
Financial development (findev)	0.001	-0.004	0.002	-0.007
	(0.003)	(0.030)	(0.019)	(0.027)
Remittance-findev interaction term	-0.001*	-0.005	-0.007**	0.003
	(0.001)	(0.004)	(0.003)	(0.007)
Investment/GDP	0.008***	0.007***	0.007***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)
Population growth	0.005	0.007	0.007	0.008
	(0.012)	(0.014)	(0.013)	(0.015)
Years of secondary education	0.036	0.043	0.041	0.067*
	(0.029)	(0.028)	(0.028)	(0.035)
Government expenditure/GDP	-0.005*	-0.005*	-0.005*	-0.005
	(0.003)	(0.003)	(0.003)	(0.004)
Trade Openness	0.001*	0.001**	0.001**	0.001**
	(0.000)	(0.000)	(0.000)	(0.001)
Observations	323	319	318	221
Countries	59	59	59	51
average no. of obs. per country	5.475	5.407	5.390	4.333

Notes: Bootstrapped standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 11: Marginal effects of remittances on economic growth for different levels of financial development – QML-FE results without Albania and Jordan