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Exploring the links between financial flows and economic growth: a panel ARDL approach

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Abstract

Purpose – Globalization occupies a central research activity and remains an increasingly controversial phenomenon in economics. This phenomenon corresponds to a subject that can be criticized through its impact on national economies. On the other hand, the world economy is evolving in a liberalized environment in which foreign direct investment plays a fundamental role in the economic development of each country. The advent of financial flows – foreign direct investment, remittances and official development assistance – can be a key factor in the development of the economy. The purpose of this study is to analyze the effect of financial flows on economic growth in developing countries. Empirically, different approaches have been used. As part of this study, an attempt was made to use a combined autoregressive distributed lag (ARDL) panel approach to study the short-term and long-run effects of financial flows on economic growth. The results indicate ambiguous effects. Economically, the effect of financial flows on economic growth depends on the investor's expectations.

Design/methodology/approach – To study the short-run and long-run effects of financial flows on economic growth, this paper considers an empirical approach based on the panel ARDL. This model makes it possible to distinguish between the short-run effect and the long-run one. This type of model is based on three estimators, namely, mean group, pooled mean group (PMG) and dynamic fixed effect.

Findings – Results confirm the existence of a long-run relationship because the adjustment coefficient (error correction parameter) is negative and statistically significant. This paper finds that the PMG estimator is more consistent and more efficient. In the short-run, foreign direct investment do negatively affect economic growth, the effect is no significant in the long-run. On the other hand, the effect of remittances on economic growth is significant in the short-run. However, it is no significant in the long-run. Finally, the results suggest that the effect of official development assistance on economic growth is insignificant; both in the long-run and in the short-run.

Originality/value – To study the interaction between financial flows and economic growth, some empirical methodology are used such as the dynamic panel data and the autoregressive vector (VAR) model. In this study, we apply the panel ARDL model to analyze the short-run and the long-run effect for each financial flow on economic growth. The objective is to study the heterogeneity on dynamic adjustment in the short-term and long-term.

Keywords Economic development, Economist, Economic policy, Foreign direct investment, Remittances, Official development assistance, Panel ARDL

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1. Introduction

The relationship among foreign direct investment, remittances, official development assistance and economic growth is yet to receive unanimous agreement among researchers and policymakers. Such a topic is popular in international economics and is widely debated.

Theoretically, the first strand of research is concerned with the impact of foreign direct investment (FDI), remittances and official development assistance (ODA) on economic growth.

There is a number of ways in which FDI can cause economic growth. Indeed, FDI have a direct relationship with the level of income. Blomstrom *et al.* (1992) found that the effect of FDI is very large in high-income economies but not for lower income ones. However, Carkovic and Levine (2005) find that FDI does not have a positive effect on economic growth. Kumar and Pradhan (2002) prove that when foreign investments are distinguished in the domestic market, the effect of FDI will be negative. Morrissey and Udomkerdmongkol (2012), prove that foreign direct investment substitutes for domestic investment. Bhalla and Ramu (2005) show that when foreign investments are destined for exports, the effect of FDI will be positive on economic growth.

Wu and Hsu (2008) show that FDI has a major effect on the economic growth of countries with better income levels. Alguacil *et al.* (2011) suggest that FDI has a lower impact in low-income countries and a greater impact in middle-income countries.

Baiashvili and Gattini (2020) give an economic explanation. In fact, local companies from countries that develop from low income levels will gradually face strong direct competition with foreign firms. Therefore, FDI leads to the closure of certain local businesses. In contrast, firms in middle-income countries may face this competitive pressure from FDI and benefit from knowledge spillovers. The effects importance of FDI move from low to middle income countries.

The impact of FDI on the export of local businesses reveals the indirect effects (Caves, 1996). Foreign affiliates may affect the manufacturing exports of the host country in several ways. For example, local businesses can increase their exports by observing the export activities of multinational firms and by making use of the infrastructure of transport, communications and financial services, which are developed to support these activities (Haddad and Harrison, 1993). Another indirect effect involves the influence of FDI on the competitiveness of enterprises in the host countries and the spread of new technologies. Vertical FDI is an export-oriented platform. The multinational company creates a subsidiary abroad to re-export. These firms set up in the foreign country to re-export are looking for cheap labor or cheaper raw material costs, in other words, they are seeking efficiency in terms of cost (Helpman, 1984).

Javaid (2017) examined the effect of external capital flow (Remittances, Foreign Direct Investment and Official Development Assistance) on gross domestic product (GDP) growth of Pakistan over the period 1973–2014. The results suggest that foreign direct investment and Official Development Assistance have overall significant and positive impacts on the GDP growth of Pakistan both in the short-run and in the long-run. Remittances have no significant role to explain the variation in the economic growth of Pakistan. According to the author, the relationship between remittances and economic growth can be explained by the fact that remittances are used for consumption to increase well-being rather than to improve the overall growth of the economy.

Remittances can have a negative effect on economic growth through the use of migrants through informal channels (Chami *et al.*, 2010; Fenny *et al.*, 2014; Lim and Simmons, 2015). Olayungbo and Quadri (2019) find that there is no relationship between remittances and the

economic growth of 20 countries in Sub-Saharan Africa for the period from 2000–2015. Das and Sethi (2019) find in his study that the effect of remittances on Sri Lanka's economic growth is very important. Economically, migrants' remittances increase family income, and therefore, the level of domestic consumption. Migrant remittances are positively associated with bank deposits and credit. More specifically, in countries with a low level of financial development, which are generally developing countries, there are several difficulties in borrowing. When access to credit is limited, individuals can use remittances to free up such credit constraints. This would result in increased growth. Migrant remittances, therefore, can ease credit constraints and act as a substitute for an inefficient financial system. Therefore, financial development is an important channel for transmitting the impact of remittances from migrants on the growth of recipient countries. So, remittances have helped solve Sri Lanka's unemployment problem. This explains the positive effect of transfers on economic growth. In addition, because of a large flow of remittances, a negative impact on growth can occur as participation in the labor market is negligible. Other reasons for the negative impact of migrants' remittances on economic growth are the unproductive use of these flows.

Households use their money to buy imported products. The inflow of migrants' remittances leads to the appreciation of the real exchange rate, which reduces the economy's exports. Olubiyi (2014) studied the relationship between remittances and imports on the one hand and remittances and exports on the other hand taking the example of Nigeria during the period 1980–2012. The results show that remittances have a positive impact on import and export, and therefore, on the countries trade openness. Moreover, the negative effect of remittances on economic growth can be explained by the massive inflows of remittances from migrants, which pushes the real exchange rate to appreciate. This appreciation makes exports less competitive (Kolawole and Olayiwola, 2013). On the other hand, these transfers trigger consumer spending on imported goods (Farzanegan and Gholipour, 2016).

W. Phiri (2017) examines the impact of foreign aid on the economic growth of the 12 countries of sub-Saharan Africa from 1995 to 2014. The results show that the aid has a statistically negative insignificant impact on economic growth. This result is due to the fact that aid does not promote economic growth because of misallocation of aid or inefficient use. In another study, Minoiu and Reddy (2008) analyzed the effect of official development assistance on the economic growth of developing countries over the period 1960–2000. Their findings indicate that development aid has a positive and important effect on economic growth. Indeed, economic growth can attract aid flows as a result of efficient use. Ouattara (2006) studied the effect of aid on the fiscal behavior of developing countries over the period 1980–2000. The results suggest that this aid has a positive and significant impact on public investment and development spending.

Besides, T. Bhavan *et al.* (2011) examined the relationship between foreign aid and foreign direct investment in the case of South Asian countries from 1995 to 2007. The results reveal; that foreign aid attracts FDI to the region. This effect is explained generally because aid is given in the form of aid for trade. Aid for Trade is a complementary factor to foreign direct investment in South Asian countries. Selaya and Sunesen (2008) have studied the relationship between foreign aid and FDI. Foreign aid can improve the marginal productivity of capital by financing public infrastructure projects and investments in human capital. Karakaplan *et al.* (2005) studied the effect of aid on foreign direct investment and came to the conclusion that aid recipient countries are more likely to receive FDI in case of good governance. In addition, official development assistance can reduce poverty and improve the health system. Das and Sethi (2019) find that official development assistance has a major role in improving the level of economic growth. They announce that governments should strengthen the country's financial system and fight corruption.

Coon and Neumann (2015) studied the relationship between remittances and FDI for 118 developing countries during the period of 1980 to 2010 and found out that an increase of 10% of FDI inflows corresponds to a 3.6% increase in remittances. Such results suggest that migrant remittances and FDI are complementary. Remittances are increasing with a larger influx of FDI providing development finance to countries that send a large number of migrants abroad. Remittances increase the level of FDI by providing relevant information and by reducing uncertainty. However, migrants can orient their income toward national investment or via FDI flows by positively affecting the economy of their native countries.

Furthermore, Lahiri and Raimondos-Moller (2000) studied the relationship between migrant remittances and foreign aid. Remittances can affect foreign aid to the country of origin. The authors claim that foreign ethnic groups put pressure on the host countries for the benefit of their native countries. However, potential investors among migrants living in donor countries are pushing toward specific types of aid, critical bottlenecks and, as a result; they help promote the productivity of their own remittances.

The relationship between migrant remittances and foreign aid is complementary. An increase in local investment financed by remittances could stimulate the effects on infrastructure and institutions financed by foreign aid by making better use of commercial opportunities, thus improving the level of economic growth of the countries of origin. In addition, migrant remittances favor economic relations between source and destination countries by reducing the volatility typical of aid disbursements (Lensink and Morrissey, 2000; Kodama, 2012).

In the end, Minasyan and Nunnenkamp (2016) argue that foreign aid does not improve the infrastructure and institutions of the recipient country or its economic growth. This discourages migrants from sending their funds and investing in their home countries. Adedokun (2017) montre que poor governance and the important size of aid matter for aid effectiveness in sub-Saharan Africa. Aid is effective in countries that are well-structured institutionally and have a strong political environment. Official development assistance therefore, pushes developing countries to be linked to the famous "debt trap" (Mallik, 2008). Rao *et al.* (2020) argued that developing economies in the South-East Asia region and South Asia need to invest more in human and physical capital to maintain a greater degree of trade integration and increase the effectiveness of official development assistance to divert the harmful effects of FDI and improve economic growth.

This paper examines the causal relationship between FDI, ODA and foreign remittances with that of economic growth of developing countries in particular middle income countries. Local firms in middle-income countries are stronger and able to absorb the adverse effects of foreign firms than local firms in low-income countries. Thus, they can benefit from positive externalities. These countries are the country's most in need of this type of funding source – FDI, migrant transfers and official development assistance. These countries tend to exhibit ambiguous trends that will be discussed in the respective section. Though there have been several kinds of literature that state the relationship of each variable with economic growth individually regarding developing countries, there are very few or negligible literature about the dynamic relationship of all the variables under consideration with a distinction between each flow both short run and long run effect by an autoregressive distributed lag (ARDL) panel model.

The rest of the paper is organized as follows. Section 2 presents the data econometric methodology. Section 3 displays and discusses the empirical findings and their interpretation, while Section 4 provides our conclusions.

2. Data and empirical methodology

The main objective of this empirical analysis is to study the short-run effect and the long-run effect of financial flows, namely, foreign direct investment, migrant remittances and official development assistance on economic growth by considering a global sample of 12 developing countries in particular middle income countries, namely, Algeria, Argentina, Bangladesh, Botswana, Brazil, Burkina Faso, Cameron, Costa Rica, El Salvador, Guinea-Bissau, Tunisia and Morocco. Specifically, we focus the interaction between country income levels (middle income countries) and financial flows. The choice of countries depends mainly on the major effect of financial flows and middle income countries. This choice of classification makes it possible to give a clearer vision of the direct effect of each financial flow on the economic growth of the country's most attractive for financial flows. In addition, it allows the governments of countries to be given more detailed information in terms of the impact of each flow on economic growth to apply the appropriate economic policies. The period span from 1990 to 2017. All data are sourced from the Word Development Indicators except FDI data is from united nations conference on trade and development.

To study the short run and long run effects of financial flows on economic growth, we consider an empirical approach based on the panel ARDL. This model makes it possible to distinguish between the short run effect and the long run one. This is to mean that it makes it possible to study the adjustment of variables toward short-term and long-term equilibrium situations. This type of model is based on three estimators, namely, mean group (MG), pooled mean group (PMG) and dynamic fixed effect (DFE).

2.1 Specificity of the panel ARDL

Having mentioned the definitions of the variables and studying the long run effect of FDI, migrant remittances and official development assistance on economic growth, we use the following equation as the basic model:

$$\begin{aligned}\text{GDP per capita}_{it} = {} & \alpha_0 + \alpha_1 \text{FDI}_{it} + \alpha_2 \text{transferts of remittances (TR)}_{it} \\ & + \alpha_3 \text{official development assistance (ODA)}_{it} + \varepsilon_{it}\end{aligned} \tag{1}$$

$\text{GDP per capita}_{it}$ is the per capita GDP growth rate for country i at date t, FDI_{it} is the stock of FDI as a percentage of GDP, transferts of remittances $(\text{TR})_{it}$ is the transfer of migrants as a percentage of GDP, official development assistance $(\text{ODA})_{it}$ is the official development assistance as a percentage of gross national product and ε_{it} is the error term. Traditional estimation methods do not permit the study of the adjustment of variables to short run and long run equilibrium situations. For this reason, we used the panel ARDL model. This approach seems necessary in the control of heterogeneity in the relationship that exist between variables integrating the individual specific effects.

Referring to the work of Pesaran and Shin (1996), the ARDL (p, q) model is specified by the following equation:

$$Y_{it} = \sum_{j=1}^{p} \varphi_{i,j} Y_{i,t-j} + \sum_{j=0}^{q} \delta_{i,j} X_{i,t-j} + \vartheta_i + \varepsilon_{it} \tag{2}$$

With i = 1,2, . . ., N is the number of countries; $t = 1, \ldots .T$ is the time; j is the number of lags; $X_{i,t}$ is the vector of the variables relating to the financial flows and ϑ_i is the specific fixed

effect of the countries. To consider the adjustment coefficient and the long run dynamics, equation (2) is reparametrized as follows:

$$\Delta Y_{it} = \varnothing_i \left(Y_{i,t-1} - \theta_i X_{i,t}\right) + \sum_{j=1}^{p-1} \varphi'_{i,j} \Delta Y_{i,t-j} + \sum_{j=0}^{q-1} \delta'_{i,j} \Delta X_{i,t-j} + \vartheta_i + \varepsilon_{it} \quad (3)$$

where $\varnothing_i$ is the adjustment coefficient of the long run dynamics. θ_i indicates the long run equilibrium relationship between $Y_{i,t}$ and $X_{i,t}$. $\varphi'_{i,j}$ and $\delta'_{i,j}$ represent the short run coefficients linking economic growth with its past values and the variables of interest $X_{i,t}$. A long run relationship between growth and financial flows exists if $\varnothing_i$ is negative and significant, then a cointegration relation exists between $Y_{i,t}$ and $X_{i,t}$. To estimate equation (3), three estimation methods will be used, namely, the MG developed by Pesaran and Smith (1995), the PMG developed by Pesaran *et al.* (1999) and the DFE estimator.

2.2 The pooled mean group estimator

The main characteristic of PMG is that it allows short run coefficients, including the intercepts, the speed of adjustment to the long-run equilibrium values and error variances to be heterogeneous country by country, while the long-run slope coefficients are restricted to be homogeneous across countries. This is particularly useful where there are reasons to accept that the long-run equilibrum relationship between the variables is similar across countries or at least, a sub-set of them. The short-run adjustment is allowed to be country-specific, due to the widely different impact of the vulnerability of financial crises and external shocks, stabilization policy, monetary policy, etc. However, there are several requirements for the validity, consistency and efficiency of this methodology.

2.3 The mean group estimator

The MG technique introduced by Pesaran and Smith (1995) calls for estimating separate regressions for each country and calculating the coefficients as invariants means of the estimated coefficients for the individual countries. This does not impose any restrictions. It allows for all coefficients to vary and be heterogeneous in the long-run and short-run. However, the necessary condition for the consistency and validity of this approach is to have a sufficiently large time series dimension of the data.

2.4 The dynamic fixed effect estimator

The DFE estimator is very similar to the PMG and imposes restrictions on the slope coefficient and error variances to be equal across all countries in the long-run. The DFE model further restricts the speed of adjustment coefficient and the short run coefficient to be equal too. However, the model features country-specific intercepts. DFE has a cluster option to estimate intra-group correlation with the standard error (Blackburne and Frank, 2007).

3. Empirical findings

3.1 Stationarity tests

Before proceeding with the estimation of the ARDL model as a panel, it is necessary to study the stationarity of the variables for the global sample. If the series are I(0), then the autoregressive vector (VAR) model is estimated and the dynamics are in the short-run. However, when the series are (I (0) and I (1)) or they are (I (1)), then we estimate the panel ARDL model as considering the series in level. Table 1 reports the results of stationarity tests using various types of tests, namely, the augmented

Table 1.
Stationarity for each variable

Variables	Fisher-type tests								IPS test				Hadri-LM
	Fisher-ADF statistic				Fisher-PP statistic								
	P	Z	L*	Pm	P	Z	L*	Pm	*t*-bar	*t*-tilde-bar	Z-*t*-tilde-bar	W-*t*-bar	*z*
GDPper capita	202.6674*	−11.5662*	−14.5066*	22.2913*	221.3604*	−11.9751*	−15.8329*	24.7045*	−4.1019*	−3.1545*	−8.5224*	−10.6548*	−0.2522
(*p*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.5996)
d(GDPpercapita)													2.9328*
(*p*-value)													(0.0017)
ln(FDI)	89.3351*	−5.8603*	−6.1239*	7.6601*	27.3047	0.1731	0.0924	−0.3480	−1.5241	−1.4407	−0.0560	−0.1644	44.8990*
(*p*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.6072)	(0.5687)	(0.5367)	(0.6361)	(0.4777)	(0.4777)	(0.4777)	(0.4347)	(0.0000)
dln(FDI)					335.3995*	−14.8545*	−23.9708*	39.4269*	−4.8462*	−3.3364*	−9.4584*	−11.4534*	
(*p*-value)					(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
ln(TR)	99.0820*	−6.6697*	−6.9526*	8.9185*	55.1164*	−1.9327**	−2.5032*	3.2425*	−1.9643	−1.7373	−1.5213	−2.2096**	38.3547*
(*p*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0034)	(0.0266)	(0.0072)	(0.0006)	(−2.2096)	(−2.2096)	(−2.2096)	(0.0136)	(0.0000)
ODA	163.3270*	−9.3024*	−11.5795*	17.2124*	159.2573*	−7.0288*	−10.6775*	16.6870*	−3.1956*	−2.4862*	−5.2207*	−6.5801*	25.4168*
(*p*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Notes: The *t*-tilde-bar $(\tilde{\boldsymbol{t}} - \boldsymbol{bar}_{NT})$ statistic is similar to the *t*-bar $(\boldsymbol{t} - \boldsymbol{bar}_{NT})$, statistic except a different error variance estimator of the Dickey-Fuller regression is used. A standardized version of the statistic *t*-tilde-bar is $-\boldsymbol{t} - \boldsymbol{tilde} - \boldsymbol{bar}(\boldsymbol{Z}_{\tilde{\boldsymbol{t}}-\boldsymbol{bar}})$. In presence of serial correlation, Dickey-Fuller regression is augmented as follow: $\Delta \boldsymbol{y}_{\boldsymbol{it}} = \boldsymbol{\phi}_{\boldsymbol{i}} \boldsymbol{y}_{\boldsymbol{i},\boldsymbol{t}-1} + \boldsymbol{z}'_{\boldsymbol{it}} \boldsymbol{\gamma}_{\boldsymbol{i}} + \sum_{\boldsymbol{j}=1}^{\boldsymbol{p}} \Delta \boldsymbol{y}_{\boldsymbol{i},\boldsymbol{t}-\boldsymbol{j}} + \boldsymbol{\epsilon}_{\boldsymbol{i},\boldsymbol{t}}$ where $\boldsymbol{p}$ is the number of lags. Im *et al.* (1997) propose thus, another statistic noted $\boldsymbol{W}_{\boldsymbol{t}-\boldsymbol{bar}}$, which follows an asymptotical standard normal distribution when $\boldsymbol{T} \to \infty$ followed by $\boldsymbol{N} \to \infty$; *, ** et *** indicates the significance at 1%, 5% et 10%

dickey fuller (ADF), Phillips perron (PP), Im Pesaran and Shin (IPS) and Hadri-LM tests. In what follows, we will conduct empirical literature regarding these different tests of unit root used. Results indicate the evidence of stationarity to two series in level such as transferts of remittances (TR) and ODA. The GDP per capita and FDI are stationary in the first difference. We can use the panel ARDL model.

3.1.1 Im, Pesaran and Shin test (2003). Im *et al.* (1997) propose a *t*-bar statistic based on the mean of individual ADF statistics to investigate the panel data unit root assumption. The authors claim that their *t*-bar statistic has a more precise size and higher power than the data panel unit root test of Levin and Lin (1993), taking into account residuals heterogeneity and serial correlation between groups. For a sample of *n* observed groups over a period *t*, the unit root regression of the conventional ADF test data Panel is given by:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{it-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta Y_{it-j} + \varepsilon_{it} \forall i = 1 \ldots n \text{ and } \forall t = 1, \ldots, T \tag{4}$$

where Y_{it} is the study variable for the country i during the period t. Δ denotes the first difference operator. α_i, β_i and γ_{ij} are the coefficients to be estimated and ε_{it} is the error term. Im *et al.* (1997) propose to test the null assumption of data Panel unit root as follows:

$$\begin{cases} H_0 : \beta_i = 0 \forall i \\ H_1 : \beta_i < 0 \forall i = 1, 2, \ldots, N_1 \, et \, \forall i = N_1 + 1, N_2 + 2, \ldots, N \end{cases}$$

The equation for the alternate hypothesis allows the coefficient to make the difference between groups and is more general than the homogeneous alternate hypothesis, namely: $H_1 \beta_i \beta_i = \beta < 0 \forall i$

Im *et al.* (1997) propose a standardized *t*-bar statistic given by:($\psi_{\bar{t}}$)

$$\psi_{\bar{t}} = \sqrt{n} \left\{ \frac{\bar{t}_{nT} - (1/n) \sum_{i=1}^{n} E\left[t_{i,T}(p_i, 0) | \beta_i = 0\right]}{\sqrt{1/n \sum_{i=1}^{n} Var\left[t_{i,T}(p_i, 0) | \beta_i = 0\right]}} \right. \tag{5}$$

Where $\bar{t}_{nT} = \frac{1}{N} \sum_{i=1}^{n} E\left[t_{i,T}(p_i,) \beta_i\right)$ and $t_{i,T}$ $(p_i) \beta_i)$ is the individual *t* statistic to test the null assumption $\beta_i = 0 \; \forall$ i. Noting that: $E[t_{i,T}(p_i,0) | \beta_i = 0]$ and Var $[t_{i,T}$ $(p_i,0) | \beta i = 0]$ are reported in Table 2 of Im *et al.* (1997). As $E[t_{i,T}(p_i,0) | \beta_i = 0]$ and Var Var $[t_{i,T}$ $(p_i,0) | \beta i = 0]$ vary when ADF regression lag length varies. In practice, we use the same lag length in all the individual ADF regressions. Under the null assumption, the standardized statistic $\psi_{\bar{t}}^{-}$ is asymptotically standard distributed $\psi_{\bar{t}} \sim N(0, 1)$.

Im *et al.* (1997) used a Monte Carlo simulation and find better performance of finite samples for the statistic $\psi \bar{t}$ compared to the Levin and Lin (1993) test. If the variables are characterized by common trends, the individual ADF regression errors could be simultaneously correlated. The error term ε_{it} is supposed to be composed of two random components:

$$\varepsilon_{it} = \theta_t + \vartheta_{it} \tag{6}$$

With θ_t a common specific individual and stationary effect taking into account one dependence degree between groups. ϑ_{it} represents an idiosyncratic (specific) random effect independently distributed between groups. According to Im *et al.* (1997), simultaneous

Table 2.
The optimal lag selection

Variables	GDP per capita	Ln(FDI)	lnTR	ODA
		ARDL (p, q, q, q)		
Countries				
Algeria	1	2	1	0
Argentina	1	1	0	1
Bangladesh	2	2	0	0
Botswana	1	2	0	2
Brazil	1	2	0	0
Burkina Faso	1	0	1	0
Cameron	2	2	0	0
Costa Rica	2	1	2	0
El Salvador	2	2	0	1
Guinea-Bissau	1	0	0	0
Tunisia	1	2	1	0
Morocco	1	1	0	2

correlations of errors from individual ADF regressions can affect the critical values and the power of data Panel unit root tests.

3.1.2 Maddala and Wu (1999) test. The Fisher test developed by Maddala and Wu (1999) highlights the *P*-values from to $P_\lambda \rho_i$ from the ADF regression for each of the ADF regressions, which are derived from the following equation:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{it-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta Y_{it-j} + \varepsilon_{it} \forall i = 1 \ldots n \ \forall t = 1, \ldots, T \tag{7}$$

The Maddala and Wu (1999) test is not parametric and is based on Fisher's (1932) work. Furthermore, this test is similar to the Im *et al.* (1997) test because it takes into consideration the different first-order autoregression correlations and has the same assumptions (null and alternate) in the estimation procedure. The Fisher test statistic $P(\lambda)$ is given as follow:

$$P(\diagdown) = -2 \sum_{i=1}^{n} \ln(\pi_i) \tag{8}$$

where π_i is the test statistic *P*-value for the individual i. The Fisher test statistic $P(\lambda)$ follows a χ^2 (2n) statistic law. Maddala and Wu (1999) show that the Fisher test type has a more precise size and higher power compared to the test of Levin and Lin (1993). The Fisher test advantage is that it allows the use of the different lags in the individual ADF regressions, although the Im *et al.* (1997) test requires the same individual regressions lag length.

According to Banerjee (1999) and Maddala and Wu (1999), the Fisher test is very useful in practice, as it reduces bias caused by the optimal lag selection procedure. Furthermore, there are three other statistics used to test the null assumption stipulating that each panel contains unit roots.

$$Z = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \Phi^{-1}(p_i) \rightarrow N(0,1) \tag{9}$$

Where $\Phi^{-1}(.)$ the inverse of the standard normal function distribution.

$$L^{*} = \sqrt{\frac{3(5N+4)}{\pi^{2}N(5N+2)}}\sum_{i=1}^{N}\ln\left(\frac{p_i}{1-p_i}\right) \rightarrow t(5n+4) \quad (10)$$

Under the null assumption, if $T \rightarrow \infty$ then by $N \rightarrow \infty$, the statistic P tends toward infinity. Thus, Choi (2001) proposed a modified χ^2 noted P_m, which converges to a standard normal distribution (N(0,1)).

$$P_m = -\frac{1}{\sqrt{N}}\sum_{i=1}^{N}\left[\ln(p_i)+1\right] \rightarrow N(0,1) \quad (11)$$

3.1.3 Hadri LM test (2000). The Hadri (2000) LM test uses panel data to test the null hypothesis that the data are stationary versus the alternate that at least one panel contains a unit root. The test is designed for cases with large T and moderate N. The motivation for the test is straightforward. Suppose we include a panel-specific time trend (using the trend option with xtunitroot hadri) and write our series, y_{it}, as:

$$y_{it} = r_{it} + \beta_i t + \varepsilon_{it} \quad (12)$$

where r_{it} is a random walk.

$$r_{it} = r_{i,t-1} + \mu_{it} \quad (13)$$

3.2 The optimal lag selection

In this work, we try to determine the optimal lag number of the model ARDL (p, q, q, q). Subsequently, we try to interpret the results of the different estimators, namely, the MG, the PMG and the DFE. The optimal lags for the global sample of countries are reported in Table 2. The most common lags between countries are chosen. Specifically, we choose the most frequent number for all countries and for each variable used by referring to the AIC criterion. The ARDL (1, 2, 0, 0) is chose.

Table 3 reports the cointegration test results. We note that the different statistics are significant and greater than 1.96 in absolute value. So there is a cointegrating relationship.

Table 4 reports the results of the short-run and long run effects of FDI, remittances and official development assistance on economic growth using three estimators, namely, MG, PMG and DFE.

The results of the estimates confirm the existence of a long run relationship, as the adjustment coefficient (error correction parameter) is negative and statistically significant at the 1%. The Hausman test makes it possible to check the hypothesis of homogeneity of the long run coefficients. We find that the PMG estimator is more consistent and more efficient.

Test stats	Panels	Group
v	1.857	
rho	−4.039	−2.899
t	−8.685	−9.961
ADF	−6.93	−7.08

Table 3.
Cointegration test

Table 4.
MG, PMG and DFE estimators: empirical results

Variables	GDP per capita (dependent variable) MG	PMG	DFE
Long-run coefficients			
ln(FDI)	−0.0417 (0.9540)	0.0141 (0.9320)	0.0851 (0.6790)
ln(TR)	0.5424 (0.2270)	0.1496 (0.4127)	0.3180*** (0.0680)
ODA	7.4358 (0.2670)	0.0017 (0.8154)	−0.0106 (0.7410)
Hausman test	1.25 (0.7404)	0.57 (0.9041)	
ECM	−0.8375*	−0.8907*	−0.8897*
Phi	(0.0000)	(0.0000)	(0.0000)
Short-run coefficients			
Dln(FDI)	−2.8971* (0.0060)	−2.3785* (0.0041)	−1.4197* (0.0000)
Dln(TR)	−2.1892* (0.0040)	−1.6741** (0.0250)	−1.3900* (0.0000)
D(ODA)	−7.1798 (0.1970)	−8.5894 (0.1170)	−0.0452 (0.1340)
Constante	2.6892 (0.1410)	1.7444* (0.0000)	1.8983* (0.0000)

Note: *, ** and *** indicates the significance at 1%, 5% and 10%

Indeed, according to the Hausman test that allows choosing on the one hand between the MG and PMG and on the other hand between the PMG and the DFE, we note that this test is statically insignificant. Therefore, we focus in our interpretation on the PMG estimator that allows analyzing the long run effects.

The results show that the overall sample, even if, in the short-run, foreign direct investment do negatively affect economic growth, the effect is insignificant in the long-run. This result implies that a 1% increase in FDI leads to a 2.3785% decrease in economic growth, which means that FDI inflows in developing countries in particularly middle income countries disadvantage economic growth. This result can be explained by the fact that FDI inflows can force the closure of some small firms, due to competitive pressure or the removal of planned investments. This result is consistent with several previous studies on FDI – economic growth linkages (Kumar and Pradhan, 2002; Morrissey and Udomkerdmongkol, 2012). These results contradict the results found by Alguacil *et al.* (2011), Javaid (2017), Baiashvili and Gattini (2020).

On the other hand, even if, in the short-run, migrant remittances crowd out economic growth, the effect is not significant in the long-run. These findings imply that in the long-run, remittances have no significant effect on economic growth. Our results are consistent with those of Chami *et al.* (2010), Fenny *et al.* (2014) and Lim and Simmons (2015). However, transfers have a negative effect on economic growth in the short-run. In the short-run, a 1% increase in remittances results in a 1.6741% decrease in economic growth, which means that remittance inflows in developing countries are detrimental to economic growth. In addition, the results suggest that the effect of official development assistance is insignificant; both in the long-run and in the short-run. This result is consistent with some previous studies (Adedokun, 2017). This result is no in line with that of Das and Sethi (2019).

4. Conclusion and policy implications

The main objective of this article is to examine the interaction between three financial flows such as foreign direct investment, official development assistance, personal remittances and economic growth. We apply the panel ARDL model to analyzes the short-run and the long-run effect for each financial flow on economic growth. We consider a panel of developing countries in particular middle income countries. The period span from 1990 to 2017. Results

confirm the existence of a long run relationship because the adjustment coefficient (error correction parameter) is negative and statistically significant. We find that the PMG estimator is more consistent and more efficient. In the short-run, foreign direct investment does negatively affect economic growth, the effect is no significant in the long-run. On the other hand, the effect of remittances on economic growth is significant in the short-run. However, it is no significant in the long-run. Finally, the results suggest that the effect of official development assistance on economic growth is insignificant; both in the long-run and in the short-run. Foreign direct investments are sources of long run financing. However, the effect of FDI on economic growth is insignificant in the long-run. This effect can be explained by the poor restructuring of government strategies of middle income countries to attract foreign investors. The effect of migrant funds is insignificant in the long-run. The effect of transfers is significant in the short-run. These private flows are, therefore, distinguished toward short-run household consumption. On the other hand, the effect of migrants' funds is insignificant in the long-run. It is who ensures the transfer of funds to informal channels. The insignificant effect of official development assistance; both long-run and short-run ensures the problem of corruption in middle income countries. This result demonstrated that official development assistance is effective in well-governed countries. However, this result can be explained by the dependence of some developing countries for help. As a result of receiving a lot of help, developing countries, especially the poorest and those with low incomes, have become highly dependent. Economic growth in developing countries has weakened despite massive flows of official development assistance. Official development assistance, therefore pushes developing countries to be linked to the famous "debt trap" (Mallik, 2008).

The international financial flows (FDI, remittances and official development assistance) have insignificant effect on the economic growth of middle income countries in the long-run. Such results urge developing countries governments to put in place economic recommendations according to FDI structure (horizontal or vertical) to encourage foreign and domestic investment. With regard to FDI, developing countries should improve the business environment and establish a facilitating framework for both domestic and foreign investors. Several countries have already taken such measures; however, much remains to be done in this direction. FDI inflows can force the closure of some small businesses, due to competitive pressure or the withdrawal of planned investments. Governments of middle income countries should highlight economic policies taking into account the structure of FDI to crowd out the eviction consequences, which is explained by the dominance of foreign investment in favor of domestic investment and vice versa.

If the effect of remittances on economic growth is no significance, so remittances from migrants are often transferred through informal channels, for example, through friends or family members traveling abroad. In other words, remittances of migrants to developing countries take place through informal channels. This therefore, poses a major challenge for developing countries to develop the financial system in terms of cost and encourage migrants to send their funds through formal channels. It is necessary to provide reliable information to migrants about transfer services and their costs. Developing countries should direct informal transfers to formal transfers to increase the tax base and allow more divestment in the hands of the government, for example, developing official money transfer agencies in all regions including rural areas and lower taxes on foreign currency deposits.

The aid received in developing countries suffers from the problem of corruption. Developing countries, therefore need to improve their governance to better manage the aid received, and thus, increase the economic benefit of aid. In addition, several developing countries are characterized by corruption or mismanagement of foreign aid received and bad

governance. However, in reality, some of these official development assistance funds are diverted for purely personal ends instead of carrying out investment projects due to the low level of savings in some developing countries. Official development assistance therefore, effectively promotes economic growth only in a good political environment. This result proves that developing countries are not well-governed. Ultimately, official development assistance received by some developing countries is intended for humanitarian reasons, including the aim of managing food crises and natural disasters, and therefore, cannot promote economic growth in an effective manner.

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