Qual Quant (2014) 48:2537–2552
DOI 10.1007/s11135-013-9906-5

Exploring the nexus between capital inflows and growth in Latin America and the Caribbean: a study of clusters led by Brazil and Mexico

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Published online: 10 July 2013

Abstract In this paper, we used pooled regression within the ARDL approach and augmented Solow framework to explore the emerging uniformity and polarization in the two clusters led by Brazil and Mexico in Latin America and the Caribbean, adopted from Izquierdo and Talvi http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=35816781, 2011. The results show that effects of capital productivity and official development assistance are predominantly led by Brazil cluster while remittances, foreign direct investment and domestic credit are led Mexico cluster. While ODA is has a negative effect on the region's growth, capital productivity, remittances, domestic credit and foreign direct investment are promising indicators for short-run and long-run growth in the region.

Keywords Personal remittances · FDI · ODA · Financial development · Brazil · Mexico · LAC · Capital inflows · Growth

1 Introduction

The aftermath of recent financial crisis has given a an added impetus to the role of capital inflows such as domestic credits, foreign direct investment (FDI), official development assistance (ODA), and personal remittance as a means of boosting investment, consumption and speeding-up the recovery process. The focus of this paper is Latin America and the Caribbean (LAC) region. Overall, LAC countries receive relatively low levels of inflows. However, when considering individual countries in the region, the levels are apparently varied with high levels for some while low levels for others. Moreover, there are countries within the region with significant similar characteristics.

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Therefore, grouping countries with similar characteristics and exploring the effect of capital inflows will provide some insights into the degree of uniformity and polarization emerging within the region. Subsequently, we subscribe to the cluster grouping of Izquierdo and Talvi (2011) and look at the effects of capital inflows on cluster-specific and regional growth. Brazil-led cluster consists of Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Trinidad and Tobago, Uruguay, and Venezuela; while Mexico-led cluster, consists of Bahamas, Barbados, Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama. In retrospect therefore, these countries operate at different centers of gravity in some areas of economic activities given its geo-economic and political environment while exhibiting some degree of uniformity in others.

The countries within Brazil-led cluster are characterized as net commodity exporters with increasing influence from Asia, particularly China as an outlet for exports; relatively high international trade exposure in goods and services with emerging markets; low dependency on remittances from industrialized countries and a vibrant domestic demand. On the other hand, countries in Mexico-led cluster are characterized as net commodity importers, relatively large recipients of remittances, particularly from United States of America; and high level of commercial opening. Moreover, countries within this cluster are mainly producers of basic commodity with low values. Mexico suffers from decline in competitiveness across the US apparel supply chain and thus not able to maximize its export potential in regional development (Frederick and Gereffi 2011). Amidst these differences, both clusters share a common legacy of issues such as weak education systems, growing income inequality, poor infrastructure, a large informal sector, corruption, obsolete legal and regulatory frameworks, and high cost of doing business (Robles 2011; Thorpe and Sizeland 2010).

The rest of the paper is set out as follows. First provide literature as background information followed by trends and patterns of key economic indicators in the region. Next we discuss data, method and results, and finally, we conclude.

2 A brief literature survey

2.1 Remittances

Remittance inflows refers to private income that is sent from one or more family members living and working abroad back to the remaining family unit in the home country (Chami et al. 2006). Notably, at a global level, over the last four decades, remittances have surpassed official development assistance (ODA) of developing countries and have been growing substantially and steadily from US$22 billion in 1985–1989 to US$307 billion in 2009 (US$338 billion in 2008)(World Bank 2011). It is argued that when relatively poor families use remittances to increase consumption and capital investment, remittances have pro-growth effects transcending poverty reduction among households and enhancing productive capacities of the economy (Buch and Kuckulenz 2010; Ratha 2007). Remittances have welfare enhancing effect when it supports growth in human capital (education), healthcare needs, entrepreneurial development, and is provided as‘buffer cash’ during economic crisis and natural disasters (De Haas 2005). However, given the high remittances transfer cost through formal channels (such as banking services), in most cases, remitters prefer to send money via informal channels which often include postal mails, visiting migrants or migrant’s relatives and friends, and informal money transfer services (IFTs) (Coxhead and Linh 2010; Irving et al. 2010). The formal channels used by remitters often include Western Union money transfers, bank drafts, and automated teller machines (ATM). It has also been argued that remitter’s job

stability and remittance-sending country's economic performance have significant influence on remittance flows to a receiving country (Maldonado et al. 2011).

2.2 Overseas development assistance (ODA)

The impact of overseas development assistance (ODA) on growth and development is a topic of much debate given the controversial views presented from differences in empirical research. The motivation of foreign aid has generally been modeled in terms of donor self-interest and recipient need, and improving growth and international income distribution (Llavador and Roemer 2001; Maizels and Nissanke 1984; McKinlay and Little 1979; Trumbull and Wall 1994).

It has been noted that per capita income growth rates of previous years have some influence on aid granting decisions of donors. For example, Sobhee and Nath (2007a) show that high-income countries such as Botswana and Mauritius have not benefitted much from external assistance as had low-income countries like Mozambique and Bangladesh. Moreover, many countries had benefitted from project-specific assistance on education, health or human capital formation in their early stages of development because of a relatively larger size of grants at initial stages of development (Sobhee and Nath 2007b).

Various scholars have argued that aid has a positive contributory power towards growth and the magnitude of the impact depends on the recipient countries policy, aid management and accountability, and geopolitical factors (Burnside and Dollar 2000; Collier and Dollar 2002; Minoiu and Reddy 2007). On the other hand, some have counter argued that foreign aid can be harmful or ineffective when donors direct the use of aid to implement their own projects and programs (Banerjee and Rondinelli 2003; Collier and Dollar 2002; Dalgaard 2008; Hansen and Tarp 2000, 2001; Wagner 2008). In all cases, aid management is crucial. It has been also argued that aid mismanagement, which results in most cases when donors give complete control to the recipient country, gives way to corruption, poverty and bureaucracy (Angeles and Neanidis 2009).

2.3 Foreign direct investment (FDI)

The FDI-growth nexus is clearly identified by the neoclassical growth models, which considers technological progress and labor force as exogenous. Noting that long-run growth can only be increased through technological and population growth, FDI therefore plays a critical role. In cases where FDI positively influences total factor productivity TFP, growth advancing effect is realized (Solow 1956). Moreover, contagion effects of FDI is realized through managerial practices and technology transfer (Findlay 1978). Besides the direct increase of capital formation of the recipient economy, foreign direct investment (FDI) may also help to increase growth by introducing new technologies, such as new production processes and techniques, managerial skills, idea, and new varieties of capital goods (Grossman and Helpman 1991; Barro and Sala-i-Martin 1995).

Various studies show that FDI is growth enhancing. Borenztein et al. (1998) use FDI inflows from industrial countries to investigate the impacts on 69 developing countries. Their results suggest that FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment. However, the higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host country. Makki and Somwaru (2004) point out that FDI

can be growth advancing if it results in shifting the production frontier through spillover and technological transfers via diffusion process.

It is also argued that countries with well developed financial markets gain significantly from FDI (Alfaro et al. 2004). In a study, Li and Liu (2005) investigate FDI-growth nexus on a panel data of 84 countries over the period 1970–1999. They conclude that FDI promotes growth directly and indirectly via interaction with human capital.

The impact of FDI on economic growth depends on the role it plays in strengthening domestic linkages in the economy. FDI brings finance and often, technology, new management and market access, and can thus contribute significantly to long-term growth in developing countries. However, in many cases flows go mostly to countries with higher incomes, larger markets, and infrastructure. In this sense, FDI appears to have contributed to growth divergences. Moreover, countries with substantial FDI increases did not necessarily realized high economic growth. For instances, even though all major countries in LAC region and some larger African countries saw higher FDI shares in the 1980s and 1990s, overall investment rates stagnated or declined. Therefore, gains from FDI are equally dependent on domestic firms and institutions absorptive capacities. Countries such as Singapore and Ireland among others made significant investments in building domestic infrastructure and human resources in order to target investors and leverage inward FDI (Ocampo et al. 2007).

Azmani-Saini et al. (2010) investigated the systemic link between freedom, foreign direct investment and economic growth in a panel of 85 countries using generalized method-of-moment system estimator. They found that FDI by itself has no direct positive impact on output growth. However, the effect of FDI is contingent on the level of economic freedom in the host countries. This means the countries that promote greater freedom of economic activities gain significantly from the presence of multinational corporations.

2.4 Financial development (domestic credit)

A growing body of literature has acknowledged the important (dynamic) role of financial sectors in reallocating and mobilizing resources to the most productive investments, diversifying risks and supporting growth of other sectors, which in turn lead to higher economic growth. The discussion on financial and banking sector development has been linked to the advancement of technology the need for stable sources of capital inflows for the sector to realize expansion in credit. Often, three indicators are used to assess financial development. These include: bank credit to the private sector as a percent of GDP, turnover rate of stock market or ratio of shares traded to GDP and the extent of shareholder and creditor protection as part of the legal or regulatory characteristics of financial system (King and Levine 1993a, 1993b; Levine and Zervos 1998).

It is argued that greater financial depth measured by the ratio of financial asset to income is associated with higher levels of productivity and thus per capita income. Financial systems serve multiple objectives in expediting economic activities—they produce information ex ante about possible investments; mobilize and pool savings and allocate capital; monitor investments and exert corporate governance after providing finance; facilitate the trading, diversification and management of risk; and ease the exchange of goods and services (Beck et al. 2000; Greenwood and Jovanovic 1990; King and Levine 1993a; 1993b; Levine and Zervos 1998; McKinnon 1973; Levine 1997). Greater accessibility of financial services to more individuals spreads out risk, which in turn boosts investment activity in both physical and human capital, thus supporting output growth. However, the efficiency of financial services is compromised with suboptimal outcomes in financing and investment activities when there are high degrees of asymmetric information, externalities in financial markets, and imperfect

Table 1 Selected indicators: Latin America and the Caribbean region

Year	GDP per capita (current USD)	Population growth (%)	GDP growth (%)	Inflation rate (%)	Personal remittances (% GDP)	ODA (% GDP)	Net FDI (% GDP)	Domestic credit (% GDP)
1961–1970	465.9	2.69	5.38	3.33	n.a.	0.71	0.43	18.5
1971–1980	1274.8	2.40	5.70	13.46	0.25	0.34	0.59	32.9
1981–1990	2046.6	2.05	1.27	12.28	0.43	0.43	0.75	40.9
1991–2000	3575.0	1.65	3.23	10.18	0.78	0.34	2.42	36.2
2001–2005	3929.5	1.34	2.62	5.82	1.75	0.29	2.96	25.2
2006	5647.6	1.22	5.82	6.97	1.91	0.23	2.30	31.1
2007	6590.3	1.19	5.93	6.65	1.73	0.19	2.98	36.0
2008	7586.1	1.16	4.32	7.79	1.51	0.22	3.01	37.9
2009	6968.7	1.14	−1.80	2.91	1.43	0.23	1.98	38.8
2010	8552.1	1.13	6.22	5.24	1.17	0.23	2.30	40.5

Source World Bank (2011) and author's own calculation

or weak competition resulting in undesirable consequences like bank runs, fraud or credit constraints (Stiglitz and Weiss 1991, 1992). Hence, in order to ensure successful financial liberalization and fostering efficient operations of financial markets, institutional factors such as legal infrastructure, bankruptcy code, accounting norms, disclosure rules and prudential regulations are very important (Aivazian 1998).

The nexus between financial development and growth has been researched widely. For instance, Hassan et al. (2011) find that there has been a positive association between finance and economic growth for developing countries but contradictory results for high-income countries. The consensus of various other studies is that there is a positive correlation between financial development and economic growth despite mixed views on the direction of causality between the two (Khan and Senhadji 2003; Odhiambo 2010; Savvides 1995). Banking sector provides a number of services such as ATM, credit card, funds transfer, cheque payment, funds deposit, balance enquiry, utility bills, statement of account, remittances, draft, pay order, phone banking and mobile banking. However, the actual link of some these services with remittance transfers and broader growth and development dynamics remains much of an untapped expedition.

3 Trends and patterns

This section highlights trends and patterns of key economic variables in the region. We include 11 countries in Brazil-led cluster and 11 countries in Mexico-led cluster. We used aggregate data for forty-two countries representing LAC region as reported by the World Bank database (World Bank 2011).

3.1 LAC region

The LAC region's per capita GDP has been growing since 1960s (Table 1). Per capita GDP grew from US$465.9 (1961–1970) to US$3925.5 (2001–2005) and to a further US$8552.1 (2010). Population growth remained positive, around 1.17 percent since 2006. The GDP growth rate was between 5 and 6 percent since 2006 with exception to 2009, where negative growth of −1.8 percent was recorded. However, much of the positive growth during these

Table 2 Selected indicators: Brazil-led cluster

Year	GDP per capita (current USD)	Population growth (%)	GDP growth(%)	Inflation rate (%)	Personal remittances (% GDP)	ODA (% GDP)	Net FDI (% GDP)	Domestic credit (% GDP)
1971–1980	1339.9	2.1	4.0	33.6	0.3	1.1	0.8	24.4
1981–1990	2113.3	2.0	0.4	63.8	0.3	1.2	1.0	36.0
1991–2000	3349.6	1.6	2.9	24.9	1.1	2.0	3.0	34.3
2001–2005	3584.7	1.3	3.0	9.0	1.7	1.1	2.9	32.1
2006	5319.1	1.2	5.5	8.6	2.3	1.0	3.4	30.6
2007	6299.5	1.2	5.0	8.1	2.2	0.5	3.4	33.4
2008	7668.7	1.1	5.2	11.0	1.9	0.5	4.3	34.7
2009	6946.9	1.1	−0.6	0.2	2.0	0.7	3.0	34.9
2010	8257.3	1.1	5.1	9.7	1.8	0.7	3.1	35.5

Source World Bank (2011) and author's own calculation

periods was also counteracted by high inflation rate. Furthermore, FDI (as a percent GDP) has been growing except for 2009 period, superseding personal remittances and ODA in their respective relative to GDP terms. In spite of the recent financial credit, domestic credit has increased consistently since 1960s. The region has also realized a consistent growth in domestic credit, increasing from 18.5 percent (1961–1970) to 40.5 percent (2010).

3.2 Brazil-led cluster

The per capita income in Brazil-led cluster has increased from US$1399.9 (1971–1980) to US$3584.7 (2001–2005) and further to $8257.3 (2010) (Table 2). Within these periods, countries in the cluster also came out from severe inflation. Inflation rate grew from an average of 33.6 percent in 1971–1980 periods to 63.8 percent in 1981–1990 and later declined to 9.7 percent (2010). The lowest inflation rate recorded in the cluster was in 2009 (0.2 percent) which was largely due to deflation in countries like Bolivia (−2.4 %), Ecuador (−4.5 %), Paraguay (−0.1 %) and Trinidad and Tobago (−28 %). Although population growth remained positive, it has declined from 2.1 percent (1971–1980) to 1.1 percent (2006–2010). Furthermore, except for 2009 where the cluster experienced negative growth (−0.6 %), the rest of the years recorded positive GDP growth, however well below the inflation growth rates.

FDI inflows (% GDP) are relatively high in Brazil-led cluster. FDI over the sample period increased from a mere 0.8 percent (1971–1980) to 3.1 percent (2010), reaching a maximum of 4.3 percent in 2008. Although Brazil-led cluster is a recipient of relatively large FDI flows, the actual impact of this on growth is unclear. ODA is relatively small with respect to the cluster's GDP (0.7 percent in 2010). Remittance on the other hand is oscillating around 2 percent since 1990s. Domestic credit, although increasing gradually, remains below the regional averages, oscillating around 35 percent since 1980s.

3.3 Mexico-led clusters

In Mexico-led cluster (Table 3), the per capita income has increased dramatically from US$932.1 (1971–1980) to US$3843.9 (2001–2005). However, during these periods, high inflation was also evident. Nevertheless, inflation rate subsided from 20.4 percent (1981–1990) to 4.3 percent (2010) and GDP growth has improved from −1.3 percent (2009) to 4.3

Table 3 Selected indicators Mexico-led cluster

Year	GDP per capita (current USD)	Population growth (%)	GDP growth (%)	Inflation rate (%)	Personal remittances (% GDP)	ODA (% GDP)	Net FDI (% GDP)	Domestic credit (% GDP)
1971–1980	932.1	2.4	4.9	10.6	0.8	2.2	1.4	32.0
1981–1990	1753.4	2.1	1.7	30.4	2.1	5.1	1.5	30.0
1991–2000	2785.4	1.9	4.3	13.9	4.0	5.6	2.8	35.1
2001–2005	3843.9	1.6	3.2	5.9	8.3	4.2	4.0	44.1
2006	4669.4	1.6	6.1	5.4	11.6	3.2	5.9	49.2
2007	5091.8	1.6	5.4	6.0	11.9	3.0	5.9	52.3
2008	5514.0	1.6	3.6	7.9	10.2	2.5	6.9	53.0
2009	5231.9	1.6	−1.3	3.0	9.3	2.4	4.9	53.7
2010	5480.6	1.6	4.1	4.3	8.4	2.6	5.0	53.0

Source World Bank (2011) and author's own calculation

percent (2010). Population growth has converged around 1.6 percent per annum. The inflow of personal remittances was higher than FDI and ODA inflows. Remittances (as a percent of GDP) increased from 0.8 percent (1971) to 11.9 percent (2007). Although remittances declined from 2008 onwards, it remained relatively higher than FDI and ODA (as a ratio of GDP). FDI inflows grew over the years (except for a notable decline in 2008–2009 periods). The cluster also experienced an inverted U-shaped trend in aid as it grew from 2.2 percent of GDP (1971–1980) to a maximum of 5.6 percent (1991–2000) and then declined since 2001. Domestic credit has grown remarkable, increasing from 30.0 percent (1981–1990) to above regional average since early 2000.

4 Data, method, and results

4.1 Data

We follow the classification of Brazil-led cluster and Mexico-led cluster from Izquierdo and Talvi (2011) and use augmented Solow (Solow, 1956) framework to construct the model for estimation. We explore the nexus between capital inflows (remittances, ODA and FDI, domestic credit) and per worker income in the two clusters and the region. We use 10 countries for Mexico-led cluster and 10 countries for Brazil-led cluster given that consistent time series data were not available for Bahamas and Trinidad and Tobago, respectively. A total of 20 countries (10 from each cluster) were grouped together to represent LAC region. Although LAC region has a total of 42 countries, because of data limitations, we were not able to include all the countries in the region. Nevertheless, our sample size represents the two clusters and the region relatively well. A summary of country sample used in the analysis is given in Table 4.

In the conventional Solow model, in order to measure output, the role of capital and labor stock is used as the primary input are all other variables are included as augmented perimeters (Rao 2010). Moreover, capital stock data are not readily available and therefore we used the perpetual inventory method to compute the capital stock with depreciation rate as of 4 percent for each country and the initial capital stock, K_0, was assumed to be 1.5 times the initial year of the real GDP of respective countries. Therefore, capital stock, K_t, is defined as $K_t = (1-\delta)K_{t-1} + I_t$, where δ is the depreciation rate and I_t is the real investment proxied

Table 4 Country samples used in the analysis

Mexico cluster			Brazil cluster		
Country	Year	Sample size	Country	Year	Sample size
Barbados	1991–2010	20	Argentina	1978–2010	33
Belize	1984–2010	27	Bolivia	1976–2010	35
Costa Rica	1977–2010	34	Brazil	1975–2010	36
Dominican Rep.	1970–2010	41	Chile	1983–2010	28
El Salvador	1976–2010	35	Colombia	1970–2010	41
Guatemala	1977–2010	34	Ecuador	1986–2010	25
Honduras	1974–2010	37	Paraguay	1975–2010	36
Mexico	1979–2010	32	Peru	1990–2010	21
Nicaragua	1977–2010	34	Uruguay	1980–2010	31
Panama	1980–2010	31	Venezuela	1985–2010	26
LAC Grouped	1979–2010	32			

Source Cluster arrangement was adapted from Izquierdo and Talvi (2011) and data sourced from World Bank (2011)

by gross fixed capital formation at constant prices. Labor stock data was estimated using average annual employment to population. All data were sourced from *World Development Indicators and Global Development Finance* database issued by the World Bank (2011). We transformed the data into log forms before pursuing the regression analysis.

4.2 Method

In terms of model specification, we used the conventional Cobb-Douglas production function, with the Hicks–neutral technical progress which assumes that output grows at the same rate equal to the rate of growth of the labor force plus the rate of technical progress. Hence, the per worker output (y_t) is defined as:

$$y_t = A_t k_t^{\alpha}, \quad 0 < \alpha < 1 \tag{1}$$

where A stock of technology and k capital per worker, and α is the profit share.

The Solow model assumes that the evolution of technology is given by

$$A_t = A_0 e^{gT} \tag{2}$$

where A_0 is the initial stock of knowledge and T is time.

We extend the model by including the shift parameters (Rao 2010) and define A_t as follows:

and

$$A_t = f(T, lrem_t, loda_t, lfdi_t, lcred_t) \tag{3}$$

where

$lrem_t$ natural log of personal remittances as a percent of GDP;
$loda_t$ natural log of net official development aid as a percent of GDP;
$lfdi_t$ natural log of net foreign direct investment as a percent of GDP; and
$lcred_t$ natural log domestic credit to private sectors as a percent of GDP.

The effects of $lrem_t$, $loda_t$, $lfdi_t$, and $lcred_t$ on total factor productivity (*TFP*) can be captured when these variables are entered as shift parameters in the production function. The data is set in a panel and ARDL procedure is applied to estimate the short-run (first-difference) and long-run effects. Before exploring the long-run and short-run relationship, it is incumbent that we find the existence of cointegration relationship. However, the ARDL bounds approach has no prescribed test for cointegration of panel data. Noting this limitation, we pursued to investigate cointegration of variables for individual countries in the panel. It is assumed that if all the individual countries in the panel have the desired cointegrated vector, then this can be generalized for the panel as well.

Although, in the ARDL bounds testing approach, pre-testing of unit roots is not required and it is possible to investigate cointegration of the levels of the variables, irrespective of their order (Pesaran et al. 2001), we carried out the unit root test to ensure the order of variables are at most integrated of order 1 (Table 5).

Subsequently, we examined the cointegration for each country used in the sample. The key specification is as follows:[1]

$$\begin{aligned}\Delta ly_t = {} & \beta_{10}+\beta_{11}ly_{t-1}+\beta_{12}lk_{t-1}+\beta_{13}lrem_{t-1}+\beta_{14}loda_{t-1}+\beta_{15}lfdi_{t-1}+\beta_{16}lcred_{t-1} \\ & +\sum_{i=1}^{p}\alpha_{11i}\Delta ly_{t-i}+\sum_{i=0}^{p}\alpha_{12i}\Delta lk_{t-i}+\sum_{i=0}^{p}\alpha_{13i}\Delta lrem_{t-i}+\sum_{i=0}^{p}\alpha_{14i}\Delta loda_{t-i} \\ & +\sum_{i=0}^{p}\alpha_{15i}\Delta lfdi_{t-i}+\sum_{i=0}^{p}\alpha_{16i}\Delta lcred_{t-i}+\varepsilon_{1t} \qquad (4)\end{aligned}$$

There are two steps in examining the long-run relationship. First, equation (4) is estimated by ordinary least squares (OLS) technique. Second, for each equation, the existence of a long-run relationship is traced by imposing a restriction on all estimated coefficients of lagged level variables equating to zero. Based on the F-statistics, we therefore test the following hypothesis:

$H_0 : \beta_{i1} = \beta_{i2} = \beta_{i3} = \beta_{i4} = \beta_{i5} = 0 = \beta_{i6} = 0$ (Null: existence of no cointegration)

$H_1 : \beta_{i1} \neq 0; \beta_{i2} \neq 0; \beta_{i3} \neq 0; \beta_{i4} \neq 0; \beta_{i5} \neq 0; \beta_{i6} \neq 0$ (Alternative: existence of long-run cointegration)

4.3 Cointegration results

The results are reported in Table 6 which confirms that in all countries, there is presence of cointegration relationship amongst the variables when real output per worker (y_t) is set as the dependent variable. This is concluded when the computed F-statistics for respective countries exceeded the upper bound critical value at least at 5 percent level of significance. The results are reported in Table 6, which shows that all countries in the sample exhibited cointegration when output per worker is set as dependent variable, at least at 5 percent level of significance.

[1] Note that cointegration relationship was examined for all variables by setting Δly_t, Δlk_t, $\Delta lrem_t$, $\Delta loda_t$, $\Delta lfdi_t$, and $\Delta lcred_t$ as dependent variable, respectively. However, only the key specification (4) is given where Δly_t is set as dependent variable to conserve space.

Table 5 Unit root test results

Country	ly_t	Δly_t	Lk_t	ΔLk	$Lrem_t$	$\Delta Lrem_t$	$Lfdi_t$	$\Delta Lfdi_t$	$Loda_t$	$\Delta Loda_t$	$Lcred_t$	$\Delta Lcred_t$
Bahamas	−1.58	-5.49^{A}	−2.14	-6.45^{A}	NSD							
Belize	−2.66	-4.13^{B}	−2.66	-4.13^{B}	−2.43	-3.98^{A}	−2.36	-6.80^{A}	-3.46^{C}	-7.53^{A}	-4.44^{A}	-4.24^{A}
Costa Rica	−3.13	-4.73^{A}	-3.25^{C}	-3.82^{A}	−2.53	-6.15^{A}	-4.93^{A}	-8.59^{A}	1.23	-4.21^{A}	−1.19	-3.70^{A}
Dominican Rep.	−0.90	-4.37^{A}	-3.28^{C}	-2.71^{C}	-3.48^{C}	-8.43^{A}	-3.13^{B}	-8.66^{A}	−2.97	-7.86^{A}	−3.62	-7.40^{A}
El Salvador	−2.60	-2.85^{C}	−0.33	-4.56^{A}	-5.25^{A}	-8.87^{A}	-2.81^{A}	-7.71^{A}	−2.40	-4.81^{A}	−1.81	-5.98^{A}
Guatemala	−3.11	-2.88^{C}	-3.66^{B}	-3.23^{B}	−2.60	-6.62^{A}	-3.72^{A}	-4.61^{A}	−2.12	-4.62^{A}	−2.01	-6.04^{A}
Honduras	−1.44	-4.22^{A}	−2.44	-3.09^{B}	−2.01	-5.69^{A}	-3.79^{B}	-4.56^{A}	−1.39	-9.88^{A}	−1.45	-4.84^{A}
Mexico	−2.10	-5.44^{A}	−0.46	-4.91^{A}	−2.56	-9.84^{A}	−2.40	-6.91^{A}	−1.31	-4.53^{A}	−1.64	-4.97^{A}
Nicaragua	−2.53	-3.25^{B}	−1.73	-1.71^{C}	−2.05	-5.88^{A}	-5.06^{A}	-15.06^{A}	−2.33	-5.26^{A}	−2.04	-7.49^{A}
Panama	−1.83	-3.24^{B}	−1.79	-3.78^{A}	−1.84	-6.63^{A}	−2.56	-5.83^{A}	−2.25	-4.82^{A}	-4.12^{B}	-3.98^{A}
Argentina	−1.41	-4.80^{A}	−2.72	-2.68^{C}	−0.81	-4.62^{A}	-3.31^{C}	-6.46^{A}	−2.37	-7.60^{A}	−2.22	-5.91^{A}
Bolivia	−1.45	-2.99^{B}	−0.98	-1.93^{C}	−2.19	-5.84^{A}	−1.86	-2.85^{C}	−2.02	-6.20^{A}	−0.99	-4.07^{A}
Brazil	-3.93^{B}	-4.25^{A}	0.22	-3.22^{A}	−1.21	-4.11^{A}	−2.20	-6.60^{A}	-4.71^{A}	-7.78^{A}	−2.53	-5.96^{A}
Chile	-3.58^{B}	-4.43^{A}	−2.06	-3.61^{B}	−2.29	-6.04^{A}	−2.56	-5.59^{A}	−1.85	-4.46^{A}	−0.43	-3.71^{B}
Columbia	-3.46^{C}	-4.33^{A}	−2.26	-3.60^{B}	−2.91	-5.58^{A}	-3.48^{C}	-6.89^{A}	−2.62	-7.90^{A}	−2.18	-6.21^{A}
Paraguay	−2.50	-3.45^{B}	-3.30^{C}	-3.82^{B}	−1.61	-4.74^{A}	−1.93	-6.38^{A}	-3.40^{C}	-8.62^{A}	−1.09	-4.93^{A}
Peru	−0.92	-3.86^{A}	-3.49^{C}	-2.94^{B}	-3.69^{B}	-2.68^{C}	−1.76	-3.69^{B}	-4.47^{B}	-5.13^{A}	-3.53^{C}	-3.43^{B}
Trinidad and Tobago	1.19	-1.96^{B}	-3.56^{B}	-3.57^{C}	NSD							
Uruguay	−2.35	-3.15^{B}	-4.45^{A}	-2.86^{C}	−1.34	-3.61^{B}	-4.19^{B}	-5.69^{A}	-9.28^{A}	-7.33^{A}	-5.94^{A}	-2.91^{C}
Venezuela	−1.57	-4.88^{A}	-3.23^{C}	-2.76^{C}	−2.13	-5.01^{A}	−1.38	-4.75^{A}	-4.97^{A}	-7.15^{A}	−1.85	-3.66^{B}
Brazil-led cluster	-2.59^{C}	-19.60^{A}	−2.38	-19.02^{A}	−2.72	-14.81^{A}	−1.02	-12.97^{A}	−2.74	-13.85^{A}	−2.09	-15.18^{A}
Mexico-led cluster	-2.89^{B}	-18.08^{A}	-2.82^{C}	-18.21^{A}	−0.78	-12.05^{A}	−0.94	-15.22^{A}	−0.47	-17.50^{A}	−1.89	-16.64^{A}
LAC region: panel	-3.24^{B}	-23.20^{A}	-4.05^{A}	-18.57^{A}	−0.96	-29.10^{A}	-5.26^{A}	-12.89^{A}	-11.02^{A}	-14.25^{A}	−2.02	-19.87^{A}
LAC region: group	−2.01	-4.23^{A}	−1.14	-3.06^{A}	−1.58	-4.74^{A}	−1.06	-2.06^{B}	−2.02	-7.12^{A}	−2.31	-8.53^{A}

The ADF critical values are based on Mackinnon (1996). The optimal lag is chosen on the basis of Akaike Information Criterion (AIC) and reviewing the trend. The null hypothesis for both ADF tests is a series has a unit root (non-stationary). A, B, and C denotes the rejection of the null hypothesis of unit root at 1, 5 and 10 % level of significance respectively. *NSD* not sufficient data

Table 6 Cointegration results from bounds tests for each country

Country/Region	y_t	k_t	REM_t	ODA_t	FDI_t	FIN_t
Mexico-led cluster						
Bahamas	NSD					
Barbados	9.25^{A}	0.58	3.54^{C}	5.30^{A}	2.65	3.84^{B}
Belize	7.18^{A}	7.18^{A}	4.00^{B}	1.56	2.00	2.33
Costa Rica	11.08^{A}	8.55^{A}	2.14	2.19	3.38	4.29^{B}
Dominican Rep.	5.45^{A}	12.74^{A}	1.36	4.96^{A}	1.84	2.73
El Salvador	24.63^{A}	6.04^{A}	1.43	8.55^{A}	1.60	0.41
Guatemala	5.36^{A}	3.60	2.48	1.13	1.43	3.45
Honduras	15.08^{A}	3.17	1.92	2.11	3.46	4.89^{A}
Mexico	5.32^{A}	13.46^{A}	3.56	1.68	2.99	1.03
Nicaragua	8.57^{A}	4.89^{A}	3.22	7.50^{A}	1.65	1.62
Panama	62.15^{A}	1.15	0.80	1.27	11.80^{A}	0.91
Brazil-led cluster						
Argentina	5.37^{A}	6.70^{A}	0.90	3.62	2.97	2.10
Bolivia	17.94^{A}	6.11^{A}	1.31	0.87	2.83	3.68
Brazil	8.67^{A}	5.42^{A}	1.19	7.98	1.92	1.55
Chile	7.50^{A}	4.24^{B}	5.75^{A}	3.67	2.02	2.56
Colombia	5.21^{A}	4.54^{B}	3.72	3.94^{B}	1.31	27.46^{A}
Ecuador	5.20^{A}	1.44	2.56	2.65	2.01	2.17
Paraguay	6.09^{A}	18.03^{A}	1.92	0.98	2.67	2.05
Peru	75.56^{A}	9.87^{A}	0.88	2.14	5.71^{A}	6.92^{A}
Trinidad and Tobago	NSD					
Uruguay	5.81^{A}	8.68^{A}	2.89	2.36	4.86^{A}	11.94^{A}
Venezuela	8.82^{A}	10.31^{A}	5.74^{A}	9.94^{A}	2.20	6.27^{A}
Mexico cluster	9.00^{A}	10.95^{A}	2.66	1.11	1.12	1.84
Brazil cluster	4.87^{A}	7.58^{A}	1.32	0.65	0.27	0.33
LAC panel	7.51^{A}	8.68^{A}	11.86^{A}	1.76	1.20	1.52
LAC aggregate	17.53^{A}	9.58^{A}	4.57^{B}	2.03	2.93	4.11^{B}
Pesaran et al. (2001)						
Unrestricted intercept and no trend [k = 5]						
Critical value	Lower bound value			Upper bound value		
1 %	3.41			4.68		
5 %	2.62			3.79		

Critical values are obtained from Pesaran et al. (2001), Table CI.(iii): Case III with unrestricted intercept and no trend, p. 300. The null hypothesis of no co-integration is rejected at A = 1 % and B = 5 %; levels of significance respectively. *NSD* not sufficient data for one or more variables. *Source* Author's own calculation

4.4 Short-run effects

In the short run results obtained from the first-difference estimation (Table 7), the capital productivity share is positive and relatively larger in Mexico-led cluster relative to Brazil-led cluster and the region. Brazil-led cluster has a short-run capital productivity share of 0.08 percent ($\Delta lk_t = 0.083$) which is very close the region's share of 0.09 percent ($\Delta lk_t = 0.088$) while Mexico-led cluster has a capital share of 0.75 percent ($\Delta lk_t = 0.751$). The trend variable was statistically not significant in LAC when estimating the effects of capital inflows and therefore we did not include the trend variable during the estimation.

Remittances share from the first-difference estimation (short-run) is −0.14 percent (negative) for Brazil-led cluster ($\Delta lrem_t = -0.136$) and −0.03 percent (negative) for the region ($\Delta lrem_t = -0.028$). One the other hand, remittances share is 0.06 percent (positive) for

Table 7 Short run coefficients and error correction representation based on Akaike information criterion

Brazil cluster (Δly_t)			Mexico cluster (Δly_t)			LAC region (Δly_t)		
Regressor	Coefficient	t-ratio	Regressor	Coefficient	t-ratio	Regressor	Coefficient	t-ratio
Δlk_t	0.0833	3.45^{A}	Δlk_t	0.7508	21.95^{A}	Δlk_t	0.0875	3.92^{A}
$\Delta lrem_t$	−0.1363	-10.91^{A}	$\Delta lrem_t$	0.0568	6.37^{A}	$\Delta lrem_t$	−0.0281	-3.57^{A}
$\Delta loda_t$	−0.1299	-14.55^{A}	$\Delta loda_t$	−0.0889	-9.51^{A}	$\Delta loda_t$	−0.2487	-21.98^{A}
$\Delta lfdi_t$	−0.0028	-0.13^{NS}	$\Delta lfdi_t$	0.0578	4.96^{A}	$\Delta lfdi_t$	0.0629	4.09^{A}
$\Delta lcred_t$	−0.1099	-3.13^{A}	$\Delta lcred_t$	0.2067	8.44^{A}	$\Delta lcred_t$	0.1905	6.36^{A}
C_t	6.2854	10.12^{A}	C_t	−0.8849	-2.14^{B}	C_t	3.6414	9.47^{A}
Trend	0.0027	6.81^{A}	*Trend*	−0.0021	-9.50^{A}	ect_{t-1}	−0.6439	-17.37^{A}
ect_{t-1}	−0.8868	-14.78^{A}	ect_{t-1}	−0.7007	-14.17^{A}			
R^2		0.90	R^2		0.96	R^2		0.71
$\bar{R}^2$		0.89	$\bar{R}^2$		0.96	$\bar{R}^2$		0.70
DW-statistics		2.00	*DW-statistics*		2.27	*DW-statistics*		1.97
ARDL		1,1,1,1,1,1	*ARDL*		1,1,0,1,1,1	*ARDL*		1,0,1,1,1,1
N		312	*N*		325	*N*		637

A, B, and C indicates 1, 5, and 10 % level of significance respectively; *NS* not statistically significant

Table 8 Long run coefficients: using the ARDL approach based on Akaike information criterion

Brazil led cluster (ly_t)			Mexico-led cluster (ly_t)			LAC region (ly_t)		
Regressor	Coefficient	t-ratio	Regressor	Coefficient	t-ratio	Regressor	Coefficient	t-ratio
lk	0.1207	3.02^{A}	*lk*	0.9061	12.60^{A}	*lk*	0.1360	3.76^{A}
lrem	−0.1307	-6.88^{A}	*lrem*	0.0811	6.10^{A}	*lrem*	0.0607	3.65^{A}
loda	−0.1209	-7.29^{A}	*loda*	−0.0377	-1.82^{C}	*loda*	−0.2493	-9.63^{A}
lfdi	−0.0588	-1.87^{C}	*lfdi*	0.0434	1.98^{B}	*lfdi*	0.0114	0.37^{NS}
lcred	−0.2539	-4.43^{A}	*lcred*	0.5320	9.62^{A}	*lcred*	0.3859	4.85^{A}
C	7.0875	16.94^{A}	*C*	−1.2629	-2.03^{B}	*C*	5.6549	14.65^{A}
Trend	0.0031	8.11^{A}	*Trend*	−0.0029	-8.71^{A}			

A, B, and C indicates 1, 5, and 10 % level of significance respectively; *NS* not statistically significant

Mexico-led cluster ($\Delta lrem_t = 0.057$). Given the negative effects of remittances in Brazil-led cluster and the overall region, we conclude that although remittances share is relatively larger for Mexico-led cluster, the effects of remittances in the region are dominated by Brazil-led cluster. Therefore, improving remittance infrastructure in Brazil-led cluster is likely to have a significant positive spillover effect on the region.

Official development assistance (ODA) share is negative all across. In the Brazil-led cluster the ODA share is −0.13 percent ($\Delta loda_t = -0.129$), in Mexico-led cluster, the share is −0.09 percent ($\Delta loda_t = -0.089$) and in the region, the share is −0.25 percent ($\Delta loda_t = -0.249$). Interestingly, the (negative) effects of ODA in LAC region are relatively larger than both Brazil-led and Mexico-led clusters which nevertheless have negative effects. Therefore, the negative effects of ODA in both the clusters have a reinforcing negative influence on the region's output.

Foreign direct investment (FDI) is marginally negative and not statistically significant for Brazil-led cluster. In Mexico-led cluster, FDI share is 0.06 percent ($\Delta lfdi_t = 0.058$) which is very close to the regional share ($\Delta lfdi_t = 0.063$). Therefore, we assert that FDI share is driven by Mexico-led cluster.

The effect of domestic credit to private sectors is negative in Brazil-led cluster and positive in Mexico-led cluster and the region. In Brazil-led cluster, financial development share is −0.11 percent ($\Delta lcred_t = 0.109$); in Mexico-led cluster, the share is 0.21 percent ($\Delta lcred_t = 0.207$); and in the region, the share is 0.19 percent ($\Delta lcred_t = 0.191$). Subsequently, Mexico-led cluster has a dominating effect from financial development in the region.

Finally, in all three cases (Brazil-led cluster, Mexico-led cluster, and the region), the error-correction term (ect_{t-1}) have correct (negative) signs and show relatively speedy convergences to long-run equilibrium. (Brazil-led cluster: $ect_{t-1} = -0.887$; Mexico-led cluster: $ect_{t-1} = -0.700$; LAC: $ect_{t-1} = -0.644$).

4.5 Long-run effects

From the long run results (Table 8), capital share for Brazil-led cluster is 0.12 percent ($lk = 0.121$), Mexico-led cluster is 0.91 percent ($lk = 0.906$) and the region is 0.14 percent ($lk = 0.136$). Notably, Brazil-led cluster's capital share is very close to the region's share, thus indicating the dominance of Brazil-led cluster in driving capital productivity. Remittances share is negative (−0.13 percent) in Brazil-led cluster ($lrem = -0.131$). However, the effect of remittances is positive in Mexico-led cluster and the region, In Mexico-led cluster,

remittance share is 0.08 percent ($lrem = 0.081$) and in the region, the share is 0.06 percent ($lrem = 0.061$).

The share of ODA is negative in both clusters and the region. Notably, ODA share in Brazil-led cluster is −0.12 percent ($loda = -0.121$); in Mexico-led cluster, the share is −0.04 percent($loda = -0.038$); and in the region, the share is −0.25 percent ($loda = -0.249$).

Foreign direct investment (FDI) share is negative for Brazil-led cluster and positive for Mexico-led cluster. On the other hand, although FDI coefficient is positive, it is not statistically significant within the desired 1–10 percent levels of significance. The Brazil-led cluster share is −0.06 percent ($lfdi = -0.059$); Mexico-led cluster is 0.04 percent ($lfdi = 0.043$); and the region is 0.01 percent ($lfdi = 0.011$).

Domestic credit share is negative for Brazil-led cluster but positive for Mexico-led cluster and the region. In Brazil-led cluster, the share is −0.25 percent ($lcred = -0.254$); in Mexico-led cluster, the share is 0.53 percent ($lcred = 0.532$); and in the region, the share is 0.39 percent ($lcred = -0.386$).

5 Conclusion

In this study, we explored the emerging polarization and uniformity in Latin America and the Caribbean as a result of dynamism in capital inflows defined as personal remittances, foreign direct investment, aid, and domestic credit. Therefore, uniformity would call for regional cooperation, sharing of ideas, resources and technology in the region, while polarization would suggest that some countries in the region are working on different centers of gravity and hence can exploit their respective comparative and relative advantages to maximize the region's output and welfare. The region can, in this regard, complement each other's differences in their effort to gain competitiveness in key areas of their relative advantages. Brazil-led cluster has a lot to improve in terms of boosting productivity levels and optimizing capital inflows. Brazil-led cluster is faced with long-run threats of negative impacts on growth and therefore need to consider addressing inherent geo-economic and geo-political risks in its effort to incentivize local and foreign investment; manage the use of aid and formalize and mobilize remittances cost effectively. On the other hand, Mexico-led cluster need to capitalize on growing remittances; relatively highly innovative and cost-effective financial system; and marginal yet positive impact of foreign direct investment. Aid effectiveness is critical to growth and therefore its effective management and deployment in productive projects is a concern as well as an area of development for both the clusters in the region.

Acknowledgments The author sincerely thanks the anonymous reviewers and the journal editor for their comments and the Springer Correction Team.

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