Exploring polarization and uniformity in sectors and inflows *vis-à-vis* growth

A study of Brazil-led and Mexico-led clusters in the region

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Abstract

Purpose – The study aims to explore the sectoral contributions defined as agriculture, manufacturing and services value added, capital inflows defined as workers' remittances, foreign direct investment, official development assistance and domestic credit by banks as a proxy for financial deepening in Brazil-led, and Mexico-led clusters, and Latin America and the Caribbean region as a whole. The goal is to ascertain the polarization and uniformity effects of these parameters in shaping the growth and development in the midst of global financial crisis and economic challenges facing the region.

Design/methodology/approach – Using the classifications of Brazil-led cluster and Mexico-led cluster from Izquierdo and Talvi, the study is advanced using panel (pool) data estimation using the ARDL approach. The author used the augmented Solow framework to advance the study. He first established the desired cointegration vector for individual countries within the cluster, each cluster level and the region prior to pursuing the regression estimation. Both clusters were combined to represent the region. The author estimates the short-run (first-difference) and long-run effects of sectoral contributions and capital inflows in the region.

Findings – The region's capital productivity is driven by Brazil-led cluster. In phase 1 (sectoral shifts), polarization is noted in agriculture (dominated by Brazil-led cluster); and services (dominated by Mexico-led cluster). Uniformity exists in two clusters and the region with respect to manufacturing share where both clusters have almost equal (positive) dominance and hence exuding positive effects in the region. In phase 2, polarization is noted in remittances (dominated Brazil-led cluster), foreign direct investment (dominated by Mexico-led cluster) and financial development (dominated by Brazil-led cluster). Uniformity is noted in both clusters and the region from negative effects of official development assistance (ODA).

Originality/value – The study is fairly new and contemporary in its attempt to analyze the effects of sectoral shifts and capital inflows in Latin America and the Caribbean (LAC) region. Using the classification of Brazil-led cluster and Mexico-led cluster, it investigates the polarization and uniformity in the region with respect to these parameters. The study contributes to policy dialogue, and explores the emerging trends in key economic and structural factors of growth whilst highlighting some burgeoning issues shaping LAC's growth and development overall.

Keywords Brazil-led cluster, Mexico-led cluster, LAC, Sectoral shifts, Capital inflows, ARDL pooled regression, South America, Central America

Paper type Research paper

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1. Introduction

The consensus on the precise causes of economic growth is a topic of much discussion and debate. As modern economic growth advances to new levels, the portfolio defining growth is becoming inclusive of structural dynamics. Within the structural paradigm, the role of sectors such as agriculture, manufacturing and modern services are gaining significant ground. Furthermore, the flow of foreign direct investment (FDI), workers' remittances, official development assistance (ODA) and domestic credit are shaping the dynamic path of growth path.

The focus of our study is Latin America and the Caribbean (LAC) region. This study is motivated by a recent study of Izquierdo and Talvi (2011) titled "One region, two speeds? Challenges of the new economic order for Latin America and the Caribbean", which highlighted some key structural characteristics of LAC countries that defines two quite different regional clusters within LAC predominantly led by Brazil (South America) and Mexico (Central and North America). In Brazil-led cluster, we have Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Trinidad and Tobago, Uruguay, and Venezuela; and in Mexico-led cluster, we have Barbados, Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama (Izquierdo and Talvi, 2011).

Considering the two clusters, we explore the sectoral (phase 1) and capital inflows effects on economic growth. We used pooled data estimation and autoregressive distributed lag (ARDL) procedure. The goal of the paper is to identify the emerging polarization with uniformity between the two clusters and the consequent dominant effect each cluster has on the region with respect to sectoral shifts and capital inflows. It is pertinent to assert at the outset that we do not consider the two clusters as competitors, however acknowledge that they operate in some cases on different centers of gravity and in others, they exhibit uniformity.

2. A brief literature survey

2.1 Sectoral shares (agriculture, manufacturing, and services)

Agriculture development has been considered as engine of growth for many low income and developing countries in terms of its contribution to providing cheap food, raw materials, labor, savings, and consequent spillover effect of demand for non-agricultural commodities (Bravo-Ortega and Lederman, 2005; Lipton, 1977; Lewis, 1954). It is also argued that relationship between agriculture and overall economic growth is dependent on the degree of openness, productivity in agriculture sector versus non agriculture, and the pace and effectiveness of industrialization (Gollin, 2010). While a few recent empirical analysis have shown negative effects of agriculture in developing countries (Gardner, 2005), others have shown that agriculture has a positive contributory effect on growth (Self and Grabowski, 2007).

Manufacturing is considered as a critical source of growth for many developing countries. It has been argued that industrial sector predominantly led by manufacturing is dynamic and hence has the potential to exploit productivity growth resulting from increasing returns to scale, innovations and learning-by-doing. Moreover, manufacturing has the ability to emulate new technologies efficiently and pursue vertical integration among different sectors of the economy through its capacity to process raw materials, intermediate industrial inputs and links with modern services (Ocampo *et al.*, 2007). Expansion in manufacturing has enabled skill upgrading, capital

deepening and enhancement of worker productivity which positively contributes to increasing income and employment levels (Rodrik, 2008). Moreover, Rajan and Subramanian (2011) underscore the use of aid in developing manufacturing and characterize manufacturing exports as a vehicle for growth take-off besides having a transcending positive impact on economic activities.

Services have been underscored as critical contributor to modern growth in recent times. Researchers focusing on services impact on growth and development have identified services to play a critical role in economic development with greater benefits evident in cases where services are relatively cheaper due to low wage cost and speedy development of key sectors in the economy (Chenery, 1960; Francois and Reinert, 1996). However splintering effect (outsourced indirect production activities raise the demand for producer services as intermediate input) has influenced the growth of services sector (Bhagwati, 1984).

2.2 Capital inflows

2.2.1 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, over the last four decades, remittances to developing countries have surpassed ODA, increasing substantially 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 (Ratha, 2007). Remittances have welfare enhancing effect when it supports growth in human capital (education), healthcare needs, entrepreneurial development, and when available as "buffer cash" during economic crisis and natural disasters (De Haas, 2005). However, given the high remittances transfer cost through formal channels 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). 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).

2.2.2 Overseas development assistance (ODA). The impact 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; Trumbull and Wall, 1994). Various scholars have argued that aid has a positive effect on growth and the magnitude of the impact depends on the recipient countries policy, aid management and accountability, and geopolitical factors (Burnside and Dollar, 2000). 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; Dalgaard, 2008; Hansen and Tarp, 2000).

2.2.3 Foreign direct investment (FDI). The FDI-growth nexus is clearly identified by the neoclassical growth models which consider 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).

It is also argued that countries with well-developed financial markets gain significantly from FDI (Alfaro *et al.*, 2004). Moreover, the impact of FDI on economic growth depends on the role it plays in strengthening domestic linkages in the economy. Hence, 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 (Ocampo *et al.*, 2007).

2.2.4 Financial development. A growing body of literature has acknowledged the dynamic role of financial sectors. 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, 1993). 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 (McKinnon, 1973). Greater accessibility of financial services to more individuals spreads out risk, which in turn boosts investment activities in both physical and human capital. However, the efficiency of financial services is compromised with suboptimal outcomes in financing and investment activities in the presence of high degrees of asymmetric information, externalities in financial markets, and imperfect or weak competition (Stiglitz and Weiss, 1992).

3. Data, method, and results

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 estimating. The study is divided in two parts. In the first part (phase 1), we consider the nexus between sectoral shares (agriculture, manufacturing, and services) *vis-à-vis* per worker income of Brazil-led and Mexico-led clusters respectively. In the second part (phase 2), we explore the nexus between capital inflows (remittances, ODA and FDI, domestic credit) and per worker income of the two clusters and the region. We combine the two clusters together to represent the region.

3.1 Data

In phase 1 study, we used 11 countries for Mexico-led cluster, and ten countries for Brazil-led cluster. All 21 countries were grouped together to represent the region. In phase 2 study (capital inflows), we included ten countries in Mexico-led cluster, and ten countries in Brazil-led cluster. A summary of country sample used in the analysis in two phases is given in Table I.

Mexico cluster Country	Years	Sample size	Brazil cluster Country	Years	Sample size
Phase 1: sectoral analysis – country sample					
Bahamas	1989-2010	22	Argentina	1970-2010	41
Barbados	1991-2010	20	Bolivia	1970-2010	41
Belize	1984-2010	27	Brazil	1970-2010	41
Costa Rica	1977-2010	34	Chile	1970-2010	41
Dominican Rep.	1970-2010	41	Colombia	1970-2010	41
El Salvador	1990-2010	21	Ecuador[a]	2005-2010	6
Guatemala	1977-2010	34	Paraguay	1970-2010	41
Honduras	1974-2010	37	Peru	1970-2010	41
Mexico	1965-2010	46	Trinidad and Tobago	1984-2010	27
Nicaragua	1994-2010	17	Uruguay	1983-2010	28
Panama	1980-2010	31	Venezuela	1970-2010	41
Phase 2: capital inflows analysis					
Bahamas[b]	–	–	Argentina	1978-2010	33
Barbados	1991-2010	20	Bolivia	1976-2010	35
Belize	1984-2010	27	Brazil	1975-2010	36
Costa Rica	1977-2010	34	Chile	1983-2010	28
Dominican Rep.	1970-2010	41	Colombia	1970-2010	41
El Salvador	1976-2010	35	Ecuador	1986-2010	25
Guatemala	1977-2010	34	Paraguay	1975-2010	36
Honduras	1974-2010	37	Trinidad and Tobago[c]	–	–
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 – Phase 1[d]	1969-2010	42			
LAC Grouped – Phase 2[e]	1979-2010	32			

Notes: [a]Ecuador sample was relatively small and hence not included in the analysis; [b] and [c] Bahamas and Trinidad and Tobago did not have complete data on capital inflows and hence excluded from the analysis; [d] and [e] represent the aggregate data for Latin America and the Caribbean in respective phases

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

Table I.
Country samples used in the analysis

3.2 Method

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 (*yt*) is defined as:

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

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:

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

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 At in each phase as follows:

$$\text{Phase 1}: A_t = f\left(T, LAGR_t, LMAN_t, LSER_t\right) \tag{3}$$

and

$$\text{Phase2}: A_t = f\left(T, LREM_t, LODA_t, LFDI_t, LFIN_t\right) \tag{4}$$

where phase 1 shift parameters are:

- *LAGRt* = natural log of agriculture value added as a percent of GDP;
- *LMANt* = natural log of manufacturing value added as a percent of GDP; and
- *LSERt* = natural log of services value added as a percent of GDP;

and phase 2 shift parameters are:

- *LREMt* = natural log of workers' remittances as a percent of GDP;
- *LODAt* = natural log of net official development aid as a percent of GDP;
- *LFDIt* = natural log of net foreign direct investment as a percent of GDP; and
- *LFINt* = natural log domestic credit to private sectors as a percent of GDP.

The effects of *LAGRt*, *LMANt*, and *LSERt* (phase 1) and *LODAt*, *LFDIt*, *LREMt*, and *LFINt* (phase 2) on total factor productivity (*TFP)* can be captured when these variables are entered as shift parameters in the production function[1]. The data is set in a panel and ARDL procedure is applied to estimate the short-run (first-difference) and long-run effects.

Since the ARDL approach has no prescribed test for cointegration of panel data, we investigated cointegration of variables for each country, which is possible using the bounds tets. It is assumed that if individual country used in the panel has the desired cointegrated vector, then cointegration holds for the panel estimation as well. The ARDL bounds testing approach to cointegration, 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). However, to ensure the order of variables are at most integrated of order one, we pursued the unit root tests of each country-specific variables to ensure they are of the same order before entering them carrying out the country-specific cointegration test. The unit root results (available upon request) confirmed that all variables used in the analysis were stationary in at least in their first differences.

The phase 1 relationship is specified as:

$$\begin{aligned}\Delta Ly_t = {} & \beta_{10} + \beta_{11} Ly_{t-1} + \beta_{12} Lk_{t-1} + \beta_{13} LAGR_{t-1} + \beta_{14} LMAN_{t-1} + \beta_{15} LSER_{t-1} \\ & + \sum_{i=1}^{p} \alpha_{11i} \Delta Ly_{t-i} + \sum_{i=0}^{p} \alpha_{12i} \Delta Lk_{t-i} + \sum_{i=0}^{p} \alpha_{13i} \Delta LAGR_{t-i} \\ & + \sum_{i=0}^{p} \alpha_{14i} \Delta LMAN_{t-i} + \sum_{i=0}^{p} \alpha_{15i} \Delta LSER_{t-i} + \varepsilon_{1t}\end{aligned} \tag{5}$$

and phase 2 relationship is specified as:

$$\begin{aligned}\Delta Ly_t &= \beta_{10} + \beta_{11}Ly_{t-1} + \beta_{12}Lk_{t-1} + \beta_{13}LREM_{t-1} + \beta_{14}LODA_{t-1} \\ &+ \beta_{15}LFDI_{t-1} + \beta_{16}LFIN_{t-1} + \sum_{i=1}^{p}\alpha_{11i}\Delta Ly_{t-i} + \sum_{i=0}^{p}\alpha_{12i}\Delta Lk_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{13i}\Delta LREM_{t-i} + \sum_{i=0}^{p}\alpha_{14i}\Delta LODA_{t-i} + \sum_{i=0}^{p}\alpha_{15i}\Delta LFDI_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{16i}\Delta LFIN_{t-i} + \varepsilon_{1t}\end{aligned} \quad (6)$$

There are two steps in examining the long-run relationship. First, equations (5) and (6) are estimated by ordinary least squares technique, separately. 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.

Phase 1: hypothesis testing:

- $H_0 : \beta_{i1} = \beta_{i2} = \beta_{i3} = \beta_{i4} = \beta_{i5} = 0$ (Null: existence of no cointegration).
- $H_1 : \beta_{i1} \neq 0; \beta_{i2} \neq 0; \beta_{i3} \neq 0; \beta_{i4} \neq 0; \beta_{i5} \neq 0$ (Alternative: existence of long-run cointegration).

Phase 2: hypothesis testing:

- $H_0 : \beta_{i1} = \beta_{i2} = \beta_{i3} = \beta_{i4} = \beta_{i5} = 0 = \beta_{i6} = 0$ (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).

3.3 Cointegration results

The results are reported in Tables II and III which confirms that all countries have the presence of cointegration relationship amongst the variables when real output per worker (*yt*) is set as the dependent variable. This is concluded when the computed *F*-statistics for respective countries exceed the upper bound value at least at 5 percent level of significance.

3.4 Short-run (first-difference) and long-run results

3.4.1 Phase 1(a): sectoral analysis – short-run effects. In the short-run, using the first-difference results presented in Table IV, we find that capital per worker for Brazil-led cluster is about 0.06 percent ($\Delta Lkt = 0.055$), Mexico-led cluster is 0.22 percent ($\Delta Lkt = 0.222$) and the region is 0.07 percent (LAC: $\Delta Lkt = 0.071$). Although the capital productivity share is relatively larger in Mexico-led cluster, the region's capital productivity follows very closely with Brazil-led cluster, thus indicating the latter's dominant role in driving capital productivity in the region.

Agriculture value added (as a percent of GDP) is negative in both clusters and the region. The effects of agriculture in Brazil-led cluster is -1.00 percent ($\Delta LAGRt = -1.00$), Mexico-led cluster is -0.49 percent ($\Delta LAGRt = -0.489$) and the

Table II.
Cointegration results from bounds tests for each country

Country/region	Phase 1: sectoral cointegration					Phase 2: capital inflows					
	yt	*kt*	*AGRt*	*MANt*	*SERt*	*yt*	*kt*	*REMt*	*ODAt*	*FDIt*	***FINt***
Mexico-led cluster											
Bahamas	5.77^{A}	2.90	1.77	4.74^{B}	2.44	NSD	NSD	NSD	NSD	NSD	NSD
Barbados	22.88^{A}	3.22	0.84	0.55	0.77	9.25^{A}	0.58	3.54^{C}	5.30^{A}	2.65	3.84^{B}
Belize	4.25^{B}	4.25^{B}	3.94	1.98	13.04^{A}	7.18^{A}	7.18^{A}	4.00^{B}	1.56	2.00	2.33
Costa Rica	30.79^{A}	6.28^{A}	17.87^{A}	3.10	4.83^{B}	11.08^{A}	8.55^{A}	2.14	2.19	3.38	4.29^{B}
Dominican Rep.	9.35^{A}	6.03^{A}	0.28	2.89	1.25	5.45^{A}	12.74^{A}	1.36	4.96^{A}	1.84	2.73
El Salvador	22.97^{A}	17.31^{A}	4.23^{B}	3.73^{B}	9.92^{A}	24.63^{A}	6.04^{A}	1.43	8.55^{A}	1.60	0.41
Guatemala	8.25^{A}	1.68	2.29	4.54^{B}	2.53	5.36^{A}	3.60	2.48	1.13	1.43	3.45
Honduras	9.53^{A}	5.01^{B}	3.72	2.98	2.45	15.08^{A}	3.17	1.92	2.11	3.46	4.89^{A}
Mexico	8.98^{A}	10.07^{A}	1.36	3.96	5.77^{A}	5.32^{A}	13.46^{A}	3.56	1.68	2.99	1.03
Nicaragua	6.11^{A}	1.55	1.61	1.22	6.44^{A}	8.57^{A}	4.89^{A}	3.22	7.50^{A}	1.65	1.62
Panama	8.46^{A}	1.82	2.96	4.56^{B}	3.20	62.15^{A}	1.15	0.80	1.27	11.80^{A}	0.91
Brazil-led cluster											
Argentina	15.82^{A}	70.48^{A}	2.92	4.29^{B}	3.59	5.37^{A}	6.70^{A}	0.90	3.62	2.97	2.10
Bolivia	4.14^{B}	3.67	4.18^{B}	3.44	2.93	17.94^{A}	6.11^{A}	1.31	0.87	2.83	3.68
Brazil	4.32^{B}	7.42^{A}	3.53	1.39	3.02	8.67^{A}	5.42^{A}	1.19	7.98	1.92	1.55
Chile	10.33^{A}	5.89^{A}	0.93	8.13^{A}	8.58^{A}	7.50^{A}	4.24^{B}	5.75^{A}	3.67	2.02	2.56
Colombia	5.80^{A}	24.72^{A}	1.94	2.80	3.35	5.21^{A}	4.54^{B}	3.72	3.94^{B}	1.31	27.46^{A}
Ecuador	NSD	NSD	NSD	NSD	NSD	5.20^{A}	1.44	2.56	2.65	2.01	2.17
Paraguay	5.71^{A}	46.69^{A}	2.34	1.09	1.35	6.09^{A}	18.03^{A}	1.92	0.98	2.67	2.05
Peru	9.31^{A}	5.05^{B}	4.70^{B}	11.87^{A}	2.03	75.56^{A}	9.87^{A}	0.88	2.14	5.71^{A}	6.92^{A}
Trinidad and Tobago	8.57^{A}	1.32	7.48^{A}	1.87	6.54^{A}	NSD	NSD	NSD	NSD	NSD	NSD
Uruguay	11.91^{A}	6.65^{A}	1.07	2.00	1.86	5.81^{A}	8.68^{A}	2.89	2.36	4.86^{A}	11.94^{A}
Venezuela	9.51^{A}	26.59^{A}	1.02	1.79	1.37	8.82^{A}	10.31^{A}	5.74^{A}	9.94^{A}	2.20	6.27^{A}
Region											
Mexico cluster	5.17^{A}	9.34^{A}	0.20	0.27	0.96	9.00^{A}	10.95^{A}	2.66	1.11	1.12	1.84
Brazil cluster	4.69^{B}	1.13	0.97	0.64	0.95	4.87^{A}	7.58^{A}	1.32	0.65	0.27	0.33
LAC panel	5.74^{A}	1.58	0.26	0.26	0.23	7.51^{A}	8.68^{A}	11.86^{A}	1.76	1.20	1.52
LAC aggregate	11.60^{A}	3.21	17.79^{A}	2.41	3.43	17.53^{A}	9.58^{A}	4.57^{B}	2.03	2.93	4.11^{B}

Notes: 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

region is −0.87 percent ($\Delta LAGRt = -0.873$). The relatively higher negative effect of agriculture in Brazil-led cluster follows closely with the results of the region, thus indicating the dominant role of Brazil-led cluster with respect to agriculture in the region. The contribution from manufacturing is positive and significant for both clusters and the region. In case of Brazil-led cluster, manufacturing has contributed close to 0.88 percent ($\Delta LMANt = 0.881$); for Mexico-led cluster, the contribution is about 0.65 percent ($\Delta LMANt = 0.651$); and for the region, the contribution is about 0.47 percent ($\Delta LMANt = 0.473$). Given that both clusters have relatively close contributions from manufacturing, both clusters have reinforcing effects of manufacturing. In regards to services, Brazil-led cluster, although has a positive effect, is not significant within 1-10 percent significance level. The effects of services on income in Mexico-led cluster is about 2.73 percent ($\Delta LSERt = 2.725$) and about 1.28 percent in the region ($\Delta LSERt = 1.278$) respectively. Mexico-led cluster henceforth has a dominant effect of services in the region.

The error correction terms (*ECTt-1*), which measures the reconciliation of short-run dynamics with long-run equilibrium, have correct (negative) signs and are significant at 1 percent levels for both clusters and the region (Brazil-led cluster: $ECTt\text{-}1 = -1.059$, Mexico-led cluster: $ECTt\text{-}1 = -0.839$, and LAC region: $ECTt\text{-}1 = -0.811$), thus indicating relatively speedy convergence to respective long-run equilibrium.

3.4.2 Phase 1(b): sectoral analysis – long-run effects. In the long run (Table V), capital productivity is positive and significant for both clusters and the region. The capital per worker share for Brazil-led cluster is 0.18 percent ($Lkt = 0.180$); for Mexico-led cluster is 0.26 percent ($Lkt = 0.265$); and the region is 0.15 percent ($Lkt = 0.145$). Notably, Brazil-led cluster's capital share is very close to the region's share. In terms of sectoral contribution, agriculture has negative effects on income in Brazil-led cluster of −1.11 percent ($LAGRt = -1.110$); and the region −0.90 percent ($LAGRt = -0.896$). Mexico-led cluster has a marginal positive effect which is not statistically significant within the desired 1-10 percent levels of significance.

Interestingly, the long-run results show both Brazil-led and Mexico-led clusters have positive effects of manufacturing of 0.57 percent ($LMANt = 0.572$) and 0.28 percent ($LMANt = 0.278$) respectively. However, in contrast to the fist-difference results which showed the positive effects all across (Table IV), the long-run results show that manufacturing has an overall negative effect of −0.22 percent ($LMANt = -0.221$). The latter is plausible when larger positive effects of manufacturing in the two clusters are dominated by only few countries and in large part, majority of the countries have a negative influence from manufacturing due to lower productivity and development in manufacturing.

Unrestricted intercept and no trend (k = 4)			Unrestricted intercept and no trend (k = 5)		
Critical value	Lower bound value	Upper bound value	Critical value	Lower bound value	Upper bound value
1 percent	3.74	5.06	1 percent	3.41	4.68
5 percent	2.86	4.01	5 percent	2.62	3.79

Note: Critical values are obtained from Pesaran *et al.* (2001)
Source: Author's own calculation

Table III.
Unrestricted intercept and no trend

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

Regressor	Brazil cluster (ΔLyt)		Mexico cluster (ΔLyt)		LAC region (ΔLyt)	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	*t*-ratio
ΔLkt	0.0550	3.33***	0.2222	2.44**	0.0709	4.11***
$\Delta LAGRt$	−1.0032	−31.86***	−0.4887	−4.34***	−0.8726	−30.64***
$\Delta LMANt$	0.8811	13.58***	0.6509	9.22***	0.4731	10.13***
$\Delta LSERt$	0.1235	0.91^{NS}	2.7253	9.24***	1.2776	10.96***
Ct	12.0314	11.66***	−12.6110	−4.43***	5.1358	5.70***
TRENDt			−0.0014	−5.53***	−0.0007	−7.94***
ECTt-1	−1.0592	−25.59***	−0.8394	−16.26***	−0.8112	−24.59***
R^2	0.91		0.96		0.88	
$\bar{R}^2$	90		95		88	
DW-Statistics	1.88		2.02		2.13	
ARDL	1,1,1,1,1		1,0,1,1,1		1,1,1,1,1	
n	383		330		713	

Notes: *, **, and *** indicates 1o%, 5%, and 1% level of significance respectively; NS – not statistically significant
Source: Author's own calculations from regression analysis

In Brazil-led cluster, services has a negative effect of − 0.96 percent ($LSERt = -0.962$) while in Mexico-led cluster, services share is 5.05 percent ($LSERt = 5.053$). The relatively larger positive share of services in Mexico-led cluster is also having a positive exerting effect of services on the region. The region's services share is about 0.95 percent ($LSERt = 0.954$).

In the next part of the analysis, we explore the effects of capital inflows characterized by workers' remittances (as a percent of GDP), official development assistance (as a percent of GDP), net foreign direct investment (FDI) (as a percent of GDP), and domestic credit by banks as a proxy of financial deepening.

3.4.3 Phase 2(a): capital inflows and financial sector development – short-run effects. In short run results obtained from the first-difference estimation (Table VI), the capital productivity share are positive and relatively larger in Mexico-led cluster ($\Delta Lkt = 0.751$) relative to Brazil-led cluster ($\Delta Lkt = 0.083$) and the region ($\Delta Lkt = 0.751$). Subsequently, the results confirm that capital productivity in the region is predominantly led by Brazil-led cluster.

Remittances share from the first-difference estimation (short-run) is − 0.14 percent in Brazil-led cluster ($\Delta LREMt = -0.136$) and − 0.03 percent (negative) for the region ($\Delta LREMt = -0.028$). One the other hand, remittances share is 0.06 percent in Mexico-led cluster ($\Delta LREMt = 0.057$). Given the negative effects of remittances in Brazil-led cluster and the 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 in the region.

Official development assistance (ODA) share is negative all across. In Brazil-led cluster the ODA share is − 0.13 percent ($\Delta LODAt = -0.129$), in Mexico-led cluster, the share is − 0.09 percent ($\Delta LODAt = -0.089$) and in the region, the share is − 0.25 percent ($\Delta LODAt = -0.249$). 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 as well.

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 ($\Delta LFDIt = 0.058$) which is very close to the regional share ($\Delta LFDIt = 0.063$). Therefore, we assert that FDI share is driven by Mexico-led cluster.

Regressor	Brazil led cluster (*Lyt*) Coefficient	*t*-ratio	Mexico-led cluster (*Lyt*) Coefficient	*t*-ratio	LAC region (*Lyt*) Coefficient	*t*-ratio
Lkt	0.1803	6.42***	0.2648	2.25**	0.1451	4.27***
LAGRt	− 1.1101	− 29.84***	0.0037	0.02NS	− 0.8960	− 18.01***
LMANt	0.5715	6.18***	0.2778	2.32***	− 0.2206	− 2.65***
LSERt	− 0.9615	− 5.28***	5.0525	8.18***	0.9542	4.68***
Ct	11.3592	12.15***	− 15.0238	− 3.95***	6.3314	5.87***
TRENDt			− 0.0017	− 5.92***	− 0.0009	− 7.99***

Notes: *, **, and *** indicates 10%, 5%, and 1% level of significance respectively; NS – not statistically significant

Source: Author's own calculations from regression analysis

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

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

Regressor	Brazil cluster (ΔLyt) Coefficient	*t*-ratio	Mexico cluster (ΔLyt) Coefficient	*t*-ratio	LAC region (ΔLyt) Coefficient	*t*-ratio
ΔLkt	0.0833	3.45***	0.7508	21.95***	0.0875	3.92***
$\Delta LREMt$	−0.1363	−10.91***	0.0568	6.37***	−0.0281	−3.57***
$\Delta LODAt$	−0.1299	−14.55***	−0.0889	−9.51***	−0.2487	−21.98***
$\Delta LFDIt$	−0.0028	−0.13NS	0.0578	4.96***	0.0629	4.09***
$\Delta LFINt$	−0.1099	−3.13***	0.2067	8.44***	0.1905	6.36***
Ct	6.2854	10.12***	−0.8849	−2.14**	3.6414	9.47***
TRENDt	0.0027	6.81***	−0.0021	−9.50***		
ECTt-1	−0.8868	−14.78***	−0.7007	−14.17***	−0.6439	−17.37***
R^2	0.90		0.96		0.71	
$\bar{R}^2$	89		96		70	
DW-Statistics	2.00		2.27		1.97	
ARDL	1,1,1,1,1,1		1,1,0,1,1,1		1,0,1,1,1,1	
n	312		325		637	

Notes: *, **, and *** indicates 10%, 5%, and 1% level of significance respectively; NS – not statistically significant
Source: Author's own calculations from regression analysis

The effect of financial development proxied by domestic credit to private sectors is negative in Brazil-led cluster ($\Delta LFINt = -0.109$), and positive in Mexico-led cluster ($\Delta LFINt = 0.207$) and the region ($\Delta LFINt = 0.191$). 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 (*ECTt-1*) have correct (negative) signs and show relatively speedy convergences to long-run equilibrium (Brazil-led cluster: $ECTt\text{-}1 = -0.887$; Mexico-led cluster: $ECTt\text{-}1 = -0.700$; LAC: $ECTt\text{-}1 = -0.644$).

3.4.4 Phase 2(b): capital inflows and financial development – log-run effects. From the long run results (Table VII), capital share for Brazil-led cluster is 0.12 percent ($Lkt = 0.121$), Mexico-led cluster is 0.91 percent ($Lkt = 0.906$) and the region is 0.14 percent ($Lkt = 0.136$). 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.

The long-run effect of remittances is negative in Brazil-led cluster ($LREMt = -0.131$), and positive in Mexico-led cluster ($LREMt = 0.081$) and the region ($LREMt = 0.061$) respectively. The share of ODA is negative in both clusters (Brazil-led: $LODAt = -0.121$; Mexico-led: $LODAt = -0.038$) and the region ($LODAt = -0.249$). Foreign direct investment (FDI) is negative for Brazil-led cluster ($LFDIt = -0.059$) and positive for Mexico-led cluster ($LFDIt = 0.043$). On the other hand, although positive, FDI is not statistically significant within 1-10 percent significance level in the region. Financial development share is negative for Brazil-led cluster ($LFINt = -0.254$) but positive in Mexico-led cluster ($LFINt = 0.532$) and the region ($LFINt = 0.386$).

3.5 Uniformity and polarization effects in LAC region

We use the first difference (short-run) results above to ascertain the uniformity and polarization resulting from the structural drivers (Table VIII).

Although Mexico-led cluster has a relatively higher share of per worker capital, the region's capital productivity is driven by Brazil-led cluster. This is noted by the relatively lower, however positive share of capital productivity in Brazil-led cluster and the region. This is confirmed from phase 1 (Table IV) and phase 2 (Table VI) results respectively. In phase 1, polarizations are noted in agriculture, which is dominated by

Regressor	Brazil led cluster (*Lyt*) Coefficient	*t*-ratio	Mexico-led cluster (*Lyt*) Coefficient	*t*-ratio	LAC region (*Lyt*) Coefficient	*t*-ratio
Lkt	0.1207	3.02^{***}	0.9061	12.60^{***}	0.1360	3.76^{***}
LREMt	−0.1307	-6.88^{***}	0.0811	6.10^{***}	0.0607	3.65^{***}
LODAt	−0.1209	-7.29^{***}	−0.0377	-1.82^{*}	−0.2493	-9.63^{***}
LFDIt	−0.0588	-1.87^{*}	0.0434	1.98^{**}	0.0114	0.37^{NS}
LFINt	−0.2539	-4.43^{***}	0.5320	9.62^{***}	0.3859	4.85^{***}
Ct	7.0875	16.94^{***}	−1.2629	-2.03^{**}	5.6549	14.65^{***}
TRENDt	0.0031	8.11^{***}	−0.0029	-8.71^{***}		

Notes: *, **, and *** indicates 10%, 5%, and 1% level of significance respectively; NS – not statistically significant

Source: Author's own calculations from regression analysis

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

Variables	Brazil-led cluster	Mexico-led cluster	Relatively larger positive share	LAC region	Cluster driven	Polarization = P/ uniformity = U
Capital productivity (Δ*Lkt*)	(+)	(+)	Mexico-led	(+)	Brazil-led	P
Phase 1: sectoral level						
Agriculture (Δ*LAGRt*)	(−)	(−)	Brazil-led	(−)	Brazil-led	P
Manufacturing (Δ*LMANt*)	(+)	(+)	Almost same	(+)	Both	U
Services (Δ*LSERt*)	(+)	(+)	Mexico-led	(+)	Mexico-led	P
Phase 2: capital inflows and financial development						
Remittances (Δ*LREMt*)	(−)	(+)	Mexico-led	(−)	Brazil-led	P
ODA (Δ*LODAt*)	(−)	(−)	Brazil-led	(−)	Both	U
FDI (Δ*LFDIt*)	(−)	(+)	Mexico-led	(+)	Mexico-led	P
Financial development (Δ*LFINt*)	(−)	(+)	Mexico-led	(+)	Mexico-led	P

Source: Author's own projection based on results from the first-difference results obtained from phase 1 (Table IV) and phase 2 (Table VI)

Table VIII.
Summary of uniformity and polarization in LAC using first difference (short-run) model

Brazil-led cluster; and services, which is dominated by Mexico-led cluster. In case of agriculture share, Brazil-led cluster's predominantly larger negative share and in case of services share, Mexico-led cluster's predominant positive share have similar direction of influence on the region; that is, while Brazil-led cluster has a negative dominating effect of agriculture in the region, Mexico-led cluster has a positive dominating effect of services. However, we assert uniformity in two clusters and the region with respect to manufacturing share where both clusters have almost equal (positive) dominance and thus exuding positive effects in the region.

In phase 2, polarization is noted in remittances, foreign direct investment and financial development. Interestingly, even though Mexico-led cluster has a positive effect of remittances, Brazil-led cluster has a negative effect which has a dominating (negative) effect in the region.

Moreover, although Brazil-led cluster has a negative effect of net FDI inflows, this is offset by the positive effect from Mexico-led cluster. Therefore, when clusters are combined (regional effect), the effect of FDI is positive, thus indicating the dominance of Mexico-led cluster. Similarly, Mexico-led cluster has a positive dominating effect of financial development in the region. On the other hand, uniformity is noted in both clusters and the region with respect to ODA. Notably, the effect of ODA is negative in both clusters and the region.

Conclusions

The study set out to explore the emerging uniformity and polarization in LAC region by disaggregating the region in two clusters led by Brazil and Mexico (Izquierdo and Talvi, 2011). The results, based on the signs of the coefficients, indicate the direction of dominance in the region. Brazil-led cluster leads the region in terms of capital productivity, agriculture and remittances. On the other hand, Mexico-led cluster leads the region in services, FDI and financial development. A shared dominance is noted in manufacturing and ODA shares. Subsequently, our results give impetus to the

emerging polarization and uniformity in the region whilst highlighting the role of sectors and inflows. Nevertheless, one can consider pursuing country-specific analysis to gain more in-depth insights of the sectoral and capital inflows as well as ascertain the degree of inherent heterogeneity within and across clusters in the region. Finally, capitalizing from the uniform and polarized effects will be a policy challenge for the region in its effort to overcome economic duel of the current times. Hence, growth targeted polices need to consider:

- boosting research and development in technology;
- enabling efficient and effective sectoral linkages, integration and management in critical areas of growth;
- improving efficiency and competitiveness in manufacturing base such as textile, energy among others;
- developing and improving transport infrastructure, public procurement and supply-chain processes;
- creating investor-friendly environment thus encouraging domestic and foreign investment;
- formalizing remittances, reducing transfer costs and encouraging Diaspora-led investment in domestic economy;
- effective use and management of aid management; and
- public-private partnership to boost economic activities.

Note

1. Capital stock, Kt, is defined as $Kt = (1 - \delta)Kt + It$, where (is the depreciation rate and It is the real investment proxied by gross fixed capital formation at constant prices; Labor stock is estimated from employment to population ratio; For each country's capital, $\delta = 4\%$ and initial $K0$ is set as 1.5 times the initial year real GDP of each country

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