Service sector labor productivity and economic growth in Ecuador

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Date received: June 13, 2023. Date of acceptance: November 7, 2023.

Abstract

This article analyzes the relationship between the services sector and Ecuadorian economic growth using cointegration and causality econometric techniques from 1990-2018. The results indicate that services as a whole, particularly trade and transportation, positively impact economic growth in the long run. However, in the short term, services as a whole have a negative effect, which may be explained by the continuous deterioration of their productivity. Meanwhile, there is a causality effect ranging from trade to economic growth, and from GDP per capita to services as a whole and transportation.

Keywords: service sector; labor productivity; economic growth; cointegration; causality.

1. INTRODUCTION

From a sectoral point of view, economic growth is initially linked to agricultural activities (Cameron and Neal, 2014; Brue and Grant, 2009, p. 35). With the advent of industrial processes, the secondary sector progressively gained relevance. In that respect, economic growth is associated with growth rates in the secondary sector (especially in manufacturing). The positive relationship between productivity growth in the industrial sector and output growth in the same sector has been empirically demonstrated (Kaldor, 1984). However, in the early 2000s, industrialized countries exhibited elevated growth in the tertiary sector, transforming themselves into service economies (Schettkat and Yocarini, 2005; Maroto-Sánchez and Rubalcaba, 2008; Maroto Sánchez, 2012).

In developing economies, service activities are increasingly important in economic activity, suggesting a pattern of tertiarization (Bonet, 2007; Timmer *et al.*, 2015; Aboal *et al.*, 2015). The expansion of services is also approached from the perspective of deindustrialization, understood as a process of continuous reduction of the manufacturing sector (Gemmell, 1982; Rowthorn and Ramaswamy, 1999; Tregenna, 2009), which is generally accompanied by an increase in the contribution of services (Gemmell, 1982; Palma, 2005). In the case of developing economies such as those in Latin America, the process is characterized as a type of premature deindustrialization. In other words, before reaching mature levels of industrialization, services tend to expand while manufacturing declines (Palma, 2005 and 2019; Rodrik, 2015; Camacho and Maldonado, 2018).

As far as the economy of Ecuador is concerned, the services sector is becoming increasingly important in the sectoral structure due to its predominance in terms of Gross Value Added (GVA) and employment. According to data from the World Bank (2023), in 2021, services as a percentage of GDP represented 53.4% and 51% as a percentage of total employment. Thus, the study of the services sector is considered relevant because the sector's significant importance in economic activity is based on low productivity levels, which have remained relatively stagnant since 2000. Together with improvements in agricultural productivity, this has contributed to a reduction in the productivity gap between the primary and services sectors while, at the same time, distancing it from the productivity of the secondary sector.

The productivity of the tertiary sector is an essential factor for encouraging economic growth, as demonstrated by Triplett and Bosworth (2004) for the U.S. economy where, after 1995, aggregate productivity growth was driven mainly by the productivity of service industries (labor productivity and total factor productivity), establishing it as one of the most dynamic and innovative sectors. Similarly, Pugno (2006) argues that health, education and cultural services drive economic growth by improving human capital. Business services also have a positive effect due to their ability to adopt and circulate information technologies (Oulton, 2001). However, the optimistic view followed the pessimism that described services as a stagnant and non-progressive sector, slowing economic growth due to low productivity levels (Baumol, 1967).

In this context, this research aims to analyze the relationship between service sector productivity and Ecuadorian economic growth from 1990-2018 using cointegration and causality econometric techniques. The main finding was that the tertiary sector and the commerce and transportation subsectors had a positive effect in the long run; however, in the short term, services as a whole have a negative influence, which can be explained by the significant deterioration in the productivity of the tertiary sector.

The paper is organized into five sections. Following the introduction, the second section reviews the theoretical and empirical framework regarding the main reasons for the expansion of tertiary activities, emphasizing papers that analyze the relationship between economic growth and service sector productivity. The third section describes the methodological strategy that follows the cointegration approach based on multivariate autoregressive distributed lag (ARDL) models and the causality of Toda and Yamamoto (1995). In addition, the database and variables used are presented. The results and discussion are developed in the fourth section and, finally, in the fifth section, the main findings and some suggestions for future research are presented.

2. LITERATURE REVIEW AND CONTRIBUTION

Interest in economic activity has been shifting from the agricultural sector to the industrial sector and, recently, to services, thus configuring two processes of structural transformation. The first occurs as a result of the displacement of economic activities from the agricultural sector to the secondary sector due to the significant productivity rates that appeared in the industrial sector, specifically in manufacturing (Lewis, 1954; Kuznets, 1973; Kaldor, 1984; Chenery and Syrquin, 1975). The second process occurs with the shift of activities towards the tertiary sector (Kuznets, 1973; Duarte and Restuccia, 2010). Specifically, the empirical work of Gemmell (1982) states that by the 1960s, there were already signs of deindustrialization and that increased participation in services often accompanied this process. Timmer *et al.* (2015) argue that since the 1990s, the service sector of developing countries has expanded rapidly.

Several elements can explain the expansion of the service sector. The most cited element in specialized literature is the so-called cost disease, which provides a negative outlook on the performance of the tertiary sector. Baumol (1967) - using an unbalanced growth model - predicts that stagnant productivity levels in services hurt economic growth. Later, Baumol *et al.* (1985) assessed cost disease by including activities that combine inputs from the progressive sector (manufacturing) and the stagnant sector (services). They conclude by arguing that the cost problem in stagnant activities is more alarming than anticipated. However, using an unbalanced growth model, Oulton (2001) presents a more optimistic view of services, mentioning that Baumol's thesis is only valid when stagnant activities produce final goods. On the other hand, the aggregate productivity growth rate will increase with services producing intermediate goods (such as business and financial services) even when their productivity growth rate is slow.

According to Ghavidel and Narenji Sheshkalany (2017), services with low levels of total factor productivity and technological progress are highly likely to suffer from cost disease. With that in mind, not all service activities suffer from it. In that respect, using an endogenous growth model, Pugno (2006) finds that activities such as health, education and cultural activities positively affect economic growth because they favor the training of human capital. In contrast, according to Baumol (2012), services related to health, education and cultural activities suffer, in a generalized way, from cost disease. Furthermore, activities such as business services are widely recognized for their importance in driving economic growth due to their ability to adopt and circulate information technologies and, by contributing to innovation processes (Pugno, 2006; Wu and Baumol, 2012; Oulton, 2001; Greenhalgh and Gregory, 2001).

Empirical evidence in developed countries suggests a negative relationship between the share of services as a whole (in terms of GVA and employment) and aggregate productivity growth; nevertheless, the conclusions may be conditional on how the service sector is defined and measured (Maroto-Sánchez, 2012 and 2013). However, some papers provide more optimistic conclusions about the role of services in the economy. Greenfield (2005), for example, suggests a re-examination of the service sector on a conceptual and empirical level because so-called cost disease may be a misdiagnosis. Meanwhile, Triplett and Bosworth (2003) assert that cost disease in service industries in the United States had been overcome.

Other determining factors for the expansion of services are: *i)* income growth (in line with Engel's Law), suggesting that the increase in income goes to the consumption of services with high income elasticity such as education, health, leisure, etcetera; *ii)* human capital, services are increasingly specialized, therefore, they require more highly skilled labor; *iii)* Information and Communication Technologies (ICT), which encourage the emergence of new services through innovation; and, *iv)* the continuous integration of services with the products of other economic sectors (Maroto-Sánchez, 2010 and 2012; Rubalcaba, 2015; Falvey and Gemmell, 1996; Howells, 2004; Messina, 2005).

Empirical evidence

On an international scale, the empirical evidence related to service sector productivity and the relationship between service sector productivity and economic growth is extensive. In this respect, Triplett and Bosworth (2000) analyze the service sector's productivity in the United States and indicate that this sector is essential for understanding the post-1973 productivity slowdown. Along the same lines, Li and Prescott (2009) investigate the factors that contributed to the slowdown in productivity growth in developed countries between 1973 and 1995 and identify the following: hypothesis of measurement error in service sector productivity, the slowdown in service sector productivity growth, oil crisis, cultural and demographic change (baby boom) and lower investment in technology and infrastructure between industries. Using the growth accounting framework, Triplett and Bosworth (2003) deduce that the primary source of labor productivity growth in U.S. service industries after 1995 is the multifactor productivity of services, followed by information technology capital and intermediate inputs.

For some Asian economies, Lee and McKibbin (2014) -through an intertemporal general equilibrium model- argue that accelerated service sector growth leads to balanced growth. In some specific cases, such as China, Wu (2015) suggests that the tertiary sector became the main generator of employment and economic growth. For Pakistan, Jalil *et al.* (2016), based on cointegration and causality approaches, confirm the existence of a long-term relationship between the service sector and economic growth, finding that services cause economic growth but not in the opposite direction. In the case of Singh (2010), he studies the relationship between the service sector and economic growth in India based on econometric modeling. His findings confirm a long-term relationship, suggesting that services directly and indirectly contribute to economic growth through agricultural and industrial activities.

Matuka and Asafo (2021) analyze the link between services and economic growth in the Albanian economy. Estimating several econometric cointegration and causality models, they conclude that transportation, communication and financial services positively affect economic growth. In contrast, manufacturing is negatively linked to GDP per capita. The causal relationships are bidirectional between transportation, communication, financial services and economic development. In the case of the Mexican economy, Castillo *et al.* (2014) -using time series analysis- find that the tertiary and secondary sectors share common trends with GDP. Di Meglio *et al.* (2018), for a broad set of developing economies and based on a Kaldorian framework, find that business services contribute to aggregate productivity growth. Meanwhile, Price and Gómez-Lobo (2021) examine the Baumol cost disease hypothesis in urban transport services, finding favorable evidence in some Latin American cities.[1]

Empirical evidence for the Ecuadorian economy is limited. Some papers analyze the percentage share of the service sector, growth processes and productivity convergence among the main economic sectors and in market and non-market services (Castillo and Tandazo-Arias, 2019; Quintana-Romero *et al.*, 2019; Correa-Quezada *et al.*, 2020). Recently, Guevara-Rosero *et al.* (2023) analyzed and collated the determinants of productivity in high and low-knowledge-intensive service firms. They conclude that the determining factors are similar, except for market power and exports. Market power is associated with higher productivity in knowledge-intensive firms when competitiveness is lower. More in line with this paper, Rubalcaba *et al.* (2016) study the link between the tertiary sector and economic growth using an input-output analysis and argue that services encourage economic growth. However, productivity and trade competitiveness are poor, suggesting that innovation is essential to improve the sector's performance.

In this context, the development of this article aims to contribute in several ways: *i)* in Ecuador, very little attention has been paid to research on the relevance of services and their contribution to economic growth, as evidenced by the few studies mentioned above. Therefore, this article contributes to identifying the long-term, short-term and causal relationships of the service sector as a whole and of the sub-sectors, transportation and commerce, with economic growth during a period of analysis close to three decades; *ii)* likewise, a methodological contribution exists when revisiting the ARDL model approach, which had traditionally been undervalued and, based on the work of Pesaran and Shin (1999), important advantages were identified. Additionally, using the critical values of Kripfganz and Schneider (2020), the bounds test for cointegration becomes more accurate. Likewise, the Toda and Yamamoto (1995) method, unlike the Granger (1969) method, permits the testing of causality with the variables in levels regardless of the order of integration.

3. METHODOLOGY

The link between service sector productivity and economic growth is studied by implementing several ARDL models to test for a long-term relationship. The variables of interest correspond to the labor productivity of the main economic sectors (agriculture, industry and services) and the trade and transport service subsectors. They are constructed as the ratio between GVA and the number of people employed. Both VAB and employment are retrieved from the Economic Transformation Database (TE) of the University of Groningen (De Vries *et al.*, 2021). The remaining variables are: Gross Domestic Product (GDP) per capita, Gross Fixed Capital Formation (fbkf) and Trade Openness. They are taken from the freely available indicators of the World Bank statistics (2023). Trade Openness is the ratio between the sum of exports and imports for the GDP. Data is collected annually from 1990 to 2018 and is transformed into logarithms. Table 1 summarizes the variables, denomination and database.

Table 1. Description of variables, abbreviations and sources of information

Variables	*Abbreviation*	*Database*
Agricultural labor productivity	yn_agr	ETD
Industrial labor productivity	yn_ind	ETD
Services labor productivity	yn_ser	ETD
Commercial services labor productivity	yn_trade	ETD
Transportation services labor productivity	yn_trans	ETD
GDP per capita	gdp_pc	World Bank
Gross Fixed Capital Formation	fbkf	World Bank
Trade openness	apertura_c	World Bank

Source: compiled by the authors.

According to Pesaran and Shin (1999), ARDL models have better properties in small sample sizes, as is the case of this research, and can be used when the variables are endogenous and I(0), I(1) or mixed. For Jalil *et al.* (2016), the absence of serial correlation in the ARDL models makes endogeneity less of a problem. The characteristics of the approach make it advantageous compared to the methods of Johansen and Juselius (1990), which conditions the series to be I(1), and the two-step method of Engle and Granger (1987), which, in addition to requiring the variables to be I(1), presents problems of bias in small samples (Mah, 2000) and is not suitable for testing cointegration between more than two series (Levendis, 2018, p. 360).

The econometric equation for estimation is as follows:

$$Y_t = c_0 + \sum_{i=1}^{p} \phi_i y_{t-i} + \sum_{i=0}^{q} \beta_i' x_{t-i} + u_t \qquad (1)$$

Where Y_t is GDP per capita, p is the lag order ≥ 1 for the dependent variable and q is the lag order ≥ 0 of the independent variables. Based on equation 1, five multivariate models are estimated where the dependent variable (GDP per capita) is fixed in all models, as are the investment and trade openness control variables (fbkf). Meanwhile, the labor productivity variables of the economic sectors and subsectors vary for each model.

The long-term relationship is evaluated using the Pesaran *et al.* (2001) bounds test, which proposes the absence of a level relationship as the null hypothesis and is rejected when the F or TE statistic is located above the upper limit of the critical value. In this case, the inference is conclusive, so there is no need to know the integration order of the series. According to Kripfganz and Schneider (2018), the validity of the test hinges on the assumptions of normality, absence of serial correlation, homoscedasticity and stability of the coefficients over time. The test is carried out based on the error correction model (ECM) represented in the following equation (2):

$$\Delta y_t = c_0 - \alpha(y_{t-1} - \theta x_t) + \sum_{i=1}^{p-1} \psi_{yi} \Delta y_{t-i} + \sum_{i=0}^{q-1} \Psi_{x_i}' \Delta x_{t-i} + u_t \qquad (2)$$

Where $\alpha = 1 - \Sigma_{j=1}^{p} \phi_i$ represents the adjustment speed coefficient and $\theta = \frac{\Sigma_{j=0}^{q} \beta_j}{\alpha}$ are the long-term ecoefficients. The MCE can also be estimated using the following reparameterization:

$$\Delta y_t = c_0 - \alpha(y_{t-1} - \theta x_{t-1}) + \sum_{i=1}^{p-1} \psi_{yi} \Delta y_{t-i} + \omega' \Delta x_t + \sum_{i=1}^{q-1} \Psi_{x_i}' \Delta x_{t-i} + u_t \qquad (3)$$

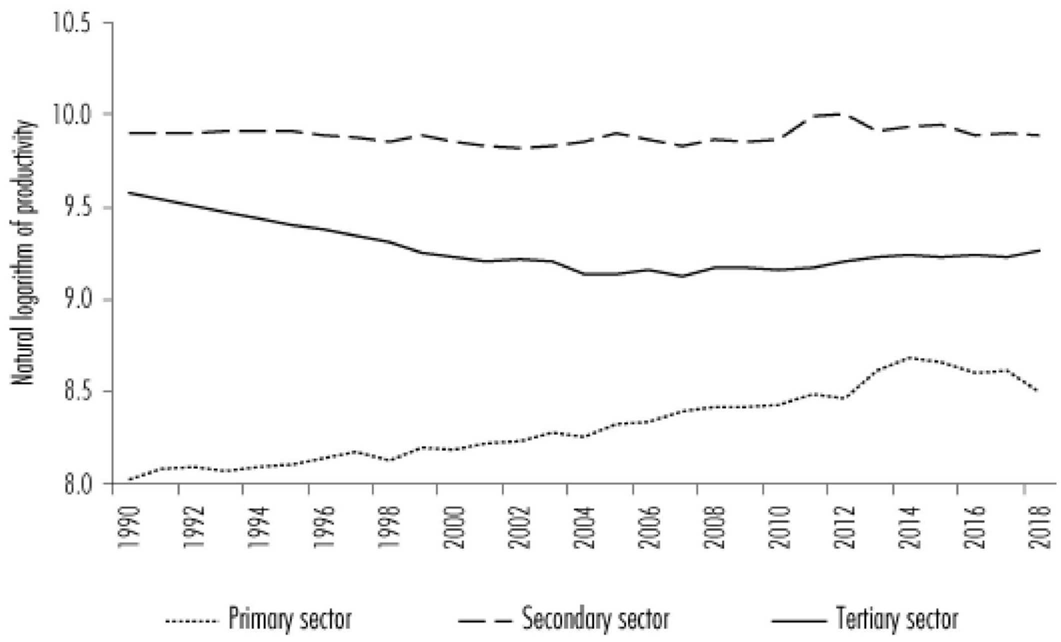
The MCE is estimated using equation (3) with the unrestricted and non-trended intercept. The critical values for the test are those proposed by Kripfganz and Schneider (2020), which have the advantage of covering all possible sample sizes, lag lengths and number of variables in the long-term relationship. The choice of lag length is critical, so several strategies are used: *i)* Schwarz (BIC) and Akaike information criteria (AIC) are allowed to determine the optimal number of lags; *ii)* following Ang (2010) and Jalil *et al.* (2016), two lags are imposed; and *iii)* following Sankaran *et al.* (2019) and Mah (2000), the maximum length of lags is restricted to three and two, with AIC being allowed to select the optimal lag. The best model choice is based on the fulfillment of the assumptions described above.

The existence of a long-term relationship implies that causality exists but does not suggest its direction; hence, the Toda and Yamamoto (1995) causality test is implemented. The method consists of adding lags ($K + d_{max}$) and allows fitting a VAR model with the variables in levels and regardless of whether the series are stationary in differences or around a deterministic trend, I(d) or cointegrated (Levendis, 2018). In that respect, five bivariate models are specified where the dependent variable for each model is GDP per capita and the explanatory variables are the labor productivity variables corresponding to each economic sector and subsector.

4. RESULTS AND DISCUSSION

In general, the labor productivity of the main economic sectors shown in Figure 1 indicates a growing trend in the agricultural sector. The secondary sector has remained at relatively high and stable levels, while the service sector indicates a declining performance which, since 2000, has remained stagnant since it has not been able to recover the productivity levels observed in 1990. Clearly, by the end of the study period, the deterioration of productivity in the tertiary sector widened the productivity gap with respect to the industrial sector, while it narrowed in relation to agricultural productivity.

Figure 1. Labor productivity of the main economic sectors



Source: compiled by the authors

Before presenting the results, Table 2 shows some descriptive measures with the information on levels. Twenty-nine observations were used. The highest average productivity can be found in industry and the lowest in the agricultural sector. The productivity of the commerce subsector shows a higher standard deviation than that observed in the large economic sectors and transportation. Investment also indicates a high level of dispersion. The minimum level of productivity is concentrated in agriculture, and the maximum is in industry.

Table 2. Descriptive measures

Variable	*Observations*	*Average*	*Standard deviation*	*Minimum*	*Maximum*
yn_agr	29	4 182.15	862.48	3 068.53	5 906.58
yn_ind	29	19 746.82	887.97	18 381.23	22 233.16
yn_ser	29	10 733.87	1 462.58	9 192.26	14 345.41
yn_trade	29	7 821.21	2 017.74	5 943.77	12 748.02
yn_trans	29	9 994.91	1 985.87	7 805.25	13 774.79
gdp_pc	29	4 982.94	705.64	4 209.35	6 218.24
fbkf	29	15 794.05	6 938.97	7 866.13	28 144.84
apertura_c	29	43.36	5.37	31.19	51.89

Notes: productivity variables are measured in dollars per worker, gdp_pc in dollars per capita, fbkf in millions of dollars and trade openness as a percentage.
Source: compiled by the authors.

Although the approach used to test a long-term relationship does not strictly require unit root tests, it is important to rule out that the variables are I(2), so Table 3 presents the results of the Dickey-Fuller Augmented (DFA) and Phillips Perron (PP) tests. The AIC criterion provides the lag length for the DFA test, while the PP test uses the Newey-West lags. In general, it is observed that the series are not I(2); however, the trade productivity variable in two of the three specifications of the DFA and PP tests suggests that it is stationary on levels.

Table 3. Unit root

Variables	*Without trend (Level)*	*With trend (Level)*	*Without constant and without trend (Level)*	*Without trend (First difference)*	*With trend (First difference)*	*Without constant and without trend (First difference)*	*Method*
lnyn_agr	-0.868	-2.034	1.668	-4.962 ***	-4.866 ***	-4.548***	DFA
	-1.154	-2.164	1.848	-5.011***	-4.924***	-4.628 ***	PP
lnyn_ind	-1.665	-1.903	-0.181	-2.575	-2.544	-2.66**	DFA
	-2.455	-2.484	-0.131	-5.461***	-5.333***	-5.587***	PP
lnyn_ser	-2.902*	-0.828	-1.020	-1.133	-2.954	-1.477	DFA
	-3.156**	-0.506	-1.482	-3.221**	-5.736***	-3.061***	PP
lnyn_trade	-2.830*	-1.048	-1.844*	-4.169***	-5.274***	-3.652***	DFA
	-3.516**	-0.728	-2.560**	-4.134***	-5.317***	-3.608***	PP
lnyn_trans	-1.831	-0.244	-1.999**	-5.400***	-5.938***	-4.787***	DFA
	-1.869	-0.358	-2.197**	-5.402***	-6.032***	-4.793***	PP
lngdp_pc	-0.426	-1.984	1.484	-3.734**	-3.696**	-3.385 ***	DFA
	-0.315	-1.802	1.927	-3.715**	-3.678**	-3.353***	PP
Lnfbkf	-0.392	-2.376	1.788*	-4.731***	-4.650***	-4.201***	DFA
	-0.381	-2.022	2.435	-4.711***	-4.625***	-4.179***	PP
lnapertura_c	-2.220	-1.545	1.167	-5.790 ***	-6.109***	-5.607***	DFA
	-2.854*	-2.127	1.390	-5.840 ***	-6.263***	-5.639***	PP

Notes: stationarity at *10%; **5%; ***1%.
Source: compiled by the authors.

Table 4 presents the bounds test results, suggesting a long-term relationship exists in all models. Hence, tables 5 and 6 present the long-term, MCE and short-term coefficients, respectively.

Table 4. Bounds test

Models		*F Value*	ARDL *(Lags)*
Model 1	lngdp_pc= f (lnyn_agr, lnfbkf, lnapertura_c)	10.523***	(1,3,3,0)
Model 2	lngdp_pc= f (lnyn_ind, lnfbkf, lnapertura_c)	6.241**	(1,1,1,1)
Model 3	lngdp_pc= f (lnyn_ser, lnfbkf, lnapertura_c)	20.373***	(3,3,0,3)
Model 4	lngdp_pc= f (lnyn_trade, lnfbkf, lnapertura_c)	4.571*	(3,0,3,0)
Model 5	lngdp_pc= f (lnyn_trans, lnfbkf, lnapertura_c)	8.181**	(1,3,1,3)

Notes: significance levels ***1%; **5%; *10%. Annex: model specification tests and CUSUM test.
Source: compiled by the authors.

The results suggest that, in the long run, the productivity of all sectors and subsectors, except for agricultural productivity, which is negatively related, indicates a positive effect on economic growth. All coefficients are statistically significant, and, specifically, transportation services exhibit the largest magnitude, revealing that a 1% improvement in transportation labor productivity translates into a 0.98% increase in GDP per capita. The MCE, for all models, falls within the expected range and with the appropriate sign (-1 and 0) and indicates the speed with which long-term distortions are adjusted in the current period. For example, in the case of the services sector, 69.1% of the long-term equilibrium distortion is corrected in the current period.

Table 5. Long-term coefficients and MCEs

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
ln pib_pc is the dependent variable					
lnyn_agr	-0.555***				
	(0.114)				
lnyn_ind		0.613***			
		(0.187)			
lnyn_ser			0.338***		
			(0.0692)		
lnyn_trade				0.101***	
				(0.0344)	
lnyn_trans					0.978**
					(0.421)
lnfbkf	0.590***	0.290***	0.372***	0.351***	0.606***
	(0.0518)	(0.0253)	(0.0252)	(0.0106)	(0.118)
lnapertura_c	-0.0235	0.116	0.302***	0.0232	0.737*
	(0.0484)	(0.0966)	(0.0989)	(0.0743)	(0.395)
MCE	-0.682***	-0.425***	-0.691***	-0.803***	-0.318**
	(0.137)	(0.107)	(0.0799)	(0.193)	(0.113)

Note: significance levels: ***p<0.01; **p<0.05; *p<0.10. Standard errors in parentheses.

Source: compiled by the authors.

In the service sector, as a whole and by activity, the long-term results are consistent with the work of Matuka and Asafo (2021), Jalil et al. (2016), Yousuf *et al.* (2019), confirming the importance of services in boosting economic growth. Specifically, the performance of traditional services such as trade and transportation is fundamental because they directly influence the competitiveness of other economic sectors (Pagés, 2010; Crespi and Vargas, 2015). In other words, they are activities highly integrated into the sectoral structure of the economy, so their good performance is desirable to boost economic growth.

However, in the short term, services as a whole hurt economic growth, which can be explained by the significant deterioration of their productivity since 1990, approaching the productivity levels of the agricultural sector by 2018. Thus, the decreasing levels of productivity in the services sector can be explained by two factors: *i)* a significant component of informal employment, which is characterized by low productivity (Freije, 2002; Arias *et al.*, 2020; Fajnzylber, 2008): and *ii)* low productivity of companies in the sector and poor allocation of resources, which, according to Pagés (2010), explain much of the low overall productivity and low productivity of services in Latin America. Similarly, Rubalcaba *et al.* (2016) argue that the poor performance of services in Ecuador is based on the inefficient allocation of resources. Furthermore, the poor allocation of resources in Latin America can be explained by the low development of the financial market, tax evasion (especially in small and low-productivity firms), and evasion of social security obligations (Pagés, 2010).

Concerning the other economic sectors, the findings presented in the agricultural sector may indicate that improving agricultural productivity is not enough, as suggested by Gollin (2010), who argues that improving agricultural productivity is neither a necessary nor sufficient condition for increasing economic growth. The productivity of the agricultural sector is at its lowest (compared to the services and industrial sectors) and exhibits an upward trend between 1990 and 2018. Despite showing improvements, the agricultural share in GVA has barely increased from 9.23% (in 1990) to 11.23% (in 2018). The low productivity levels that characterize the sector result from significant inequalities in terms of land distribution and technical progress (Castillo, 2014; Liudmila *et al.*, 2019; García Pascual, 2006). In the short term, the coefficient is not statistically significant.

Table 6. Short-term coefficients

	Model 1	Model 2	Model 3	Model 4	Model 5
D.lnyn_agr	-0.0546				
	(0.0465)				
D.lnyn_ind		0.228***			
		(0.0628)			
D.lnyn_ser			-0.265*		
			(0.144)		
D.lnyn_trade					
D.lnyn_trans					-0.0638
					(0.0659)
D.lnfbkf	0.206***	0.172***		0.203***	0.271***
	(0.0265)	(0.0316)		(0.0329)	(0.0402)
D.lnapertura_c		0.109	0.0473		0.0298
		(0.0647)	(0.0624)		(0.0726)
_cons	-0.390*	-2.023***	-3.094***	-0.547	-5.542***
	(0.188)	(0.642)	(0.805)	(0.492)	(1.462)

Note: significance levels: ***p<0.01; **p<0.05; *p<0.10. Standard errors in parentheses.

Source: compiled by the authors.

The secondary sector's direct relationship in the long and short term is as expected and in tune with the extensive literature, which suggests the importance of industrial development to boost economic growth (Lewis, 1954; Kaldor, 1984; Baumol, 1967; Rodrik, 2009; Szirmai, 2012; Szirmai and Verspagen, 2015; Attiah, 2019). In Ecuador, the secondary sector presents the highest levels of labor productivity, but its contribution to GVA does not exceed 40%.

Table 7 presents the results in relation to the direction of causality. The service sector, as a whole, is led by GDP per capita, but not the other way around. As for the trade and transportation subsectors, causality is one-way and runs from trade to growth and from growth to transportation activities. Moreover, bidirectional causality exists between the agricultural sector and GDP per capita. Conversely, industry causes GDP per capita but not vice versa.

Table 7. Toda and Yamamoto Causality

Y	X	F statistic	Probability
lngdp_pc	lnyn_agr	4.514	0.045
lnyn_agr	lngdp_pc	4.536	0.045
lngdp_pc	lnyn_ind	4.156	0.022
lnyn_ind	lngdp_pc	1.771	0.195
lngdp_pc	lnyn_ser	1.233	0.280
lnyn_ser	lngdp_pc	4.718	0.042
lngdp_pc	lnyn_trade	3.290	0.058
lnyn_trade	lngdp_pc	1.817	0.206
lngdp_pc	lnyn_trans	0.712	0.598
lnyn_trans	lngdp_pc	2.978	0.060

Notes: null hypothesis: x does not cause y.

The specification tests of the VAR models are presented in Table A2 of the Annex.

Source: compiled by the authors.

The direction of causality between services and GDP per capita supports the thesis that suggests that the increase in income levels contributes to the expansion of some service activities that have an income elasticity of demand greater than unity (Maroto-Sánchez, 2012; Rubalcaba, 2015; Falvey and Gemmell, 1996). Furthermore, a tentative explanation is that the growing economy allows for greater resources to be available and invested in infrastructure for the transportation sector, which contributes to improving its productivity levels. Commercial activities represent important sources of employment and consumption and are essential for the functioning of other economic sectors; therefore, good performance of their productivity will boost economic growth.

5. CONCLUSIONS

This study examined the relationship between service sector labor productivity and economic growth using multiple multivariate ARDL models and the causality approach. The results indicated a long-term equilibrium relationship between the main economic sectors and service subsectors (transportation and trade) and GDP per capita.

Based on the bounds test, in the long-term, services with their corresponding subsectors and industries have a positive and statistically significant impact on economic growth, in contrast to agriculture, which is negatively affected. In the short term, the services sector as a whole presents an inverse relationship, while industry has a positive effect. The coefficient of agricultural productivity is not statistically significant. In this context, the relevance of the service sector and the trade and transportation subsectors in driving and boosting Ecuador's economic growth in the long term is confirmed. However, the continued deterioration of labor productivity in services as a whole negatively affects economic growth in the short term.

Toda and Yamamoto's (1995) test revealed a bidirectional causality relationship between agricultural productivity and economic growth; several unidirectional causality relationships range from the industrial sector and trade to GDP per capita and from economic development to services and transportation. The expansion of transportation services with economic growth may be because a growing economy allows for allocating more resources that directly influence its productivity levels. On the other hand, commercial services are highly integrated into the productive structure, which drives economic growth.

The findings of this article can suggest some possibilities for future research. For example, the factors that explain the deterioration of productivity in the service sector (some already identified in this research) can be studied in depth from a microeconomic perspective at the company level. This would facilitate the identification of critical elements for a more accurate design of public policies for sectoral development.

ACKNOWLEDGMENTS

The authors are grateful for the review and comments made by anonymous reviewers, which contributed to significantly improving the final version of this article.

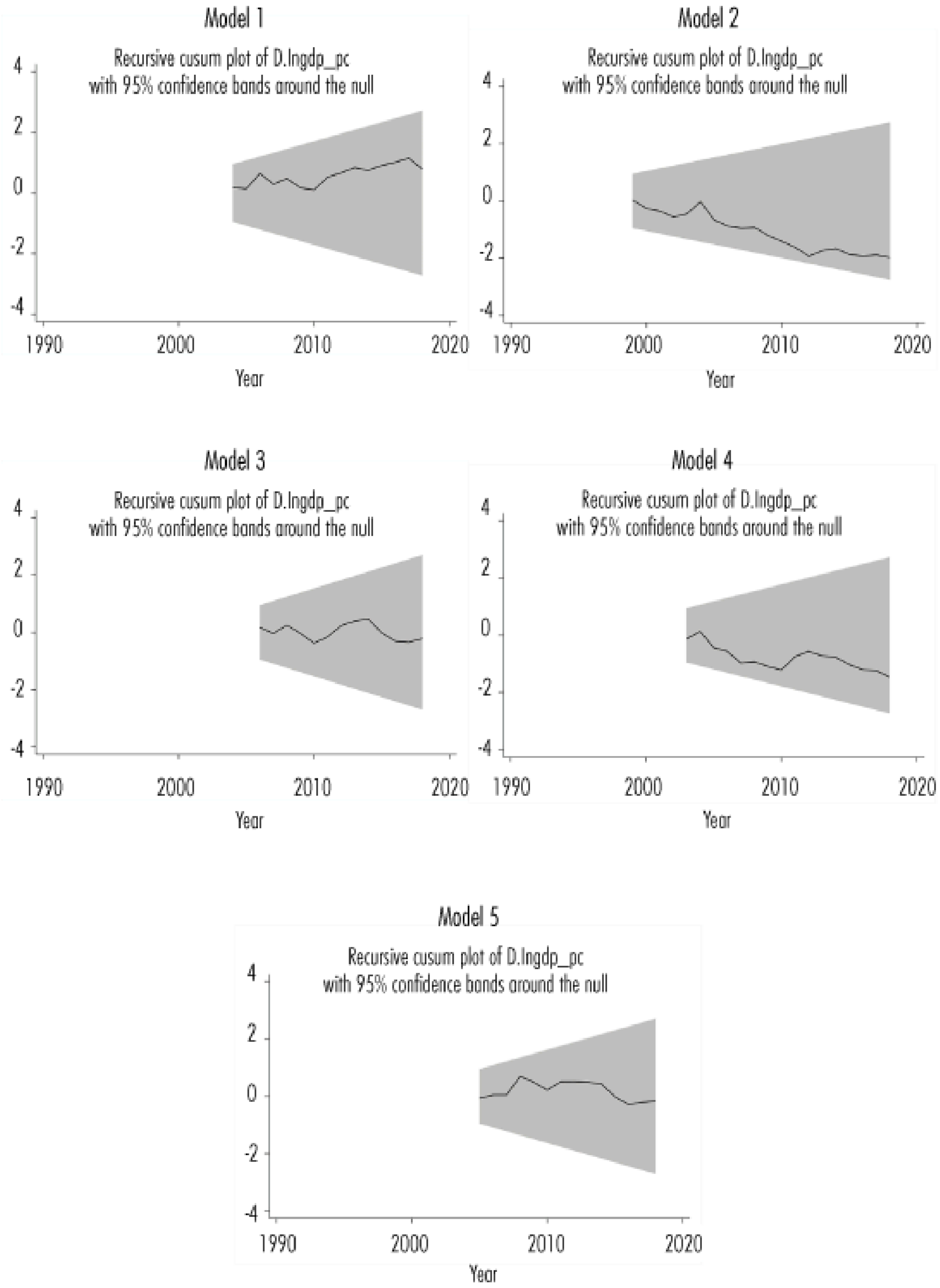
ANNEXES

Table A1. Specification tests of the ARDL models

Models	*Normality*	*Heteroscedasticity*	*Serial correlation*	*CUSUM*
Model 1	0.565	0.407	0.883	Stable
Model 2	0.308	0.172	0.944	Stable
Model 3	0.596	0.142	0.426	Stable
Model 4	0.601	0.068	0.149	Stable
Model 5	0.483	0.231	0.344	Stable

Source: compiled by the authors.

Figure A1. CUSUM test for stability of ARDL models



Source: compiled by the authors.

Table A2. Specification tests of the VAR models

Models	*Normality*	*Serial correlation*	*Stability*
Agriculture	0.285	0.728	Stable
Industry	0.754	0.145	Stable
Services	0.482	0.132	Stable
Commerce	0.318	0.361	Stable
Transportation	0.765	0.102	Stable

Source: compiled by the authors.

Bibliography

Aboal, D., Crespi, G. and Rubalcaba, L. (eds.) (2015). *La innovación y la nueva economía de servicios en América Latina y el Caribe. Retos e implicaciones de política*. BID, CINVE and IDRC.

Ang, J. (2010). Does foreign aid promote growth? Exploring the role of financial liberalization. *Review of Development Economics, 14(2).* https://doi.org/10.1111/j.1467-9361.2010.00547.x

Arias, K., Carrillo, P. and Torres, J. (2020). *Análisis del sector informal y discusiones sobre la regulación del trabajo en plataformas digitales en el Ecuador.*

Comisión Económica para América Latina y el Caribe (CEPAL). https://hdl.handle.net/11362/45866

Attiah, E. (2019). The role of manufacturing and service sectors in economic growth: An empirical study of developing countries. *European Research Studies Journal, 22(1).* https://ersj.eu/journal/1411#

Baumol, W. (1967). Macroeconomics of unbalanced growth: The anatomy of urban crisis. *The American Economic Review, 57(3).* http://www.jstor.org/stable/1812111

__________ (2012). Why health-care costs keep crising. In W. Baumol. *The cost disease. Why computers get cheaper and health care doesn't* (pp. 3-15). Yale University Press.

Baumol, W., Blackman, S. and Wolff, E. (1985). Unbalanced growth revisited: Asymptotic stagnancy and new evidence. *The American Economic Review, 75(4).* http://www.jstor.org/stable/1821357

Bonet, J. (2007). La terciarización de las estructuras económicas regionales en Colombia. *Revista del Rosario, 10(1).* https://www.redalyc.org/articulo.oa?id=509555107003

Brue, S. and Grant, R. (2009). *Historia del pensamiento económico.* Cengage Learning.

Camacho, J. and Maldonado, A. (2018). De la desindustrialización madura a la desindustrialización prematura: la dinámica e inflexión del debate teórico. *Investigación Económica, 77(303).* https://www.jstor.org/stable/10.2307/26388397

Cameron, R. and Neal, L. (2014). *Historia económica mundial. Desde el Paleolítico hasta el presente.* Alianza Editorial, S. A.

Castillo, M. (2014). Productividad agrícola en Ecuador: un largo camino por recorrer. *Ecuador Debate, (92).* http://hdl.handle.net/10469/9488

Castillo, K. and Tandazo-Arias, T. (2019). Análisis regional del sector servicios en el Ecuador, 2007-2014. *Revista Espacios, 40(30).* https://www.revistaespacios.com/a19v40n30/19403025.html

Castillo, R., Flores, C. and Rodríguez, M. (2014). The relative importance of the service sector in the Mexican economy: A time series analysis. *Lecturas de Economía, (80).* https://doi.org/10.17533/udea.le.n80a5

Chenery, H. and Syrquin, M. (1975). *Patterns of development 1950-1970.* Oxford University Press.

Correa-Quezada, R., Cueva-Rodríguez, L., Álvarez-García, J. and Del RíoRama, M. (2020). Application of the Kernel Density Function for the analysis of regional growth and convergence in the service sector through productivity. *Mathematics, 8(8).* https://doi.org/10.3390/math8081234

Crespi, G. and Vargas, F. (2015). Innovación y productividad en las empresas de servicios en ALC. Evidencia a partir de encuestas de innovación. In D. Aboal, G. Crespi and L. Rubalcaba (eds.). *La innovación y la nueva economía de servicios en América Latina y el Caribe. Retos e implicaciones de política* (pp. 105-135). BID, CINVE and IDRC.

De Vries, G., Arfelt, L., Drees, D., Godemann, M., Hamilton, C., Jessen-Thiesen, B., Ihsan Kaya, A., Kruse, H., Mensah, E. and Woltjer, P. (2021). The Economic Transformation Database (etd): Content, Sources, and Methods. WIDER Technical Note 2/2021. https://doi.org/10.35188/UNU-WIDER/WTN/2021-2

Di Meglio, G., Gallego, J. and Maroto, A. and Savona, M. (2018). Services in developing economies: The deindustrialization debate in perspective. *Development and Change, 49(6).* https://doi.org/10.1111/dech.12444

Duarte, M. and Restuccia, D. (2010). The role of the structural transformation in aggregate productivity. *The Quarterly Journal of Economics, 125(1).* http://www.jstor.org/stable/40506279

Engle, R. and Granger, C. (1987). Co-Integration and error correction: Representation, estimation, and testing. *Econometrica, 55(2).* https://doi.org/10.2307/1913236

Fajnzylber, P. (2008). Informalidad, productividad y la firma. In G. Perry, W. Maloney, O. Arias, P. Fajnzylber, A. Mason and J. Saavedra-Chanduvi. *Informalidad: escape y exclusión* (pp. 153-172). Banco Mundial / Mayol Ediciones, S.A.

Falvey, R. and Gemmell, N. (1996). Are services income-elastic? Some new evidence. *Review of Income and Wealth, 42(3).* https://doi.org/10.1111/j.1475-4991.1996.tb00182.x

Freije, S. (2002). El empleo informal en América Latina y el Caribe: causas, consecuencias y recomendaciones de política. *Banco Interamericano de Desarrollo (BID).* https://publications.iadb.org/es/publicacion/14938/el-empleo-informal-en-america-latina-y-el-caribe-causas-consecuencias-y

García Pascual, F. (2006). El sector agrario del Ecuador: incertidumbres (riesgos) ante la globalización. *Iconos. Revista de Ciencias Sociales, (24).* https://www.redalyc.org/articulo.oa?id=50902407

Gemmell, N. (1982). Economic development and structural change: The role of the service sector. *The Journal of Development Studies, 19(1).* https://doi.org/10.1080/00220388208421849

Ghavidel, S. and Narenji Sheshkalany, A. (2017). Cost disease in service sector. *The Service Industries Journal, 37(3-4).* https://doi.org/10.1080/02642069.2017.1306056

Gollin, D. (2010). Agricultural productivity and economic growth. In P. Pingali and R. Evenson. *Handbook of Agricultural Economics* (pp. 3825-3866). Elsevier.

Granger, C. W. J. (1969). Investigating causal relations by Econometric Models and Cross-spectral Methods. *Econometrica, 37(3).* https://doi.org/10.2307/1912791

Greenfield, H. (2005). Letter: curing “Baumol’s Disease”. *The Service Industries Journal, 25(2).* http://dx.doi.org/10.1080/0264206042000305466

Greenhalgh, C. and Gregory, M. (2001). Structural change and the emergence of the new service economy. *Oxford Bulletin of Economics and Statistics, 63.* https://doi.org/10.1111/1468-0084.63.spe1.2

Guevara-Rosero, G., Carrión-Cauja, C., Simbaña-Landeta, L. and Camino-Mogro, S. (2023). Productivity determinants in the service industry: differences between high and low knowledge intensive sectors. *Academia Revista Latinoamericana de Administración, 36(1).* https://doi.org/10.1108/ARLA-05-2022-0121

Howells, J. (2004). Innovation, consumption and services: encapsulation and the combinatorial role of services. *The Service Industries Journal, 24(1).* https://doi.org/10.1080/02642060412331301112

Jalil, A., Manan, S. and Saleemi, S. (2016). Estimating the growth effects of services sector: A cointegration analysis for Pakistan. *Economic Structures, 5(1).* https://doi.org/10.1186/s40008-016-0037-8

Johansen, S. and Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration-with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52(2).* https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Kaldor, N. (1984). Causas del lento ritmo de crecimiento del Reino Unido. *Investigación Económica, 43(167).* https://www.jstor.org/stable/42779413

Kripfganz, S. and Schneider, D. (2018). ardl: Estimating autoregressive distributed lag and equilibrium correction models, proceedings of the 2018 London Stata Conference. http://www.kripfganz.de/research/Kripfganz_Schneider_ardl.html

__________ and Schneider, D. (2020). Response surface regressions for critical value bounds and approximate p-values in equilibrium correction models. *Oxford Bulletin of Economics and Statistics, 82(6).* https://doi.org/10.1111/obes.12377

Kuznets, S. (1973). Modern economic growth: Findings and reflections. *The American Economic Review, 63(3).* http://www.jstor.org/stable/1914358

Lee, J. and McKibbin, W. (2014). Service sector productivity and economic growth in Asia. *Asian Development Bank Institute adbi (Working Paper), (490).* http://hdl.handle.net/11540/1252

Levendis, J. (2018). *Time series econometrics. Learning through replication.* Springer.

Lewis, A. (1954). Economic development with unlimited supplies of labor. *The Manchester School, 22(2).* https://doi.org/10.1111/j.1467-9957.1954.tb00021.x

Li, X. and Prescott, D. (2009). Measuring productivity in the service sector. *University of Guelph.* http://tourismhr.ca/wp-content/uploads/Measuring_Productivity_Service_SectorSept_EN.pdf

Liudmila, S., Cevallos, R. and Iglesias, C. (2019). Agricultural mechanization in Ecuador. *AMA, Agricultural Mechanization in Asia, Africa and Latin America, 50(2).* https://www.researchgate.net/publication/341979883_Agricultural_Mechanization_in_Ecuador

Mah, J. (2000). An empirical examination of the disaggregated import demand of Korea-the case of information technology products. *Journal of Asian Economics, 11(2).* https://doi.org/10.1016/S1049-0078(00)000531

Maroto-Sánchez, A. (2010). Crecimiento y productividad de las ramas de servicios. El papel de las TIC. *Cuadernos de Economía, 33(93).* https://doi.org/10.1016/S0210-0266(10)70072-8

____________ (2012). Productivity in the services sector: Conventional and current explanations. *The Service Industries Journal, 32(5).* https://doi.org/10.1080/02642069.2010.531266

____________ (2013). Las relaciones entre servicios y productividad: un tema a impulsar en el ámbito regional y territorial. *Investigaciones Regionales, (27).* https://www.redalyc.org/articulo.oa?id=28928823007

Maroto-Sánchez, A. and Rubalcaba, L. (2008). Services productivity revisited. *The Service Industries Journal, 28(3).* https://doi.org/10.1080/02642060701856209

Matuka, A. and Asafo, S. (2021). Effects of services on economic growth in Albania: An ARDL Approach. *The Journal of International Trade & Economic Development, 30(6).* https://doi.org/10.1080/09638199.2021.1910723

Messina, J. (2005). Institutions and service employment: A panel study for OECD countries. *Labour, 19(2).* https://doi.org/10.1111/j.14679914.2005.00298.x

Oulton, N. (2001). Must the growth rate decline? Baumol's unbalanced growth revisited. *Oxford Economic Papers, 53(4).* https://www.jstor.org/stable/3488605

Pagés, C. (ed.) (2010). *La era de la productividad: cómo transformar las economías desde sus cimientos.* Banco Interamericano de Desarrollo.

Palma, J. G. (2005). Four sources of "De-Industrialization" and a new concept of the "Dutch Disease". In J. A. Ocampo (ed.). *Beyond reforms: Structural dynamics and macroeconomic vulnerability* (pp. 71-116). United Nations Economic Commission for Latin America and the Caribbean.

____________ (2019). Desindustrialización, desindustrialización "prematura" y "síndrome holandés". *Trimestre Económico, 86(344).* https://doi.org/10.20430/ete.v86i344.970

Pesaran, H. and Shin, Y. (1999). An autoregressive distributed lag modelling approach to cointegration analysis. In S. Strøm (ed.). *Econometrics and economic theory in the 20th century. The ragnar frisch centennial symposium* (pp. 371-413). Cambridge University Press.

____________ , Shin, Y. and Smith, R. (2001). Bounds testing approaches to the analysis of level relationship. *Journal of Applied Econometrics, 16(3).* https://doi.org/10.1002/jae.616

Price, J. and Gómez-Lobo, A. (2021). Baumol's cost disease and urban transport services in Latin America. *Transportation Research Part A: Policy and Practice, 149.* https://doi.org/10.1016/j.tra.2021.04.019

Pugno, M. (2006). The service paradox and endogenous economic growth. *Structural Change and Economic Dynamics, 17(1).* https://doi.org/10.1016/j.strueco.2005.02.003

Quintana-Romero, L., Correa-Quezada, R., Ramón-Mendieta, M. and ÁlvarezGarcía, J. (2019). Sectoral regional growth and convergence in Ecuador: An analysis of the intra-distributive dynamics of productivity. *Symmetry, 11(4).* https://doi.org/10.3390/sym11040461

Rodrik, D. (2009). Growth after the crisis. *Commission on Growth and Development Working Paper, (65).* http://hdl.handle.net/10986/27937

____________ (2015). Premature deindustrialization. *Journal of Economic Growth, 21.* https://doi.org/10.1007/s10887-015-9122-3

Rowthorn, R. and Ramaswamy, R. (1999). Growth, trade, and deindustrialization. *imf Staff Papers, 46(1).* https://doi.org/10.2307/3867633

Rubalcaba, L. (2015). El crecimiento de los servicios. In D. Aboal, G. Crespi and L. Rubalcaba (eds.). *La innovación y la nueva economía de servicios en América Latina y el Caribe. Retos e implicaciones de política* (pp. 13-38). BID, CINVE and IDRC.

Rubalcaba, L., Gago, D., Ariano, M. and Tripathi, A. (2016). Services and innovation for the competitiveness of the Ecuadorian economy. *Policy Research Working Paper, (7767).* http://hdl.handle.net/10986/24848

Sankaran, A., Kumar, S., K, A. and Das, M. (2019). Estimating the causal relationship between electricity consumption and industrial output: ARDL bounds and Toda-Yamamoto approaches for ten late industrialized countries. *Heliyon, 5(6).* https://doi.org/10.1016/j.heliyon.2019.e01904

Schettkat, R. and Yocarini, L. (2005). The shift to services employment: A review of the literature. *Structural Change and Economic Dynamics, 17(2006).* https://doi.org/10.1016/j.strueco.2005.04.002

Singh, T. (2010). Services sector and economic growth in India. *Applied Economics, 42(30).* http://dx.doi.org/10.1080/00036840802360229

Szirmai, A. (2012). Industrialisation as an engine of growth in developing countries, 1950-2005. *Structural Change and Economic Dynamics, 23(4).* https://doi.org/10.1016/j.strueco.2011.01.005

Szirmai, A. and Verspagen, B. (2015). Manufacturing and economic growth in developing countries, 1950-2005. *Structural Change and Economic Dynamics, 34.* https://doi.org/10.1016/j.strueco.2015.06.002

Timmer, M., De Vries, G. and De Vries, K. (2015). Patterns of structural change in developing countries. In J. Weiss and M. Tribe (eds.). *Routledge handbook of industry and development* (pp. 65-83). Routledge.

Toda, H. and Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics, 66.* https://doi.org/10.1016/0304-4076(94)01616-8

Tregenna, F. (2009). Characterising deindustrialisation: An analysis of changes in manufacturing employment and output internationally. *Cambridge Journal of Economics, 33(3).* http://www.jstor.org/stable/23601756

Triplett, J. and Bosworth, B. (2000). Productivity in the services sector. *Brookings Institution.* https://www.brookings.edu/wp-content/uploads/2016/06/20000112.pdf

____________and Bosworth, B. (2003). Productivity measurement issues in services industries: “Baumol’s disease” has been cured. *Economic Policy Review, 9(3).* https://www.newyorkfed.org/research/epr/2003.html

____________ and Bosworth, B. (2004). *Productivity in the U.S. services sector. New sources of economic growth.* Brookings Institution Press.

World Bank (2023). Open access data from the World Bank. https://datos.bancomundial.org/

Wu, Y. (2015). China’s services sector: The new engine of economic growth. *Eurasian Geography and Economics, 56(6).* https://doi.org/10.1080/15387216.2016.1153429

Wu, L. and Baumol, W. (2012). Productivity growth, employment allocation, and the special case of business services. In W. Baumol. *The cost disease. Why computers get cheaper and health care doesn’t* (pp. 116-137). Yale University Press.

Yousuf, Md., Ahmed, R., Akther, N. and Sumon, S. (2019). Estimating the services sector impact on economic growth of Bangladesh: An econometric investigation. *Asian Journal of Economic Modelling, 7(2).* https://doi.org/10.18488/journal.8.2019.72.62.72

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[1] The study presents evidence from 22 cities in Colombia, Buenos Aires (Argentina), Panama City (Panama) and Santiago (Chile).