Determinants of digital service exports in Latin America and the Caribbean

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Date received: June 4, 2024. Date of acceptance: September 24, 2024.

Abstract

This study analyzes the impact of regulatory and other barriers on digital services (DS) exports from Latin American and Caribbean (LAC) countries at the intraregional level and to third-party markets. Reducing disparities in DS trade regulations among LAC countries could increase intraregional trade in these services by up to 8%. On the other hand, the existence of trade agreements with a services chapter between LAC countries would have allowed for a 44% increase in intraregional digital services trade. Investments in human capital and connectivity in LAC countries would contribute to the growth of intraregional trade in DS.

Keywords: exports; digital services (DS); trade barriers; gravity model; Poisson PseudoMaximum-Likelihood (PPML).

1. INTRODUCTION[1]

The service sector dominates economies and job creation in Latin America and the Caribbean (LAC), accounting for between half and two-thirds of these aggregates in the countries of the region (UNCTAD, 2019). Since the beginning of this century, there has been sustained growth in global trade in services, exceeding trade in goods. This is most evident in so-called digital services (DS).

DS are also referred to as knowledge-based services, as they are generally defined as those for which Information and Communication Technologies (ICT) play an important role in facilitating trade (Borga and Koncz-Bruner, 2012; Bamber *et al.*, 2022). In general terms, this study understands DS (digitally enabled or delivered) to mean the following: *a)* telecommunications, computer, and information services; *b)* financial services; *c)* insurance and pension services; *d)* intellectual property charges; and *e)* other business services (Loungani *et al.*, 2017; Liberatore and Wettstein, 2021).

According to the Economic Commission for Latin America and the Caribbean (ECLAC, 2023), DS (or modern services) is the most dynamic category of world trade in the last 20 years due to the digital revolution and the mass introduction of broadband since the 2000s. This innovation facilitates cross-border trade in various services that were

previously considered difficult to trade, such as business, financial, engineering, design, educational and medical services.

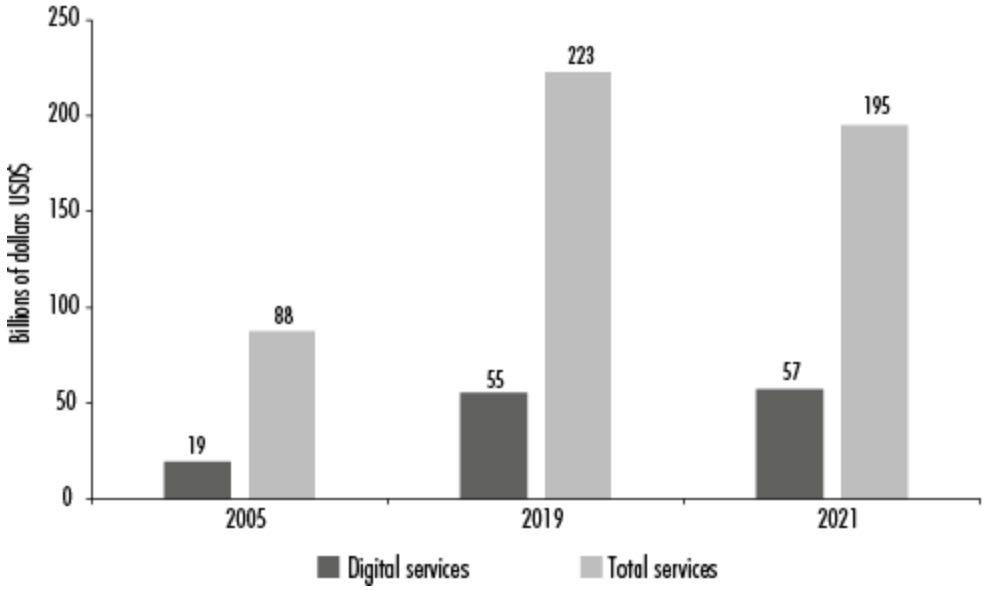
The relative importance of restrictions on trade in DS has been documented in various studies, albeit with data from member countries of the Organization for Economic Cooperation and Development (OECD), which includes few LAC countries (mainly Chile and Mexico). Helping to close this knowledge gap is one of the main objectives of this study, which uses a database on DS trade restrictions in 17 LAC countries for the period 2014-2021.[2] Other obstacles and drivers of DS trade are also analyzed in order to provide a basis for the development of a preliminary DS-based trade integration agenda, which could become a new driving force for LAC integration.

To develop the study, the second section, following the introduction, presents an overview of DS trade in the region. The third section summarizes the literature on obstacles and drivers of DS trade. The fourth section describes the methodology used, together with the empirical strategy and data used for the econometric exercise. A fifth section presents the results of the analysis. Finally, the conclusions of the study are presented.

2. DS REGIONAL TRADE BALANCE

Given the profound changes in the speed and form of economic development brought about by the technological and industrial revolution—particularly due to advances in digital information technologies such as the Internet, big data, and artificial intelligence—the digital economy has increased its share of the economy. An important feature of this new context is the growth of DS exports by LAC countries (see Figure 1).

Figure 1. LAC exports of services and DS (in billions of US dollars)



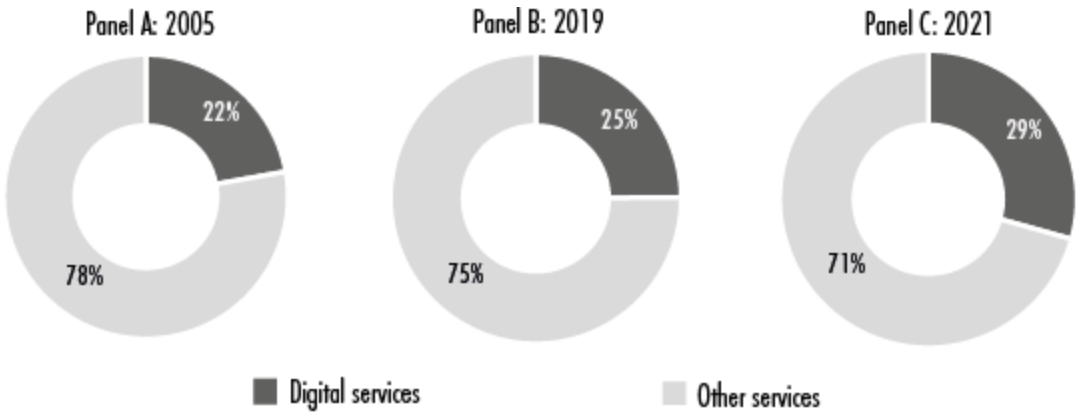
Source: prepared by the authors using data from the Balanced Trade in Services (BaTIS) dataset.

LAC DS exports rose from USD$19,412 million in 2005 to USD$55.434 billion in 2019 and to USD$57.240 billion in 2021, showing an average annual growth rate between 2005 and 2021 of 7%. This result is higher than the growth in total service exports, which rose from USD$87,563 million to USD$195,150 million during the same period (average

annual growth rate of 5.1%). In addition, the growth of LAC DS exports was slightly lower than that observed for the world as a whole (7.7%) during the period 2005-2021.

Meanwhile, the share of DS exports in total service exports rose from 22% to 29% during the period 2005-2021 (see Figure 2). This latter result contrasts with the global picture where the share of DS exports in total services rose from 44% to 62% over the same period. These differences could be due to particular obstacles faced by countries in the region.

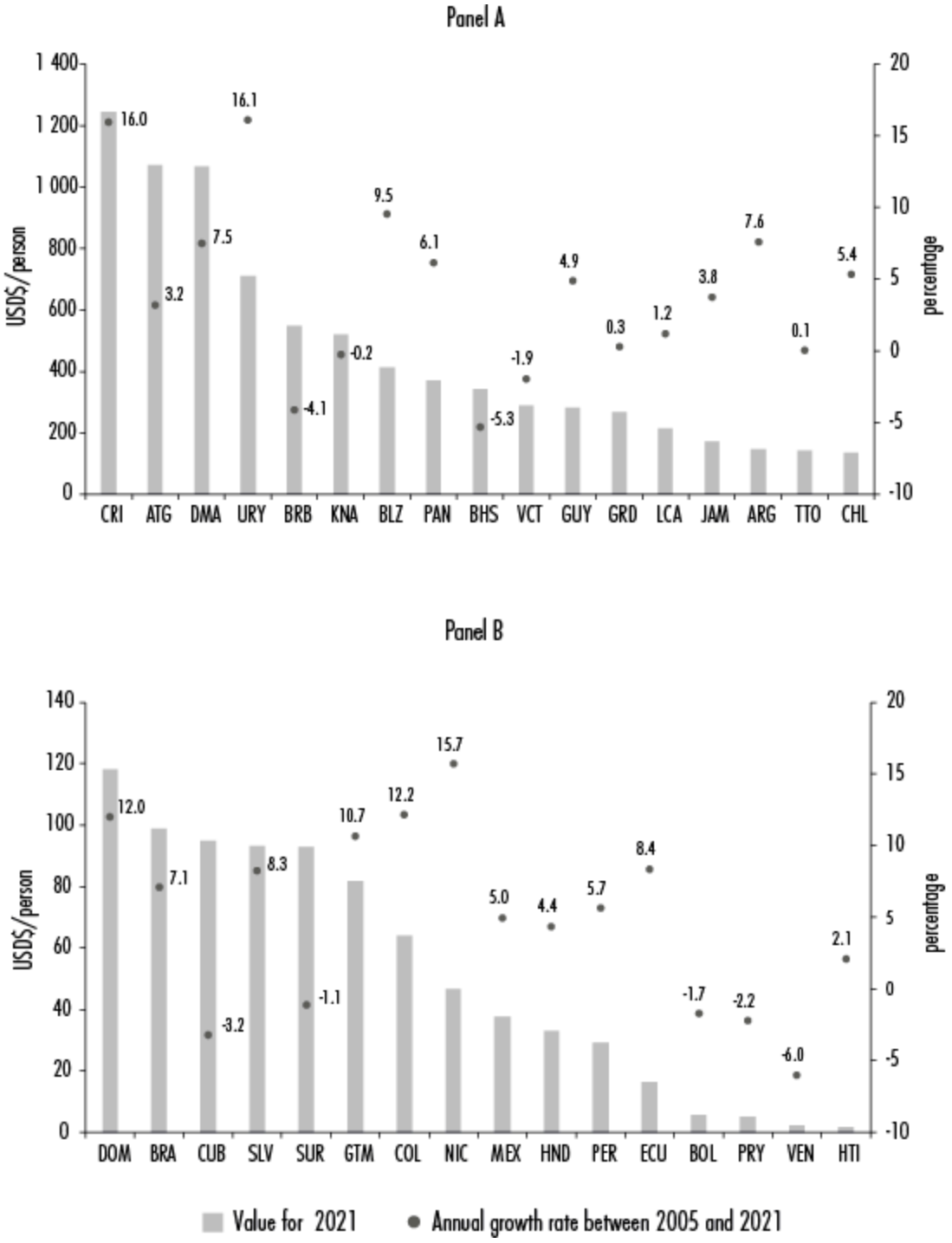
Figure 2. Share of DS exports (2005, 2019, and 2021)



Source: Prepared by the authors using data from the Balanced Trade in Services (BaTIS) dataset.

An analysis of the dynamics of DS exports in the region (see Figure 3) shows that Brazil, Argentina, Costa Rica, Mexico, and Colombia are the leading DS exporters in the region (Panel A). Furthermore, Uruguay, Costa Rica, Nicaragua, Colombia and the Dominican Republic are the countries with the highest growth rates in DS trade, with values of 16.1, 16, 15.7, 12.2, and 12%, respectively.

Figure 3. Exports per capita and growth rates of DS in LAC, 2021



Source: Prepared by the authors with data from the Balanced Trade in Services (BaTIS) dataset.

ECLAC (2023) points to Costa Rica and Uruguay as the Latin American countries with the highest growth in the value of DS exports. For example, Costa Rica has specialized in exports of professional and management consulting services, as well as technical services, and is also home to several transnational companies that provide services to all their branches in the Americas and, increasingly, to other continents. Meanwhile, Uruguay focuses on exporting IT services (software and other services), most of which are exported by transnational companies. The success of both countries in this area is based mainly on the highly specialized training of professionals in the field of professional consulting, management, technical and IT services, and on the presence of foreign companies that are attracted, in part, by incentives linked to free trade zones. In these countries, policy coordination and implementation is also

carried out by entities that are highly specialized in attracting Foreign Direct Investment (FDI), promoting DS exports, and trade policy.

3. LITERATURE REVIEW ON OBSTACLES AND DRIVERS OF DS TRADE

In their review of the literature on SD trade, Di *et al.* (2022) point to three important characteristics of this type of trade: first, transactions are based on internet technology; second, the object of trade is intangible knowledge and technology-intensive DS; and third, marginal production and transport costs are almost zero. These characteristics have important implications for studying the barriers and drivers of DS trade as they point to the relative importance of having the appropriate digital infrastructure, the development of skilled human resources and the irrelevance of physical distance as a barrier to trade in these services.

Furthermore, trade in DS is affected by a complex system of national and international rules and regulations. International trade rules are embedded in the rules and agreements of the World Trade Organization (WTO), which cover aspects of digital trade, as well as in regional trade agreements that increasingly incorporate a wide range of digital measures (López González and Ferencz, 2018). Trade liberalization in DS is a key factor for increasing and integrating trade in this type of commerce (Crenshaw and Robison, 2006).

All of the above can constitute a serious obstacle to trade and regional integration in this type of service in LAC. Several studies with data from OECD member countries show the relative importance of this type of obstacle. These studies, which include few LAC countries (generally Chile and Mexico), indicate that countries with greater restrictions on trade in services import and export fewer services, and that the contraction in exports resulting from these restrictions is twice as high as in the case of imports (Nordas and Rouzet, 2017; Ciuriak and Lysenko, 2016). Furthermore, restrictions on trade in services have been found to be much more limiting than barriers to trade in goods (Hoekman and Shepherd, 2021).

Meanwhile, barriers to trade in services in LAC are higher than estimates for other regions of the world and are above the global average in all sectors analyzed, meaning that the region lags behind in terms of competitiveness. In addition, the Services Trade Restrictiveness Index (STRI) shows significant heterogeneity across sectors, with countries such as Mexico and Costa Rica even falling below the global average in restrictions on digitally enabled services (Giordano and Ortiz de Mendívil, 2021).

Furthermore, specialized literature indicates that each component of the degree of readiness for trade in services may represent both an obstacle and a driver of this type of trade, depending on whether that component constitutes a weakness or a strength in the countries under consideration, e.g. the degree of development of physical and digital infrastructure; the availability of skilled human resources; and the adoption of new technologies and FDI in services. In addition to these variables, other factors include the existence of free trade agreements (FTAs) with services chapters;[3] the relative importance of exports of goods; the proximity of trading countries; a common language; a common religion; a similar colonial history; and the intensity of passenger traffic on bilateral flights and through air transport (Gervais, 2018; Borchert and Yotov, 2017; Anderson *et al.*, 2018; Benz and Jaax, 2020; Gupta *et al.*, 2022; Benz *et al.*, 2022).

In the specific case of DS, other key components of digital readiness for trade in this type of service have been identified, including the availability of human capital (Reddy and Gairola, 2002); digital connectivity (internet penetration and speed) (Wang, 2021); investment and adoption of ICT by companies and individuals (Freund and

Weinhold, 2002); and policies and the regulatory environment related to the ecosystem for trade in DS (Woo Kang *et al.*, 2022).

Regarding the determinants of DS exports, Nasir and Kalirajan (2016) calibrate a stochastic frontier gravity model with a sample of 25 countries to explore the determinants of bilateral DS exports in three subgroups: *1)* telecommunications services, *2)* ICT services, and *3)* business and personal services. The results show that the number of graduates (tertiary education) and the quality of ICT infrastructure in emerging economies are among the key factors for increasing DS exports, as well as internet use among the population. Conversely, the index of restrictions on trade in services (the STRI estimated by the OECD) shows a negative relationship with exports in the three service subgroups.

Fraser (2021) explores a gravitational modeling methodology to estimate the effect of restrictions on trade in DS and simulates their trade impact, with an emphasis on the level of restrictions on trade in services in free trade agreements. The effect of STRI (estimated by the OECD) is analyzed together with trade agreements, concluding that restrictions negatively impact exports of DS.

Meanwhile, Woo Kang *et al.* (2022) study DS exports from countries in the Asia-Pacific region, using a gravitational model with pairs of countries (exporter-importer), assessing the potential impact of variables related to human capital, digital connectivity, ICT investments and the trade policy and regulatory environment. Additionally, they incorporate controls such as distance between countries, contiguity and common official language, as well as a variable indicating regional trade agreements (RTA). The results indicate that human capital, faster international internet bandwidth, telecommunications-related investments and greater internet freedom have a positive and significant association with DS exports. Contrary to this, the RTA dummy variable appears to have no relationship.

Based on a sample of 33 countries, Di *et al.* (2022) use a multiple linear regression model to assess the interrelationship between DS exports and investment in telecommunications infrastructure, human capital, innovation, FDI flows, and intellectual property rights. The study indicates that there is a positive and significant relationship between digital infrastructure, human capital, science and technology, and innovation capabilities and the competitiveness of trade in DS. Furthermore, science, technology, and innovation capabilities have the strongest effect on trade in DS compared to digital infrastructure and human capital.

Using a gravitational model, López-González *et al.* (2023) find that growing global digital connectivity generates a double dividend by increasing both domestic and international trade. They also conclude that digital trade has the potential to double the effect of trade agreements, while reductions in internal barriers affecting digital trade have a significant effect on improving DS exports. Overall, the results suggest that digital connectivity and digital trade policies play an important and growing role in reducing trade costs and increasing international trade.

Focusing on the trade integration of African countries, UNECA (2023) calibrates a gravitational model to investigate how regulatory heterogeneity relates to intraregional trade in DS, identifying high heterogeneity associated with lower trade integration. This suggests that efforts to harmonize regulation in trade negotiations on DS would benefit intraregional trade flows, with a stronger impact as countries become more open to trade.

Based on the evidence described above, it is important to study the possible impact of the variables analyzed in the literature on bilateral trade in DS between LAC countries, as well as other potential determinants of such trade. This issue is addressed below.

4. METHODOLOGY

This study estimates a gravitational model to identify the obstacles and drivers of trade in DS among LAC countries. The gravity model of trade has been the "workhorse" for estimating the impact of various trade policies and other determinants of trade flows, including the effects of trade agreements, thanks to its theoretical foundations and empirical success (Yotov, 2022), as well as the representation of microfundamentals (Arkolakis *et al.*, 2012). Furthermore, it is no longer used exclusively for the analysis of trade in goods, but is also successfully applied to the study of trade in services (Nordas and Rouzet, 2017; Fraser, 2021; Khachaturian and Oliver, 2021).

Following the system of equations of the structural gravity model, initially developed by Anderson (1979) and refined by Anderson and van Wincoop (2003):

$$X_{ij}^k = \frac{E_j^k Y_i^k}{Y^k} \left(\frac{t_{ij}^k}{P_j^k \Pi_i^k} \right)^{1-\sigma^k} \quad (1)$$

$$\left(P_j^k\right)^{1-\sigma^k} = \sum_i \left(\frac{t_{ij}^k}{\Pi_i^k} \right)^{1-\sigma^k} \frac{Y_i^k}{Y^k} \quad (2)$$

$$\left(\Pi_i^k\right)^{1-\sigma^k} = \sum_j \left(\frac{t_{ij}^k}{P_j^k} \right)^{1-\sigma^k} \frac{E_j^k}{Y^k} \quad (3)$$

Where X_{ij}^k denotes the value of exports from country *i* to destination *j* in sector *k*. E_j denotes total expenditure in sector *k* in destination *j*, while Y_i^k denotes the total value of production *k* from country *i* to all destinations. *Y* is the total world production of goods *k*, while σ^k is the trade substitution elasticity between the countries of origin of goods *k*. Π_i is the multilateral resistance to trade, which systematically adds the trade costs faced by producers in each region as if they were trading in a uniform world market. Similarly, the internal multilateral resistance, P_j, consistently adds the trade costs for consumers in each region *j* as if they were purchasing in a uniform world market (Franco-Bedoya, 2023).

Empirical strategy for estimating the gravity model

There is consensus in the literature that, when estimating the impact of trade policies on trade flows in services, an empirical strategy should be used that applies the structural gravitational model, following the Poisson Pseudo-Maximum-Likelihood (PPML) method. Santos and Tenreyro (2006) show that the PPML estimator allows for the direct inclusion of trade flows with a value of 0 and avoids biases in the coefficient in the presence of a heteroscedastic error term. Fally (2015) also shows that the PPML estimator is consistent with the theoretical assumptions underlying gravity models:

$$X_{ijt} = exp^{\left[Z'_{k,ijt}\beta_k + v_{ij} + p_{jt} + \gamma_{ij}\right]} * \epsilon_{ijt} \quad (4)$$

Where X_{ijt} is the value of exports from country *i* to country *j* in year *t*; Z ´ is a *k* × 1 vector of independent variables specific to pairs of exporting and importing countries in year *t* that may have an effect on exports; while β_k is the *k* × 1

vector of regression coefficients to be estimated.

Vector *Z'* contains two sets of variables. The first includes explanatory variables of the amount of DS exports by pairs of exporting-importing countries, commonly used in gravity models. The second set of variables includes trade policy variables that help explain DS trade flows.

A challenge when estimating the gravity equation (4) is that the terms of multilateral resistance P_j and Π_i are theoretical constructs and, as such, are not directly observable by the researcher and/or person responsible for formulating policy. Meanwhile, Baldwin and Taglioni (2006) emphasize the importance of adequate control for terms of multilateral resistance.

Hummels (1999) and Feenstra (2016) suggest fully accounting for multilateral resistance terms by using directional fixed effects (exporter and importer) in cross-sectional estimates (exporting country-year ($\boldsymbol{v_{it}}$) and importing country-year ($\boldsymbol{p_{jt}}$) fixed effects). Olivero and Yotov (2012) demonstrate that multilateral resistance terms can be taken into account using fixed effects for export time and importer time in a dynamic gravity estimation framework with panel data. It should be noted that, in addition to taking into account non-observable multilateral resistance terms, fixed exporter time and importer time effects will also absorb the size variables (E_j and Y_i) of the structural gravity model, as well as all other observable and unobservable country-specific characteristics that vary according to these dimensions, including various national policies, institutions and exchange rates.

As a result, fixed effects per exporting country-year (v_{it}) and importing country-year (p_{jt}) were included in the estimation of equation (4) to control for external multilateral resistance and internal multilateral resistance, respectively, while ($\boldsymbol{\epsilon_{ijt}}$) is the usual residual.[4]

To complement this, in order to avoid endogeneity bias in trade policy variables due to bilateral factors, country-pair fixed effects (γ_{ij}) are included in the estimation (Baier and Bergstrand, 2009). It should be noted that the set of country-pair fixed effects will absorb all time-invariant bilateral covariates (e.g., bilateral distance), which are used as standard in gravity regressions. However, country-pair fixed effects will not prevent the estimation of bilateral trade policy effects, as by definition trade policies vary over time. Furthermore, country-pair fixed effects will also account for any non-observable time-invariant trade cost components (Yotov *et al.*, 2016).

It is important to bear in mind the restriction on introducing variables related to non-discriminatory trade policies into the equation (4) model, such as the Digital Services Trade Restrictiveness Index (DSTRI) (estimated by the OECD and ECLAC). The problem with non-discriminatory trade policy covariates is that they are specific to the exporter and/or importer and will therefore be absorbed, respectively, by the fixed effects of export time and importer time that should be used to control for multilateral resistances in the structural gravity model (Yotov *et al.*, 2016). In general terms, in the presence of fixed exporter and importer effects, the gravity model can no longer estimate the impact of any variable *i)* that affects the propensity of exporters to export to all destinations (e.g., an island); *ii)* that affects imports without taking origin into account (e.g., DSTRI applied at the country level); and *iii)* that represent sums, averages, and differences of country-specific variables (Head and Mayer, 2014).

Therefore, when estimating the gravity model of equation (4), we use the HDSTRI and the binary variable on the existence of a services chapter in trade agreements as trade policy variables in separate regressions. These are the two trade policy variables to be estimated in the gravity model in an unbiased and efficient manner. The HDSTRI is

constructed by assessing, for each pair of countries and each measure, whether or not the countries have the same regulation on DS trade. As noted above, for each pair of countries, the indices reflect the (weighted) proportion of measures for which the two countries have different regulations. The HDSTRI index takes a value from 0 to 1. The HDSTRI will be equal to 0 if the two countries under analysis have the same regulation in terms of the DSTRI (homogeneous regimes), or 1 if the two countries have completely different regulations (heterogeneous regimes) (Ferencz, 2019). In the case of the binary variable, it is equal to 1 if both countries (exporter and importer) have a free trade agreement on goods that includes a chapter on services, and 0 otherwise.

Finally, it should be noted that the coefficients associated with the explanatory variables in vector Z ´ of equation (4) can be calculated in percentage terms, when the variables are binary, as follows:

$$\left(e^{\beta k} - 1\right) x\ 100 \qquad (5)$$

Where *βk* is the estimate of the effects of any gravity indicator variable specified in the gravity model. For example, the estimate of the effects of FTAs in gravity regressions found in the empirical literature, β_{FTA} = 0. 76, implies that the FTAs that came into effect between 1960 and 2000, have on average increased trade by $[e^{0.76} - 1] \times 100 = 114\%$ (Baier and Bergstrand, 2009).

In the case of continuous variables, the interpretation of the coefficient associated with that variable is the elasticity of the value of exports with respect to the continuous variable, i.e., the percentage change in the value of exports given a 1% change in the continuous variable.

Data

A data panel for 89 countries, including 17 from LAC, was used for the period 2005-2021.[5] The analysis of the determinants of DS exports is based on a review of the literature on the factors that appear to influence the export performance of these services in these countries.

For statistical analysis purposes, the dependent variable was the dollar value of DS exports from each exporting country to its various trading partners (importing countries). Data on DS exports come from the latest version (April 2023) of the OECD-WTO Balanced Trade in Services ([Batis]; Liberatore and Wettstein, 2021).[6] The following are commonly used as covariates in gravity models:[7]

Distance: distance in kilometers between countries.

Border: binary variable equal to 1 if countries *i* and *j* share a border, 0 otherwise.

Common language: binary variable equal to 1 if countries *i* and *j* have a common language, 0 otherwise.

Shared colonial history: binary variable equal to 1 if countries *i* and *j* have the same colonial ties, 0 otherwise.

In addition, the following covariates were used, including trade policy variables.

Heterogeneity of DSTRI (HDSTRI): the Heterogeneity Digital Services Trade Restrictiveness Index is constructed by assessing, for each pair of countries and each measure, whether or not the countries have the same regulation on DS trade. For each pair of countries and each sector, the indices reflect the (weighted)

proportion of measures for which the two countries have different regulations. The HDSTRI index takes a value between 0 and 1. The HDSTRI will be equal to 0 if the two countries under analysis have the same regulations in terms of DSTRI (homogeneous regimes), or 1 if the two countries have completely different regulations (heterogeneous regimes; Ferencz, 2019).[8]

Free trade agreements containing a chapter on services: binary variable equal to 1 if countries *i* and *j* have a free trade agreement on goods with a chapter on trade in services.[9]

Human capital: average years of schooling in countries, based on data from the United Nations Development Program (UNDP). The value for both the DS-exporting country and the importing country or countries is used.

Investment in telecommunications: investment in telecommunications infrastructure. The annual amount in US dollars, according to the United Nations International Telecommunication Union (ITU). The value of both the DS-exporting country and the importing country or countries is used.

Broadband use: per Internet user, based on data from the United Nations ITU. The value for both the DS-exporting country and the importing country or countries is used.

5. RESULTS

Equation 4 is estimated using the PPML method for all countries included in the sample (worldwide), for intraregional trade in LAC (intraregional LAC) and for LAC trade with the rest of the world (extraregional LAC) (see Table 1). It shows that the gravity model estimated using the PPML method and employing the variables traditionally used for this type of exercise is robust. In addition to the variables related to the cost of trade, following Nordas and Rouzet (2017), four trade policy covariates are included: the HDSTRI heterogeneity index, the interactions between the HDSTRI and the DSTRI of the exporting and importing countries, and the variable "free trade agreement with a services chapter." It should be noted that the interactions between the HDSTRI and the DSTRI allow us to see whether the regulatory heterogeneity of different countries is more or less important, given the general level of restriction on digital trade in a country (UNECA, 2023).

Table 1. Results of the gravitational model with trade cost variables and regulatory heterogeneity (dependent variable: DS exports)

	Entire world	*LAC with LAC*	*LAC with the rest of the world*
Log distance	-.461***	-.658***	-.925***
	(.012)	(.045)	(.067)
Border	.04	.031	-1.17***
	(.049)	(.073)	(.123)
Shared language	.289***	(Omitida)	.769***
	(.038)		(.068)
Shared colonial history	.13**	(Omitida)	(Omitida)
	(.052)		
FTA (with Services Chapter)	.25***	.421***	-.285***
	(.027)	(.047)	(.061)
DSTRI heterogeneity	-.231	-3.465***	-.045
	(.334)	(.616)	(.591)
Heterogeneity DSTRI*DSTRIExp	1.9	-9.729***	8.971***
	(1.352)	(3.466)	(2.595)
Heterogeneity DSTRI*DSTRIImp	-2.495*	25.445***	2.069
	(1.373)	(3.256)	(2.662)
Constant	25.875***	22.527***	28.231***
	(.09)	(.332)	(.601)
Observations	53 136	1 920	8 448
Pseudo R2	.961	.943	.973
Exporter-year FE	Yes	Yes	Yes
Importer-year FE	Yes	Yes	Yes

Note: Some variables omitted due to collinearity. Standard errors in parentheses. *** p < .01; ** p < .05; * p < .1.
Source: prepared by the authors.

The results in Table 1 show that, in the case of LAC trade with LAC, regulatory heterogeneity takes on a statistically significant negative value. This result indicates that heterogeneity in DS trade restrictions between countries in the region effectively reduces intraregional DS trade. Thus, a reduction in the heterogeneity of trade restrictions could substantially improve trade flows between countries in the region. For example, a 1% (0.01) reduction in the HDSTRI index could lead to a 3.5% increase in DS exports between LAC countries.

Interactions between regulatory heterogeneity and the DSTRI of the exporting and importing countries, on the other hand, yield statistically significant results, but with different signs. Thus, the marginal impact of regulatory heterogeneity on service exports varies positively with the DSTRI of the importing country and negatively with that of the exporting country. This seems to indicate that, although regulatory heterogeneity is associated with lower levels of digital trade (HDSTRI coefficient), the positive result in the interaction term (HDSTRI*DSTRI) suggests that this heterogeneity is more important when a country has fewer restrictions on digital trade (in the case of the importing country) and vice versa (in the case of the exporting country).

Meanwhile, free trade agreements with a services chapter (FTA) have had a positive impact on DS exports in intraregional trade (FTA with FTA). This result suggests that the existence of an FTA with a services chapter allows for greater DS trade in the region (52%) despite existing regulations (see Table 1). Given that the LAC region has a high degree of DS trade restrictions, especially among countries in the region, this result reinforces the importance of further promoting the liberalization of intraregional DS trade.

When analyzing the above results for the entire sample (worldwide) and LAC trade with the rest of the world, it can be seen that only the coefficient related to FTAs with a services chapter has a positive and significant value. This reinforces the importance of this type of instrument in facilitating DS trade.

The results in Table 1 show the importance of free trade in terms of DS between LAC countries and between them and other countries outside the region. However, these estimates need to be corrected for the endogeneity bias of trade policy variables due to bilateral factors. For this purpose, we follow Baier and Bergstrand (2009) and use fixed effects of pairs of countries in the estimation of equation 4.[10] It should be noted that the set of fixed effects of pairs of countries will absorb all bilateral time-invariant covariates such as those shown in Table 1 (e.g., bilateral distance, common language, etc.). However, the fixed effects of pairs of countries will not prevent the estimation of the effects of bilateral trade policy, since trade policies by definition vary over time. In addition, the fixed effects of pairs of countries also take into account any unobservable and time-invariant trade cost component (Yotov *et al.*, 2016) (see Table 2).

Table 2. Results of the model with heterogeneity and trade and public policy variables (dependent variable: Latin American DS exports)

	(1) Entire world	*(2) LAC with LAC*	*(3) LAC with the rest of the world*
FTA (with Services Chapter)	.055	.365**	.004
	(.036)	(.165)	(.115)
Heterogeneity DSTRI	.049	-8.122***	1.589**
	(.318)	(2.814)	(.669)
Heterogeneity DSTRI*DSTRIExp	-1.142	11.146**	-10.787***
	(1.049)	(5.603)	(3.427)
Heterogeneity DSTRI*DSTRIImp	1.121	12.288*	4.146
	(.925)	(6.783)	(2.865)
Average years of schooling (years)	.002	.095*	-.01
	(.007)	(.056)	(.028)
Broadband internet usage	0.01***	0.03***	0.0
	(.01)	(.01)	(.02)
Constant	21.957***	9.966**	21.533***
	(1.029)	(4.59)	(2.942)
Observations	3 0452	1 170	5 067
Pseudo R2	.998	.991	.998
Exporter-year FE	Yes	Yes	Yes
Importer-year FE	Yes	Yes	Yes
Exporter-Importer FE	Yes	Yes	Yes

Notes: standard errors in parentheses. *** $p < .01$; ** $p < .05$; * $p < .1$.

Source: prepared by the authors.

In addition to the HDSTRI heterogeneity variables, the interactions between the HDSTRI and the DSTRI of the exporting and importing countries, and the existence of FTAs with a services chapter, two additional variables are included which, according to the literature, could also explain trade flows in the case of DS. These two variables are public policy variables, specifically: human capital (years of schooling) and broadband Internet use. In the case of trade between Latin American countries (LAC with LAC), all the model coefficients are statistically significant and show the expected sign. The opposite is true for trade in the entire sample (worldwide) and for Latin America with the rest of the world, where most of the coefficients are not significant. Furthermore, the gravity model estimated using the PPML method is robust.

In LAC intraregional trade (LAC with LAC), the existence of free trade agreements with a services chapter has a significant impact on DS trade for countries in the region. In fact, according to the results in Table 2, it can be concluded that the existence of a free trade agreement with a services chapter has led to a 44% increase in DS trade between countries in the region.

The coefficient associated with the HDSTRI variable shows that heterogeneity in trade regulations in this type of trade between countries in the region significantly hinders trade flows. Thus, a reduction in the heterogeneity of trade restrictions could substantially improve the flow of DS trade between countries in the region. For example, a 1% (0.01) reduction in the HDSTRI index could lead to an 8.1% increase in DS exports between LAC countries.[11]

Interactions between regulatory heterogeneity and the DSTRI of the exporting and importing countries, on the other hand, yield statistically significant results with the expected sign (positive). This result indicates that the marginal impact of regulatory heterogeneity on service exports varies positively with the DSTRI of the importing and exporting countries. In other words, regulatory heterogeneity is more important when a country has fewer restrictions on digital trade, both in the case of the importing country and the exporting country (UNECA, 2023). Finally, level of education and broadband Internet penetration appear to be important factors in facilitating DS trade between LAC countries.

It is important to promote a reduction in the degree of heterogeneity in DS trade regulations (HDSTRI) between LAC countries, as this would significantly increase trade integration. For example, considering that the HDSTRI between LAC countries averages 0.234 (ranging from 0.021 to 0.462), reducing DS trade regulations by the equivalent of the average HDSTRI value would increase DS trade in the region by more than 200%.

6. CONCLUSIONS

LAC DS exports grew by an average of 7% per year between 2005 and 2021, more than total service exports (5.1%). The share of DS in total service exports in LAC rose from 22% to 29% over the same period, compared with the global figures (44% to 62%).

LAC countries differ widely in their DS export performance, with Brazil, Argentina, Costa Rica, Mexico, and Colombia being the largest exporters. Small countries such as Uruguay, Costa Rica, Chile, Colombia, and the Dominican Republic show higher growth rates in DS exports.

Regional integration in DS is low in LAC. Only for Argentina and Paraguay does LAC represent more than 25% of the destination market. For Saint Lucia, Uruguay, Saint Vincent and the Grenadines, Grenada, Colombia, and Costa Rica, LAC represents between 15% and 25%. For the rest of the countries in the region (25), LAC represents less than 15% of the market.

The results of the econometric model indicate that reducing the heterogeneity in DS trade regulations (HDSTRI) between LAC countries by 1% could increase intraregional trade in these services by up to 8%. Likewise, the existence of free trade agreements that include a chapter on services between LAC countries would have allowed intraregional DS trade to be 44% higher.

Increasing human capital (years of formal education) is a policy that can strengthen or boost DS trade between LAC countries. It is also important to increase connectivity between these countries in order to promote intraregional DS trade both within the region and between LAC and the rest of the world.

In general terms, it can be argued that the promotion of intraregional exports of DS in LAC could be strengthened by implementing a productive development policy approach based on four pillars: *1)* reducing and leveling regulatory barriers to intraregional DS trade; *2)* promoting, among the countries of the region, the inclusion of a services chapter in free trade agreements; *3)* increasing broadband Internet connectivity; and *4)* increasing investment in human capital.

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[1]

[2] Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Mexico, Panama, Paraguay, Peru, Dominican Republic, and Uruguay.

[3] Although recent trade agreements include provisions on trade in services, few within LAC go beyond the provisions of the General Agreement on Trade in Services (Giordano and Ortiz de Mendívil, 2021).

[4] The challenge of equation (4) lies in estimating the coefficients associated with the impact of the different independent variables, while control is maintained for any factors that may affect the exports of country *i* in year *t*. Therefore, equation (4) is estimated by PPML using robust fixed effects and cluster standard errors. With the fixed effects estimation, the relationship between the independent and outcome variables within countries is explored, eliminating the effect of unobserved time-invariant characteristics. The robust error option is used to account for heteroscedasticity and serial correlation within the panel in the idiosyncratic error term (Greene, 2008; Das, 2019).

[5] Except for trade policy variables: Heterogeneity Digital Services Trade Restrictiveness Index (HDSTRI) and the existence of a free

trade agreement with a services chapter, where available figures cover the period 2014-2021.

[6] Batis is a comprehensive, consistent, and balanced matrix of international trade in services statistics. It contains annual bilateral data for 202 countries (17 in Latin America), broken down into the 12 main categories of EBOPs2010 (BPM6). For analysis purposes, the following were added to the DS category: Insurance and pension services; Financial services; Intellectual property charges n.i.e.s.; Telecommunications, computer and information services; and Other business services (see https://www.OECD.org/SDd/its/balanced-trade-statistics.htm).

[7] The source of this data is "The CEPII Gravity database." http://www.cepii.fr/CEPII/en/bdd_mo- dele/bdd_modele_item.asp?id=8

[8] The HDSTRI was constructed by the OECD based on barriers to international DS trade estimated by the OECD itself, from the DSTRI for the period 2014-2022.

[9] The source is "The CEPII Gravity Database." http://www.cepii.fr/CEPII/en/bdd_modele/bdd_mo- dele_item.asp?id=8

[10] It should be noted that the problem of endogeneity generates biases in the ordinary least squares (OLS) regression coefficients, hence the importance of this correction in the estimation of equation 4.

[11] López-González *et al.* (2023) indicate that small changes in the DSTRI can generate high variations in trade; for example, a change of 0.1 points in the DSTRI may represent a significant regulatory reform. By way of comparison, a decrease of 0.08 reflects a shift from a more restrictive to a less restrictive approach to data transfers in a country. Although exercises that include DSTRI in the analysis of the determinants of DS exports are scarce in the literature, most studies that estimate the impact of regulations report high coefficients, which, in most cases, are higher than those obtained in this exercise (see López-González *et al.* (2023); UNECA (2023); Khachaturian and Oliver (2021); Fraser (2021); Nordas and Rouzet (2017); Nasir and Kalirajan (2016)).