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Financial inclusion and Fintech: catalysts for the Sustainable Development Goals in Latin America

Inclusión financiera y Fintech: catalizadores de los Objetivos de Desarrollo Sostenible en América Latina

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Abstract: fintech are critical players in the inclusive digitalization of finance, helping to reduce inequality by providing access to a range of financial services that banks do not normally serve. They thus contribute to financial inclusion as a fundamental factor for sustainable development. The aim of the study is to assess how financial inclusion and Fintech growth contribute to the achievement of the sustainable development goals in Latin America. A quantitative approach is employed with a descriptive-correlational and longitudinal scope. It works with evidence based on information from six Latin American countries with the highest nominal GDP in US$ (Argentina, Brazil, Chile, Colombia, Mexico, Peru). The data analysis method used is Pearson's correlation. The overall SDG index and the individual indices of SDG 2, SDG 7, SDG 9, SDG 16 and SDG 17 are significantly, positively and with a large effect size associated with the study variables on financial inclusion in Latin America. Examining the SDG9 Index in depth, it is the most statistically significant of all the SDG indices with related variables, both in terms of financial inclusion and in terms of measuring the Fintech ecosystem. This work contributes to promoting further research on the SDGs achievement, financial inclusion, and Fintech development in Latin America.

Keywords: 2030 Agenda, correlation, financial inclusion, Fintech, indexes, Latin America, Sustainable Development Goals, sustainability.

Resumen: las Fintech son actores esenciales para la digitalización inclusiva de las finanzas ayudando a reducir la desigualdad al brindar acceso a variados servicios financieros que los bancos normalmente no atienden y aportando así a la inclusión financiera como factor fundamental para el desarrollo sostenible. El propósito del estudio es evaluar si la inclusión financiera y el crecimiento Fintech contribuyen al logro de los objetivos de desarrollo sostenible en Latinoamérica. El diseño de investigación es cuantitativo, descriptivo correlacional en su alcance y de corte longitudinal. Se trabaja con evidencia basada en información de seis países del ámbito latinoamericano con mayor PIB nominal en US$ (Argentina, Brasil, Chile, Colombia, México, Perú). El método de análisis de datos utilizado es la correlación de Pearson. El índice general de los ODS y los índices individuales del SDG2, SDG7, SDG9, SDG16 y SDG17 están asociados significativa, positivamente y con un tamaño del efecto grande con las variables de estudio sobre inclusión financiera en América Latina. Analizando en profundidad el Índice SDG9, es de todos los índices por ODS el que mayor relevancia estadística ha tenido con una gran cantidad de variables relacionadas, tanto de inclusión financiera como de medición del ecosistema Fintech. Este trabajo contribuye a promover nuevas investigaciones sobre la relación entre la inclusión financiera el desarrollo Fintech y el cumplimiento de los ODS en América Latina.

Palabras clave: Agenda 2030, correlación, Fintech, inclusión financiera, índices, Latinoamérica, Objetivos de Desarrollo Sostenible, sostenibilidad.

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Introduction

Financial inclusion focused on access to useful and affordable financial products that meet the needs of individuals and businesses in a responsible and sustainable manner, is a crucial element in addressing today's global challenges including inequality, poverty, environmental degradation, peace, prosperity and justice, being a central axis in achieving the Sustainable Development Goals (SDGs) (Demirguc-Kunt *et al*., 2022).

The 17 SDGs, with their respective 169 targets, were established by the United Nations (UN), through the United Nations Development Program (UNDP) and the 2030 Agenda, valid over fifteen years and involving one hundred and ninety-three countries from all over the planet (Orzes *et al*., 2018). With the emergence of the 2030 Agenda during September 2015, it was considered important that the global population be able to access a broader level of financial services in order to directly impact the fulfillment of at least seven SDGs: SDG1 End of Poverty, SDG2 Zero Hunger, SDG3 Health and Well-being, SDG5 Gender Equality, SDG8 Decent Work and Economic Growth, SDG9 Industry, Innovation and Infrastructure, and ODS10 Reduction of Inequalities (Deloitte, 2021; UNSGSA, 2023).

In turn, tech-finance startups – Fintech – essential players in the inclusive digitization of finance, help reduce inequality by providing access to a variety of financial services and reaching out to groups and geographic areas that banks typically do not serve. Thousands of people can pay, collect, save and invest without having an institutionalized bank account thanks to these entities that provide new sources of services in order to accelerate the adoption of sustainable business models, thus contributing to the achievement of the SDGs and financial inclusion (Arner *et al*., 2020).

Sustainable Development Goals - SDGs

Due to the globalization of business, technological advances, fierce competition for natural resources, and growing awareness of climate change, all sectors of the economy are expected to participate in the development of solutions and in the provision of a global response to these problems (Salvia *et al*., 2018), so the UN 2030 Agenda was created with the purpose of aligning international cooperation to achieve ambitious and quantitative objectives that help countries move towards a sustainable development model, taking into account the three main dimensions of the sustainable model: economic development, social inclusion and environment. The SDGs, which were outlined in order to protect the planet, ensure peace and prosperity and eliminate poverty for all the people of the world without discrimination, are therefore broader in scope than that proposed in the previous Millennium Development Goals (MDGs), challenging national governments to align their goals with what the community requests around sustainable development (Orzes *et al*., 2018).

The study by Confraria *et al*. (2024) has linked the SDGs that countries distinguish as priorities with those to which the greatest research and development resources have been contributed in order to improve them, with SDG1, SDG2 and SDG9 being the ones that stand out in a sample of 125 countries. Works like that of Boto-Álvarez and García-Fernández (2020) investigate the voluntary disclosures of certain countries and their help to achieve the SDGs, from a macroeconomic perspective, considering the government actions carried out. In this line, Sachs *et al*. (2017) studied the SDGs and their respective achievements in Latin America and the Caribbean, finding that insecurity and violence are the most important challenges at the Latin American level, as well as improvements in education and health systems.

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Financial Inclusion

Developing countries have the highest proportion of the world's unbanked population and lower levels of financial inclusion than developed countries (Dupas *et al.*, 2018). Financial inclusion is a key element in solving today's global challenges and is established as the quest for all economic actors to have access to and be able to use formal financial services effectively, which has become a public policy priority after the global financial crisis. It is a concept that is constantly evolving, constructed and debated and whose development and measurement can be analyzed and promoted from different perspectives.

Multiple studies have sought to operationalize and measure financial inclusion through selected indicators and indices. Various authors (Gautam *et al.*, 2022; Wang Tok and Heng, 2022) consider the "access" dimension of financial inclusion using variables obtained based on financial service providers, considering the number of ATMs each certain distance or population density, number of bank branches per adult or per kilometer, internet penetration, among other elements. When assessing financial inclusion under this approach, the contribution of digital financial inclusion is left aside (Khera *et al.*, 2022; Tay *et al.*, 2022), which has been enhanced with the emergence of new financial participants such as Fintech, distinguishing that currently the equipment and physical facilities of traditional banks are not useful to recognize a real development in financial inclusion (Demir *et al.*, 2022; Gabor and Brooks, 2017; Ozili, 2023; Yang and Zhang, 2022). On the other hand, there are authors such as Feghali *et al.* (2021); Lyons *et al.* (2022) and; Orazi *et al.* (2021) who have preferred to carry out the study under a "demand" perspective of financial services, with data collected from the database with greater scope and depth at the international level in the subject, the Global Findex Database (Demirguc-Kunt *et al.*, 2022), a criterion that will be considered in this research.

Currently and at the Latin American level, Martínez *et al.* (2022) have analyzed the changes in financial inclusion and its main demographic determinants, assessing formal financial accounts, formal savings and formal loans as a "proxy" of financial inclusion in seven Latin American countries using the Global Findex of 2011 and 2014. With the same tool, Orazi *et al.* (2023) study the progress of financial inclusion in South American countries considering the evolution of variables of formal "access" and "use" of the main financial instruments, the access gaps that exist among the population, and the barriers that prevent the development of the financial services market.

Fintech Ecosystem

The financial industry is constantly changing and in recent years has left the door open for the immersion of a new financial actor, which distances from the rest by not having participated in the non-transparent era that burned down traditional banks. These startups, which are a fundamental part of the technological innovations that arise in the financial field, are the so-called "Fintech" as its express term, a contraction of the English phrase "Financial Technology" – "Financial Technology". Fintech can offer unprecedented opportunities to overcome barriers to financial inclusion and close gaps in access and use of accounts in financial institutions, taking advantage of the increasing penetration of mobile technology (Demir *et al.*, 2022).

Companies that focus on combining emerging technologies associated with finance for the benefit of consumers have been increasing dramatically in terms of number and quality (Demirguc-Kunt *et al.*, 2022). Saksonova and Kuzmina-Merlino (2017) stated that competition between banks and Fintech companies is growing in advanced economies, but even more so in emerging markets, so financial technology has a positive impact on the banking system in Latin America. In the region during the period 2017-2021, the number of Fintech

companies has quadrupled from 703 to 2482, hosting 22% of all Fintech companies in the world. The countries with the greatest relevance in the sector are Brazil and Mexico, followed by Colombia, Argentina and Chile, concentrating among them 81% of the Fintech activity of Latin America (Bakker *et al*., 2023).

Financial inclusion, the Fintech ecosystem and its contribution to the SDGs

For developing countries like most of Latin America, financial inclusion is a key pillar of economic growth, fostering the formation of strong and sustainable financial institutions that promote savings, investment, and money flows (Orazi *et al*., 2023).

Studies such as those by Arner *et al*. (2020), Demirguc-Kunt *et al*. (2018), and Dhahri *et al*. (2024) argue that financial technology is the key driver for financial inclusion and underlies balanced sustainable development. In this sense, it is recognized that financial inclusion is indispensable for sustainable progress, contributing directly or indirectly to the fulfillment of the totality of the SDGs (Klapper *et al*., 2016).

Innovative research has aimed to interrelate financial inclusion with the achievement of the SDGs at the macroeconomic level. Ozili (2022) studies developed countries belonging to the Organization for Economic Co-operation and Development (OECD), the relationship between variables of financial inclusion, focused on the supply of financial services and environmental development in each of the countries in the sample, obtaining results with positive and significant relationship especially in countries which are not part of the European Union. Research by Gautam *et al*. (2022) in 28 states in India finds a positive relationship between high levels of sustainable development and financial inclusion variables based on national cooperative banks. Nada (2019) derives as a result of the work that financial inclusion explains significantly and is a determining factor in Egypt's sustainable development at the country level between 2004 and 2017. On the other hand, considering studies that examined the relationship with SDGs on an individual basis, Yap *et al*. (2023) with a sample of fifty countries indicate in their results that financial inclusion correlates positively with SDG 2, 5 and 8 and the study of Ma'ruf and Aryani (2019) on member countries of the Association of Southeast Asian Nations obtained as a result a negative and significant relationship of financial inclusion with the achievement of SDG 1.

Some studies have used country-level measurements of the Fintech ecosystem. Haddad and Hornuf (2019) used as a dependent variable the total number or amount of such digital financial firms that were in operation per year and per country. In contrast, Lyons *et al*. (2022) used a more complex measure on Fintech, with an index called "The Global Fintech Index" (Findexable, 2022) that is used as one of their explanatory variables of study.

This feasible association between the fulfillment of sustainable development, the variables of progress of the Fintech ecosystem and the variables of financial inclusion, has not been applied from an empirical perspective in the Latin American field, becoming transcendental for research in digital financial inclusion and sustainable development to deepen the analysis of the existing link between these elements. Hernández-Pajares (2023), on a bibliographic review on sustainability in Latin America, found that there is little research on the subject of contribution towards the SDGs of the region, which exhibits the relevance of the study.

Therefore, the purpose of the paper is to assess whether financial inclusion and Fintech growth contribute to the achievement of the sustainable development goals in Latin America.

The rest of the article is presented as follows: the design and working methodology is described where the type of research, data sources, study variables and the analysis tool are exposed; later, a detail of the results obtained with theirdiscussion is presented, ending with the conclusions section.

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Materials and methods

The research design is quantitative type, descriptive correlational with a longitudinal scope. It considered information from 2017 and 2021, because these are the last two periods with data released after the Sustainable Development Goals (January 2016) and the World Bank's financial inclusion metrics.

In terms of geographical contextualization, financial inclusion, sustainable development and the Latin American Fintech ecosystem will be analyzed based on data from the most influential countries in the region. The six Latin American countries with the highest nominal GDP in US$ (World Bank, 2022), made up of the four members of the Pacific Alliance (Chile, Colombia, Mexico and Peru), were designated, and the addition of two countries relevant in the South American market, Brazil, the only Latin American member of the BRICS (emerging economies with the greatest development potential) and Argentina, due to the country's representativeness for South America and being a member of the Group of 20 (G-20), the main area of political and economic deliberation in the world.

Data

Financial Inclusion

It uses information from the two most recent periods, 2017 and 2021, presented in the World Bank's Global Findex database (2018, 2022) "World Bank" that includes detailed questions about access to and use of financial services. For each country, the World Bank has randomly selected nationally representative samples of at least 1,000 individuals and collected in-depth information through surveys on how people save, borrow, make payments, and manage financial risk. The samples were taken from the non-institutionalized civilian population of each country over the age of 15. In order to ensure nationally representative samples, the World Bank's work used a base sample weight and a post-stratification sample weight. The weighting of the base sampling was adjusted to take into account the unequal probability of selection. Post-stratification weighting was adjusted to take into account sampling and non-response errors related to population statistics for each country by sex, age, education and socioeconomic status. See Demirgüç-Kunt *et al.* (2022) for a complete presentation of the survey data, sampling and methodology. As well as being a publication of an official body, it is the largest financial inclusion database with the widest scope, depth and quantity of compilations worldwide (Sarkar *et al.*, 2022).

Chile, Colombia, Mexico and Peru completed 1000 respondents, Brazil 1002 and Argentina 1003. All of them with inhabitants with different demographic characteristics such as place of birth, economic level, sex, level of education and age.

Fintech

In order to complement the analysis and not only consider the size of the Fintech ecosystem of each country (number of companies), the database "The Global Fintech Index Ecosystem" (Findexable, 2022) is used, the first global index that establishes a common set of metrics and the same algorithm to generate a score that classifies the Fintech ecosystems of eighty-three countries and more than two hundred and sixty-four cities.

Sustainable Development Goals - SDGs

Since the creation of the 2030 Agenda, "The SDG Index & Dashboards Report", the most relevant global report that evaluates the situation of each country in the achievement of the Sustainable Development Goals, has been produced year by year (Sachs *et al.*, 2017, 2021). It is used by governments and the community to determine priorities for action, understand key implementation challenges, track progress, ensure accountability, and identify situations to be corrected to achieve the SDGs. The SDG

Index is an assessment of each country's overall performance on the seventeen SDGs at a given measurement point, giving equal importance to each goal in crafting the overall index, using a total of 115 indicators. The score indicates the position of a country between the worst possible value (0) and the best, or target result (100).

Variables

Financial inclusion variables derive from the review of previous empirical studies (Feghali *et al.*, 2021; Lyons *et al.*, 2022; Orazi *et al.*, 2023), where categorizing between access and use of financial services determines the following as presented in Table 1:

Access: Account opening: includes the proportion at country level of individuals holding an account with a financial institution or mobile money provider in the last 12 months.

Card opening: The proportion at the country level of individuals who have a debit or credit card in their name for the past 12 months.

Usage: Loans/Credits: the proportion at country level of respondents who have borrowed money formally (financial institution) or informally (credits with family or friends) during the last 12 months.

Savings: the proportion at the country level that respondents report having saved in the past 12 months, either generally or for retirement purposes.

Payments/Collections: The proportion at the country level of individuals who have made payments or collections digitally or through a debit or credit card during the last 12 months.

Table 1
Operationalization of variables

Category		Subcategory	Variable	Code	Code database World Bank (Demirguc-Kunt *et al.*, 2022)
Financial Inclusion	1. Access	1.1 Account Opening	1.1.1 Financial Institution Account	ACEF	FIN1.T.D
			1.1.2 Mobile Money Account (CDM)	ACDM	MobileAccount.T.D
		1.2 Opening Card	1.2.1 Debit or Credit Card	ATDTC	FIN2.7.T.D
	2. Use	2.1 Loans/credits	2.1.1 Loan application	UPR	borrow.any
			2.1.2 Loan in a Financial Institution or CDM	UPRFOR	fin22a.c.MM.d
			2.1.3 Loan from family and friends	UPRINF	FIN22B.T.D
		2.2 Savings	2.2.1 Savings (general)	UAHO	save_any
			2.2.2 Retirement Savings	UAHJUB	FIN16_T_D
			2.2.3 Savings in entity or CDM	UAHOFOR	FIN17A.17A1.D
		2.3 Payments/Receipts	2.3.1 Use of debit or credit cards	UTDTC	FIN4.8.T
			2.3.2 Digital payment/collection	UPCDIG	g20_t_d
Fintech			Global Fintech Index	GFI	
			Fintech Quantity	QFIN	

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Category	Subcategory	Variable	Code	Code database World Bank (Demirguc-Kunt *et al.*, 2022)
SDG	General	Overall SDG Index	SDGI	
	Individuals	SDG Index 1…17	SDG1…17	

Regarding the variables selected to measure the Fintech ecosystem, the variables Global Fintech Index and Fintech quantity were defined. The Global Fintech Index, also called "Global Fintech Index" is developed by Findexable (2022) based on a three-dimensional weighting:

The number or number of Fintech companies, Fintech centers, coworking spaces, accelerators, global influencers, called the size of the Fintech ecosystem.

The quality or impact of Fintech companies, depending on factors such as size, growth, investment, web presence, monthly visits, customer base, website ranking, events, international collaboration, the number of unicorns, among others.

The environment, a measure of the ease of doing business and the attractiveness of a particular country; based on technological infrastructure, critical mass, and the regulatory environment Fintech.

Regarding the amount variable, Fintech represents the delimitation of the ecosystem size by year and country (Inter-American Development Bank [IDB] *et al.*, 2022).

Finally, in the same Table 1, the variables "SDG Index general level" and the seventeen "Individual SDG Indices" are observed for each of the six countries studied, collected through the database of Sachs *et al.* (2017, 2021), where the progress of each country towards the achievement of the SDGs is rated.

Data analysis

The statistical technique used through STATA v.16 to assess the association between financial inclusion indicators, Fintech variables, and the overall SDG Index and Individual SDG Indices (SDGI and SDG1-17) is Pearson's correlation, a statistic widely used to measure the strength of the linear association between two variables.

Pearson's correlation coefficient was calculated for each of the eighteen sustainability indexes proposed with the eight financial inclusion variables and the two Fintech ecosystem variables individually, considering the levels of significance ($p<0.01$; $p<0.05$; $p<0.10$) for additional analysis.

Results and discussion

Table 2 below presents the descriptive statistics of the sample studied. It reflects the number of observations obtained for each variable, the indices of sustainable development and financial inclusion with rational values ranging from 0 to 1; the variables Fintech, QFIN, with a minimum integer value of 16 and maximum of 771, and GFI, with rational values ranging from 1,007 to 8,163.

Table 2

Descriptive statistics. Sustainable development, financial inclusion and fintech variables

Variable	Obs.	Average	Dev. Std.	Min.	Max. Max.
SDGI	12	0.705	0.032	0.648	0.771
SDG1	12	0.941	0.056	0.834	1
SDG2	12	0.634	0.064	0.527	0.719
SDG3	12	0.812	0.034	0.771	0.887
SDG4	12	0.884	0.084	0.75	0.991

Variable	Obs.	Average	Dev. Std.	Min.	Max. Max.
SDG5	12	0.712	0.049	0.642	0.81
SDG6	12	0.875	0.072	0.786	0.985
SDG7	12	0.867	0.058	0.746	0.948
SDG8	12	0.657	0.072	0.522	0.773
SDG9	12	0.428	0.111	0.233	0.625
SDG10	12	0.272	0.137	0.108	0.51
SDG11	12	0.849	0.074	0.724	0.958
SDG12	12	0.766	0.054	0.699	0.867
SDG13	12	0.88	0.032	0.841	0.939
SDG14	12	0.596	0.122	0.351	0.782
SDG15	12	0.553	0.057	0.42	0.607
SDG16	12	0.583	0.094	0.44	0.773
SDG17	12	0.67	0.065	0.576	0.812
GFI	*6	3,715	2,439	1,007	8,163
QFIN	12	233	215,453	16	771
ACEF	12	0.591	0.169	0.354	0.871
ACDM	**11	0.141	0.11	0.024	0.351
ATDTC	12	0.476	0.183	0.273	0.792
UPR	12	0.426	0.076	0.318	0.588
UPRFOR	12	0.238	0.078	0.118	0.407
UPRINF	12	0.199	0.051	0.137	0.291
UAHO	12	0.399	0.08	0.303	0.581
UAHJ	12	0.153	0.048	0.068	0.264
UAHOFOR	12	0.144	0.072	0.072	0.311
UTDTC	12	0.34	0.184	0.145	0.706
UPCDIG	12	0.531	0.17	0.317	0.843

Note. Descriptive statistics of all study variables. *There are only six observations in GFI, being a data available for 2021 and not for 2017. **In the ACDM variable, there are eleven observations because Chile has not submitted data during 2021. Both constraints (*,**) are solved with pairwise elimination, using all available observations for a pair of variables, even if other variables are missing for the same observations.

With less than 50 observations, the Shapiro–Wilk test was implemented to examine the normality of the data. This test compares the cumulative distribution of samples to an ideal normal distribution. The results (Table 3) revealed p-values greater than 0.05 accepting the null hypothesis that the data follow a normal distribution in each of the variables to be correlated.

Table 3

Shapiro-Wilk normality test

Variable	Obs.	W	V	z	Prob>z
SDGI	12	0.952	0.798	-0.440	0.670
SDG1	12	0.904	1,600	0.915	0.180

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Variable	Obs.	W	V	z	Prob>z
SDG2	12	0.936	1,069	0.131	0.448
SDG3	12	0.925	1,253	0.439	0.330
SDG4	12	0.933	1,125	0.229	0.409
SDG5	12	0.940	0.995	-0.011	0.504
SDG6	12	0.923	1,293	0.501	0.308
SDG7	12	0.958	0.706	-0,678	0.751
SDG8	12	0.956	0.741	-0.583	0.720
SDG9	12	0.958	0.706	-0.680	0.752
SDG10	12	0.935	1,085	0.158	0.437
SDG11	12	0.957	0.719	-0.642	0.740
SDG12	12	0.916	1,408	0.667	0.252
SDG13	12	0.890	1,831	1,178	0.119
SDG14	12	0.928	1,201	0.357	0.360
SDG15	12	0.845	2,590	1,854	0.062
SDG16	12	0.967	0.552	-1,157	0.876
SDG17	12	0.932	1,133	0.243	0.404
GFI	6	0.876	1,535	0.671	0.251
QFIN	12	0.828	2,879	2,060	0.060
ACEF	12	0.943	0.946	-0.108	0.543
ACDM	11	0.899	1,634	0.915	0.180
ATDTC	12	0.893	1,782	1,126	0.130
UPR	12	0.962	0.630	-0.901	0.816
UPRFOR	12	0.965	0.584	-1,050	0.853
UPRINF	12	0.931	1,148	0.269	0.394
UAHO	12	0.913	1,452	0.726	0.234
UAHOJUB	12	0.936	1,075	0.141	0.444
UAHOFOR	12	0.851	2,488	1,776	0.058
UTDTC	12	0.902	1,638	0.961	0.168
UPCDIG	12	0.946	0.897	-0.211	0.583

The test performed determines the decision of selecting the appropriate statistical method. In this case and having the variables a linear tendency and being continuous numerical, it allows to use a parametric test for the analysis, the Pearson correlation coefficient, which measures the linear statistical relationship between two continuous variables.

Table 4

Pearson correlations - Sustainable development variables, financial inclusion and fintech

	GFI	QFIN	ACEF	ACDM	ATDTC	UPR	UPRFOR	UPRINF	UAHO	UAHJ	UAHFOR	UTDTC	UPCDIG
SDGI	-0.191	0.154	0.692**	0.580*	0.731***	0.364	0.368	0.230	0.446	0.513*	0.687**	0.776***	0.757***
SDG 1	-0.233	-0.584**	-0.026	-0.432	0.257	-0.426	-0.044	-0.733***	0.365	0.005	0.064	0.278	-0.045
SDG 2	0.041	0.354	0.778***	0.569*	0.720***	0.582**	0.587**	0.432	0.206	0.425	0.627**	0.686**	0.789***

	GFI	QFIN	ACEF	ACDM	ATDTC	UPR	UPRFOR	UPRINF	UAHO	UAHJ	UAHFOR	UTDTC	UPCDIG
SDG 3	-0.453	-0.554*	0.172	-0.120	0.274	-0.105	0.030	-0.343	0.545*	0.249	0.345	0.368	0.179
SDG 4	-0.769	0.296	0.252	0.618**	0.173	0.215	0.002	0.565*	0.134	0.414	0.308	0.266	0.377
SDG 5	0.039	0.347	-0.214	0.397	-0.121	-0.024	-0.169	0.266	-0.124	-0.036	-0.264	-0.045	-0.067
SDG 6	0.225	-0.388	0.268	-0.501	0.460	-0.134	0.247	-0.639**	0.252	-0.094	0.278	0.418	0.162
SDG 7	0.634*	0.632**	0.761***	0.757***	0.646**	0.789***	0.629**	0.604**	0.162	0.363	0.529*	0.639**	0.798***
SDG 8	-0.225	0.095	0.440	0.382	0.561*	0.112	0.184	0,000	0.417	0.371	0.528*	0.642**	0.521*
SDG 9	0.623*	0.640**	0.799***	0.628**	0.808***	0.512*	0.509*	0.252	0.516*	0.622**	0.789***	0.840***	0.849***
SDG 10	-0.548	-0.620**	-0.397	-0.408	-0.190	-0.381	-0.088	-0.489*	-0.284	-0.508*	-0.489*	-0.249	-0.439
SDG 11	-0.041	-0.419	-0.086	-0.539*	0.141	-0.411	-0.118	-0.694**	-0.069	-0.398	-0.119	0.097	-0.154
SDG 12	-0.524	0.275	0.084	0.483	-0.198	0.288	-0.144	0.781***	-0.035	0.336	0.173	-0.128	0.168
SDG 13	0.322	0.554*	0.369	0.487	0.173	0.538*	0.452	0.473	-0.017	0.210	0.317	0.156	0.342
SDG 14	-0.611	0.134	0.367	0.300	0.251	0.123	-0.091	0.362	0.111	0.374	0.461	0.266	0.425
SDG 15	-0.002	0.225	0.482	0.399	0.306	0.600**	0.427	0.635**	-0.041	0.249	0.224	0.237	0.474
SDG 16	-0.290	0.085	0.651**	0.779***	0.559*	0.501*	0.343	0.433	0.726***	0.805***	0.747***	0.679**	0.740***
SDG 17	0.469	0.469	0.610**	0.352	0.608**	0.370	0.267	0.203	0.578**	0.604**	0.718***	0.670**	0.669**
GFI	1,000	0.965***	0.400	0.296	0.393	0.557	0,628	-0,022	0.281	0.249	0.273	0.363	0.365
QFIN	0.965***	1,000	0.372	0.594*	0.288	0.548*	0.421	0.444	0.106	0.323	0.297	0.295	0.418

Note. *** p<0.01, ** p<0.05, * p<0.1. This table shows Pearson's correlation coefficient and its significance, between each of the SDG Indices with the Fintech ecosystem progress and financial inclusion variables. Variables described in the methodological section.

Table 4 shows the correlation coefficients between the contribution to the SDGs and each of the variables of financial inclusion and Fintech in the six Latin American countries for the periods 2017 and 2021. Analyzing the correlation with the general SDG index (SDGI), where the 17 objectives have the same weighting, a significant positive and strong correlation is observed with all the access variables of financial inclusion (Figure 1), account openings in a financial institution, in mobile money account and possession of debit/credit cards. Thus, the higher the percentage of development of financial inclusion, the higher the compliance with the SDGs for each country/year. Figure 2 presents the relationship of the general index with the variables of use. There is a strong and very significant positive correlation between the overall SDG index and the Payment/Collection usage subcategory, both for the use of debit/credit card and payment/collection with digital means (QR, transfers, keys, etc.). On the other hand, formal saving also has a significant positive relationship with SDGI, and neither of the two Fintech variables considered have demonstrated an existing correlation with the overall SDG index in the study countries.

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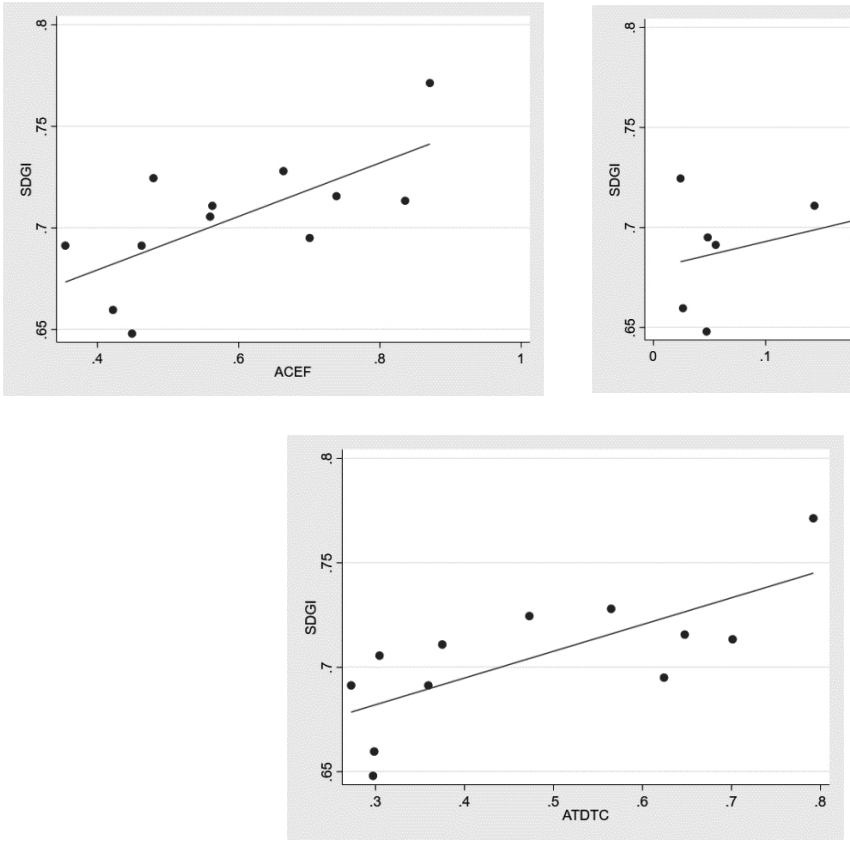
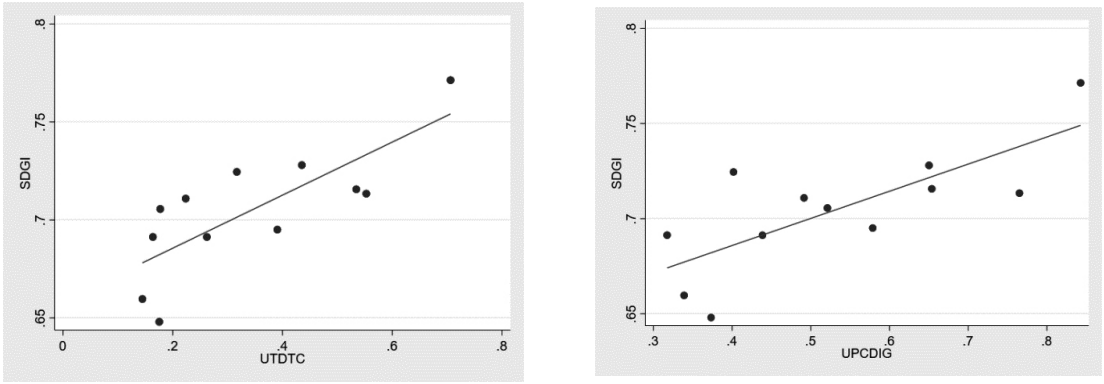
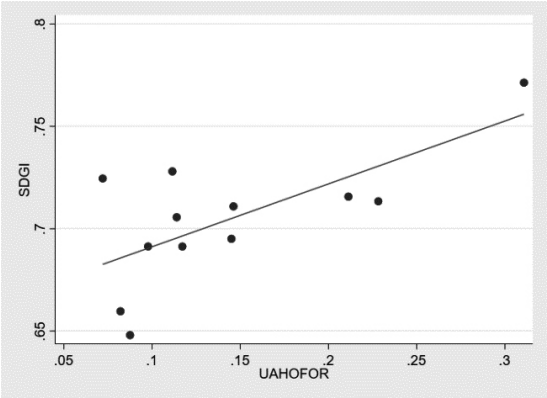
Figure 1
Dispersion diagram. SDGI- "Access"



Note. The dispersion diagrams between the SDGI General Index and the three variables of access to financial inclusion are shown: Financial Entity Account Opening (ACEF), Mobile Money Account Opening (ACDM) and Debit or Credit Card Opening (ATDTC), in their respective order.

Figure 2
Dispersion diagram. SDGI- "Use"



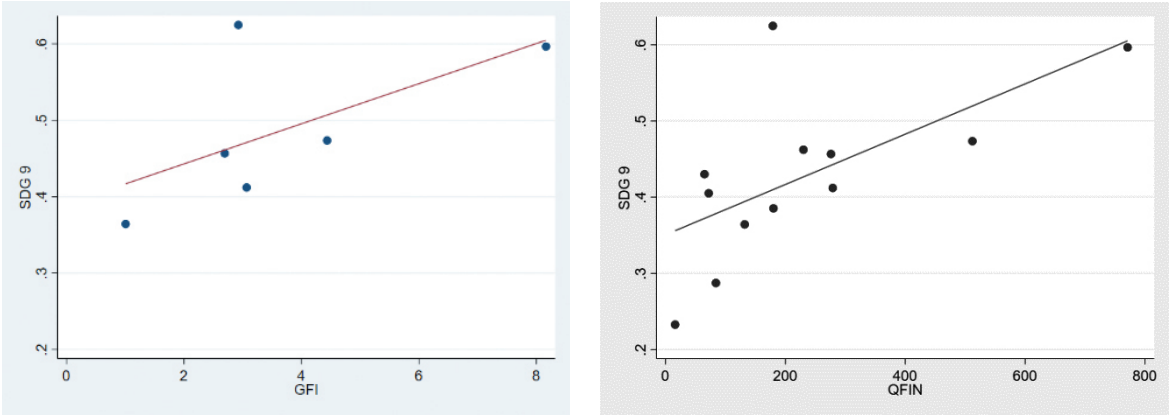


Note. It reflects the dispersion diagrams between the SDGI General Index and the three variables with the most significant correlation by using financial inclusion: Debit Card or Credit Card Use (UTDTC), Digital Payment/Collection Use (UPCDG), Formal Savings Use (UAHOFOR), respectively.

Continuing with the analysis of Table 4 and Pearson coefficients, but at the individual level of each SDG (SDG1-SDG17) it was found that the ones that most correlate the variables of financial inclusion in a significant and considerable way are: SDG9 and SDG7 in the first measure, together with SDG16, SDG17 and SDG2.

The SDG9 Index is the one of all the indexes by SDG that has had the greatest statistical relevance with a large number of related variables, both financial inclusion (with access and use) and Fintech measurement. Just as the SDG 7 Index are the only cases that reflect a positive and statistically significant association with the two defined study variables for the Fintech ecosystem of Latin American countries, note in Figure 3. In turn, the SDG 9 Index has very strong positive correlations of statistical significance with: digital payment/collection, access and use of debit/credit card, access to an account in a financial institution or mobile money account and formal savings (in descending order). See table 5 and figures 4 and 5.

Figure 3
Dispersion diagram. SDG-"Fintech"



Note. The scatter diagrams between the SDG9 Index and the two Fintech variables are shown: Global Fintech Index (GFI), Fintech Quantity (QFIN).

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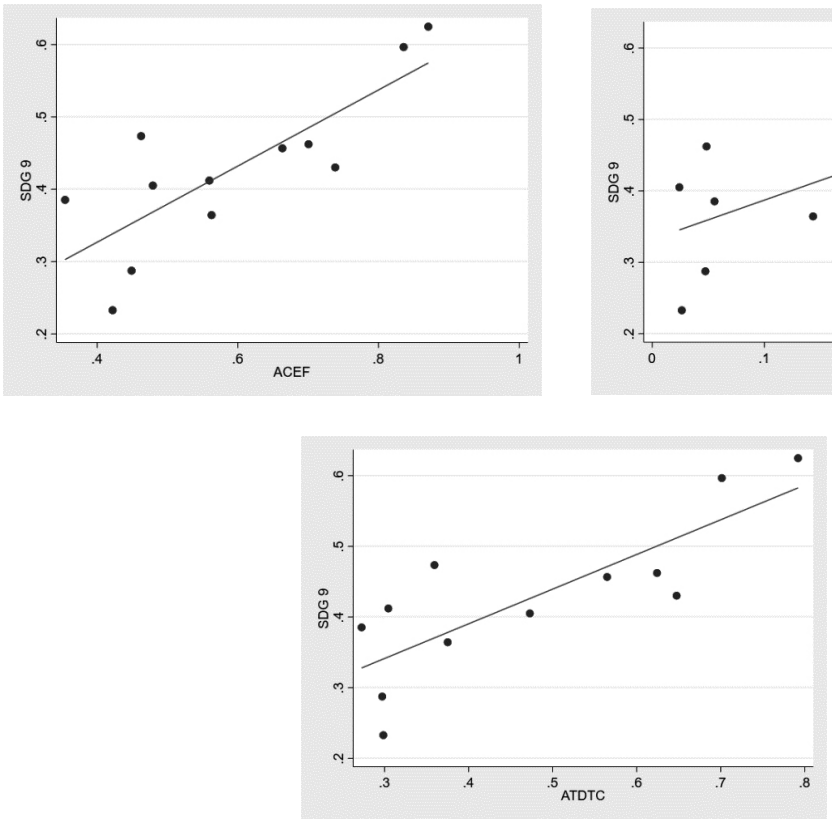
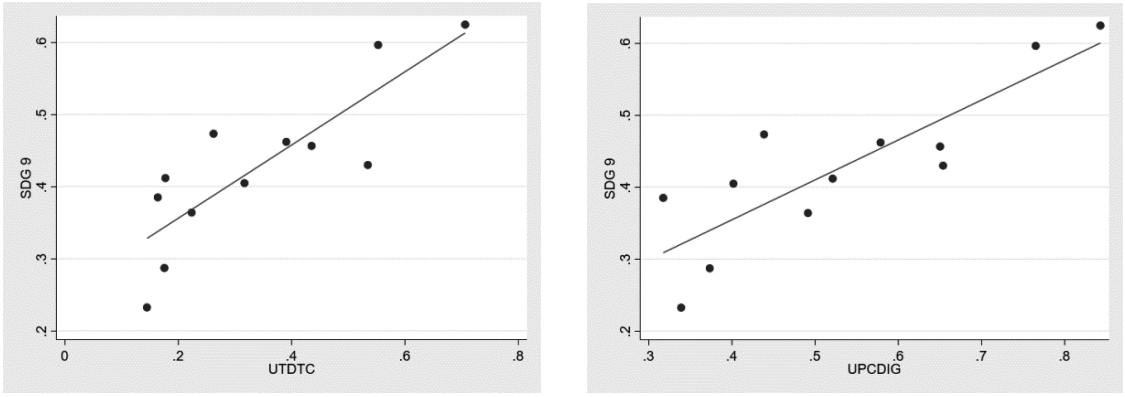
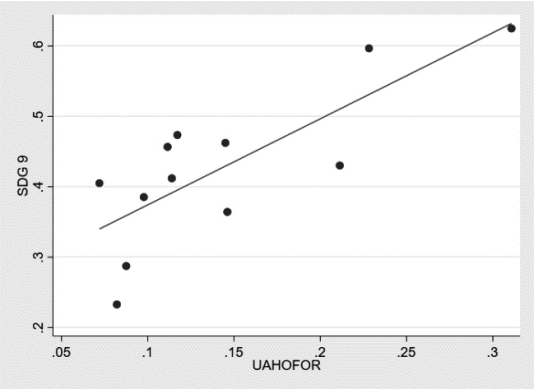
Figure 4
Dispersion diagram. SDG 9-"Access"



Note. The dispersion diagrams between the SDG9 Index and the three variables of access to financial inclusion are observed: Financial Entity Account Opening (ACEF), Mobile Money Account Opening (ACDM) and Debit or Credit Card Opening (ATDTC), in their respective order.

Figure 5
Dispersion diagram. SDG 9-"Use"





Note. It reflects the dispersion diagrams between the SDG9 Index and the three variables with the most significant and strong correlation by using financial inclusion: Debit Card or Credit Card Use (UTDTC), Digital Payment/Collection Use (UPCDG), Formal Savings Use (UAHOFOR), respectively.

Other individual indices reflected in Table 4 have significant and strong positive correlations with at least five financial inclusion variables. Among them, the positive correlation between the variables of payment/collection (digital or cards), possession of an account in a financial institution or mobile money account, and possession of debit or credit cards, with the SDG Indices 2,7,8,16 and 17 stand out.

Thus, the three financial inclusion variables classified as access to financial services show a significant and large correlation with the achievement of most of the SDGs at the individual level. In addition to the above, the usage subcategory on payments/collections also presents direct, significant positive correlation values. The variables of use through savings are not so significant; and being the variables of use, loans, the least significant and considerable for the achievement of the SDGs. The results obtained and presented in this section support the relationship between certain variables of financial inclusion and a prominent Fintech ecosystem with the fulfillment of some SDGs at the individual level and various associations with the general index that conglomerates the 17 objectives.

According to the findings of the study, the SDGI General Index, consistent with results obtained in other geographical contexts by Ozili (2022) Gautam *et al*. (2022) and Nada (2019), shows a positive and significant relationship with financial inclusion variables. Considering the classification and categorization of the study variables, it can be observed that this relationship is clearer and more determinant with all the access variables and with only a few of the ones of use.

As for the individual indices, as shown in the results, the SDG9 Index that refers to industry, innovation and infrastructure, is the one that is associated in an evident, direct and significant way with the largest number of study variables on financial inclusion; in accordance with what was exposed in the framework of the United Nations Development Program (UNDP) by the Fintech surveyed in Argentina regarding the SDG to which their products and services contribute the most (UNDP and Fintech's Argentine Chamber, 2021) and what was assured by studies of other institutions at present (Deloitte, 2021; UNSGSA, 2023). The individual indices that continue to the aforementioned one in terms of greater association with the financial inclusion variables are the SDG Indices 2,7,16 and 17, the first of them being the one that adjusts to the results obtained by Yap *et al*. (2023) although this study is differentiated from the aforementioned one because it has not found any relationship between the financial inclusion variables and the SDG Indices 5 and 8.

The incorporation in the analysis of the Fintech variables reflects that the amount of Fintech in the ecosystem of each country, a variable used by Haddad and Hornuf (2019), has obtained a better relationship with the SDG indices, especially through SDG9 and SDG7, finding no association

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with the SDGI General Index. These values obtained should be useful for the improvement in the determination and use of variables on the Fintech ecosystem in empirical works that relate the Fintech development with the achievement of the SDGs at the macroeconomic level.

Conclusions

The study evaluated through a correlation model the association between financial inclusion and Fintech development, with the fulfillment of the SDGs in Latin America, finding this as significant and positive. It has been observed that variables of access to financial services, such as opening accounts in financial institutions and the use of debit/credit cards, have a strong association with the overall SDG index (SDGI). Specifically, this means that the more people have access to opening accounts with financial institutions and using debit or credit cards, the more likely countries are to make progress on the SDGs. Evoking that the overall SDG index (SDGI) is a measure that assesses a country's progress against the 17 SDGs set by the UN, a strong partnership with SDGI suggests that financial inclusion through access to these services contributes significantly to sustainable development in the region. In addition, the use of digital means to make payments and collections, such as electronic transfers, by debit/credit card, or through mobile applications shows a significant positive relationship with their fulfillment. The results have shown th*et al*so individual indices such as SDG9 or to a lesser extent SDG2, SDG7, SDG16 and SDG17, present considerable positive correlations with the variables of financial inclusion and Fintech development.

The research highlights the importance of financial inclusion and a robust and developed country-level Fintech ecosystem in order to contribute to the SDGs. This approach allows governments, international organizations, businesses, and society to distinguish value in Fintech and in accessing and using better financial tools, identifying areas that require additional efforts to promote sustainable development.

The limitations of the study are that only secondary sources have been used without undermining their high methodological validity made by other international organizations for the operationalization of variables used in the development of the work; in addition, the methodological tool applied for analyzing the data was the correlation coefficients, which do not imply causality; therefore, the synergies observed with the SDG indexes could be independently related to other variables than those of financial inclusion and Fintech.

Despite the limitations, the work is relevant due to the empirical results, creating potential opportunities for future research in the subject. Among these possibilities, it is proposed to apply the study objective to more countries, either those that generate additional results for the Latin American region, as well as other countries that are comparable with those already selected in this work, such as the group of emerging markets. On the other hand, carrying out a comparative analysis of data discriminated at the individual level by country could be an enriching case. In turn, research complementing the variables of financial inclusion from the perspective of the demand for financial services with others obtained on the supply side, as well as the variables of the Fintech ecosystem that as new empirical work on the subject is developed; more tools, indicators and variables will be available that enrich the measurement studies on Fintech. These options would contribute to complexity and enhance the study, obtaining various proposals, approaches and challenges on a research topic that is booming.

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