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Article

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The effect of financial inclusion on economic and social indicators in Mexico

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ABSTRACT

This paper analyses the relationship between financial inclusion and the economic and social development in Mexico. For this quantitative research, a study sample composed by 448 observations during the 2007–2020 was analyzed using fixed effect estimations with instrumental variables 2SLS. Empirical results show that access to banking services reduces poverty, informality and inequality and favor the human development and its components of health, standard of living and education. The banking penetration decreases poverty, informality and inequality and enhances the standard of living and education. An increase in the usage of banking services diminishes the poverty and informality and increases the human development. This research contributes to practical implications for policy makers to enhance financial inclusion and human development in Mexico.

1. Introduction

Financial inclusion has become the dynamic driving force for economic and development growth and poverty reduction (Banerjee, 2020; Dircio-Palacios-Macedo et al., 2023b). In the context of Mexico, financial inclusion is defined as the access and use of formal financial services, under an appropriate regulation that guarantees protection for consumers and promotes financial education to improve the financial capacity of all segments of the population (CNBV, 2024). Promoting financial inclusion through access, usage and quality of banking services constitutes one of the most important challenges in Mexico: to achieve sustainable development (Uchenna-Okoye et al., 2017). Financial inclusion is associated with lower account costs, greater proximity to financial intermediaries, stronger legal rights and more politically stable environments (Allen et al., 2016). In most developing countries, the banking sector represents the backbone of the financial system. Therefore, an efficient and profitable banking sector may help ensure an effective financial system, which is conducive to economic growth and development (Kamarudin et al., 2016).

Microsavings programs are designed to help the unbanked, individuals who also tend to be poor. By the nature of the program, individuals with low initial wealth are able to save and receive match money to either consume or invest in a business (Liu, 2018). Despite the fact that Mexico is one of the 15 largest economies in the world and has a medium-high level of human development, the country has a significant lag in terms of financial inclusion, given that more than half of its population does not have access to banking services, placing it in the 4th lowest position in Latin America, only above countries such as Haiti, Nicaragua and El Salvador (The World Bank, 2021). This situation is even more critical in the semi-urban and rural areas of the country, that is, 75 % of municipalities in Mexico do not have physical access points to financial services within a radius of 2 kms, while 95 % of less-than-500 pesos daily

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purchases are made in cash (UNDP, 2021).

Although there is evidence of favorable progress in terms of financial inclusion in Mexico — and it has a consolidated financial system in terms of resources volume and level of sophistication— this has been partial, since it shows a high concentration in demographic and territorial matters. For example, there is greater financial inclusion in urban areas that are characterized by greater economic and social development, while rural areas or regions with higher rates of poverty and marginalization (Goedecke et al., 2017). The same can be seen in the usage of credit, which remains low as a proportion of the gross domestic product [GDP], and compared to high-income countries. In addition, the Mexican population has a preference for the use of cash over other financial instruments, which is why Mexico is considered a country with a high level of financial exclusion (Demirgüç-Kunt et al., 2018).

The objective of this research is to analyze the impact of financial inclusion dimensions in its access to banking services, banking penetration and usage of banking services over the performance of indicators that measure poverty, inequality in labor income, informality rate and human development level in the Mexican States. The study sample is composed by 448 observations during the 2007–2020, that is, 14 elements of analysis per State in Mexico. Fixed effect estimations with instrumental variables 2SLS are adopted to perform the econometric analysis, addressing possible problems of endogeneity between the study variables (Chhorn, 2021).

Although Mexico has one of the most diverse and robust financial industries in Latin America and a strong presence in the Fintech sector, the financial inclusion has shown an unfavorable evolution at the end of 2020. For instance, progress in attracting financial services is limited, while credit penetration of GDP reached just 36.9 % in 2019, a lower figure than its peers in the region. Furthermore, the persistence in the use of cash is explained by the low financial inclusion and informal economic activity in Mexico (Del Angel, 2016). The challenges the country faces in terms of financial inclusion refer to poor connectivity infrastructure, economic informality, and high service costs. In addition, the high rate of informality in the economy promotes the usage of cash, while around half of the employed population has an informal job (Deloitte, 2021). In this context, there is a need for a deeper understanding of the problem of financial inclusion from a federal entity level, where banking services development may have a positive effect on poverty alleviation (Marín and Schwabe, 2019; Cruz-García et al., 2021).

This work extends the international literature and contributes to different relevant aspects in the field of financial inclusion and reduction of inequality. First, it has practical implications for policy makers in Mexico. We recognize the crucial role of the institutional environment, such as the characteristics of formal financial system's operations and the new challenges of central banks might face for the implementation of policies conducive to increase financial inclusion and alleviate poverty (Rojas-Suárez and Amado, 2014; Beck et al., 2007). This paper identifies a series of recommendations for central banks to enhance financial inclusion. Second, to the best of our knowledge, it is the first comparative study in Mexico at a sub-national level. The analysis has been conducted at a sub-national level, since important differences between Federal Entities suggest that further research is needed to identify regional strategies and recommendations to enhance financial inclusion.

This paper is structured as follows. Section 2 develops the theoretical background and the study hypotheses. Section 3 describes data, measures and employed empirical methods. Section 4 reports and discuss the findings. The study concludes with the conclusions, implications and limitations of the research.

2. Contextual and hypotheses development

2.1. The economic and social context in Mexico

Latin America and the Caribbean are currently facing the complex juncture in 2022 due to the war between Russia and Ukraine from a weaker position than the rest of the world. According to the Economic Commission for Latin America and the Caribbean [ECLAC] (2022) new estimates predicts and average growth of 1.8 % for the region, where the conflict in Ukraine has heightened inflation, increasing financial volatility and costs. The economies of South America will grow by 1.5 %, Central America and Mexico 2.3 %, while 4.7 % growth is expected for the Caribbean economies. The pandemic has brought economic consequences and exacerbated inequalities in the educational, labor, and health system sectors in Latin America (Kazemikhasragh and Buoni-Pineda, 2022).

Regarding to financial inclusion, at the end of 2020 the number of branches decreased by 4 % compared to 2019, reaching the figure of 16,135 (National Banking and Securities Commission [CNBV], 2021b). Internationally, the number of commercial banking branches for every 10,000 adults was 1.4 for Mexico, lower than Brazil, Colombia and Chile; and superior to Peru. Likewise, the percentage of the population that lives less than 4 kms away from a branch was 77 %. The number of correspondents was 46,162, which represented a growth of 3 % compared to 2019, obtaining a municipal coverage of 73 % and a demographic coverage of 98 %. The main business that acted, as correspondent was the Oxxo convenience store chain, although this figure was lower than in Colombia, Peru and Brazil. Regarding the number of ATMs, a 3 % growth was observed compared to 2019, a municipal coverage of 59 % and a demographic coverage of 95 %, with a total of 59,415 ATMs. Mexico is below Spain, Brazil and Peru; and above Chile, Colombia and Honduras, obtaining an average of 6.2 ATMs for every 10 thousand adults. Transfers sent by CoDi had a significant increase from 38.3 to 154.4 thousand operations. Income from remittances sent to Mexico registered an increase of 11 % compared to 2019. Finally, the analysis of gender gaps revealed that the gap in banking penetration of deposit accounts was 2.7 percentage points in favor of women, in multiple bank mortgages of 24.6 percentage points in favor of men; in bank credit cards of 2 percentage points in favor of men, while in bank debit cards of 7.9 percentage points in favor of women (CNBV, 2021b).

In Mexico, the percentage of the population living in poverty decreased from 44.4 % in 2008 to 43.9 % in 2020 (currently, 55.7 million Mexicans are poor). At the same time, the extreme poverty indicator went from 11.0 % in 2018 to 8.5 % in 2020, the population in vulnerable conditions due to social deprivation dimension decreased from 32.3 % in 2008 to 23.7 % in 2020 (the indicators of education, health and access to quality, nutritious food have been favored, while social security, housing quality and spaces, and access

to basic housing services have decreased). The vulnerable population by income shows an increase from 4.7 % in 2008 to 8.9 %, while the indicator of the non-poor and non-vulnerable population increased from 18.7 % in 2008 to 23.5 % in 2020 (CONEVAL, 2021). According to available historical statistics, these results represent a similar proportion to the one that existed in 1984 (Ordóñez-Barba, 2018).

Mexico has increased its level of human development between 2010 and 2015. A positive change in the human development index [HDI] was observed in 93 % of Mexican municipalities, and where health was the dimension that made the greatest contribution to the process of equal opportunities, followed by education and income. However, there is evidence of a high development gap between the states and the municipalities, and even more pronounced in the latter (Gerónimo-Antonio et al., 2020).

2.2. Research hypotheses

Financial inclusion refers to the access and usage of sustainable banking services under appropriate regulations to ensure consumer protection schemes and a greater socioeconomic equality (Cabeza-García, Del Brio and Oscanoa-Victorio, 2019). Although there is no a global consensus on the financial inclusion measurement, it has the characteristic of being a multidimensional phenomenon (Zulaica-Piñeyro, 2013). The absence of financial inclusion leads in turn to financial illiteracy and the emergence of the informal financial sector that generates enormous costs for the people who attend to this market (Angadi, 2003).

Financial inclusion and financial intermediaries contributes to economic growth through the creation of value for companies and with positive effects on the human development, inequality and poverty indicators (Sethi and Sethy, 2019; Liu and Walheer, 2022). At the individual level, access to finance leads to the creation of equal opportunities to all groups of people and enables their smooth integration into the national economy (Arora, 2014; Aslan et al., 2017). Use of intermediaries for financial access includes access to technology that links the community members to services, access to the knowledge about the available financial solutions in terms of products and services, and the skills as well capabilities to make use of the technology (Chandwani and Kulkarni, 2018). Other financial intermediaries include microfinance institutions, technology-based solutions and machine learning such as Common Services Centres (Dwivedi et al., 2016). In recent years, financial inclusion has been adopted as a dynamic tool to achieve multidimensional macroeconomic stability, sustainable and inclusive economic growth, job creation, poverty reduction and income equality, both for developed and emerging countries (Omar and Inaba, 2020; Banna, Hassan, and Rashid, 2021). By contrast, lack of access to finance is often the critical mechanism for generating persistent income inequality, as well as slower economic growth, which has important implications in terms of growth and macroeconomic stability of any society (Banerjee, 2020; Beck et al., 2009).

Empirical evidence shows an increase in income levels in countries that have a greater number of bank branches and deposits (Neaime and Gaysset, 2018); an increase in the growth rate of GDP per capita and income distribution (Dhrifi, 2013); and a reduction in poverty levels (Beck et al., 2007). Bruhn and Love (2014) and Kochar (2011) conclude that greater access to banking services favor job creation, reduce poverty in rural areas and mitigate inequality in the population's income.

Park and Mercado (2018) analyzed the impact of financial inclusion on poverty and income inequality indicators in 151 countries, concluding that the greater the financial inclusion, the greater the economic growth and lower poverty rates. Although this result was only significant for the high and medium-high income countries, but not for those with medium-low and low income; while they did not find a significant effect of financial inclusion on inequality in labor income. Similarly, Jabir et al. (2017) analyzed the effect of financial inclusion on the reduction of poverty rates in low-income households for 35 countries in Sub-Saharan Africa; finding that financial inclusion significantly reduced the level of poverty by providing a higher level of well being in the population living in poverty.

Arner et al. (2020) affirm that financial inclusion is a strategic element in the current global environment, since it constitutes a means to reduce inequality gaps, in their dimensions of income, health, crime, poverty and unemployment. In the African context, Matekenya, Moyo and Jeke (2020), show that financial inclusion generates a positive impact on human development indicators, and that access to and usage of banking services motivates the creation of companies, allows people invest in health and education, risk is managed and the effect of financial crises is reduced and, therefore, it has an impact on greater economic and social development.

In the Latin American context, Dabla-Norris et al. (2015) found that financial inclusion strategies increased economic growth and reduced inequality indicators in Latin America and the Caribbean. In the particular case of Mexico, Salazar-Cantú et al. (2015) concludes that higher financial inclusion initially leads to higher inequality in labor income, but as financial inclusion increases, inequality decreases significantly at the municipal level. The discussion above leads us to establish the following research hypotheses:

H1a. The greater financial inclusion (access to banking services), the lower levels of poverty, informality and inequality.

H1b. The greater financial inclusion (access to banking services), the higher level of human development.

H2a. The greater financial inclusion (banking penetration), the lower levels of poverty, informality and inequality.

H2b. The greater the financial inclusion (banking penetration), the higher the level of human development.

H3a. The greater financial inclusion (usage of banking services), the lower levels of poverty, informality and inequality.

H3b. The greater financial inclusion (usage of banking services), the higher level of human development.

3. Methodology of research

3.1. Sample of study

The study sample is composed by 448 observations during the period of 2007–2020, that is, 14 elements of analysis per state in Mexico. The financial inclusion is divided into three dimensions: access (infrastructure) of banking services, banking penetration, and usage of banking services (Mandira, 2010). These dimensions were motivated by the availability of relevant and consistent data for a large number of countries (Zulaica-Piñeyro, 2013). For the Mexican case, we have used the information contained in the National Financial Inclusion Survey [ENIF] (CNBV, 2024). The ENIF 2021 is the most recent survey, and which has been carried out on a triennial basis. As a whole, the four surveys allow us to monitor the evolution of financial inclusion in the country, particularly topics such as the possession of financial products, the use of access channels to the financial system, the adoption and challenges of the usage of the means of payment and, in recent surveys, the situation of economic-financial competencies and the economic well-being of the population. The survey is representative of the adult population of the country and allows disaggregation at the regional and local levels, which makes it invaluable for generating indicators that allow identifying and addressing gaps and difficulties in access and participation in matters of inclusion and financial education in Mexico (CNBV, 2024).

The ENIF is the main instrument to measure financial inclusion in Mexico and its objective is to generate statistical information and official indicators at the national and regional level that allow financial authorities to make diagnoses, design public policies and

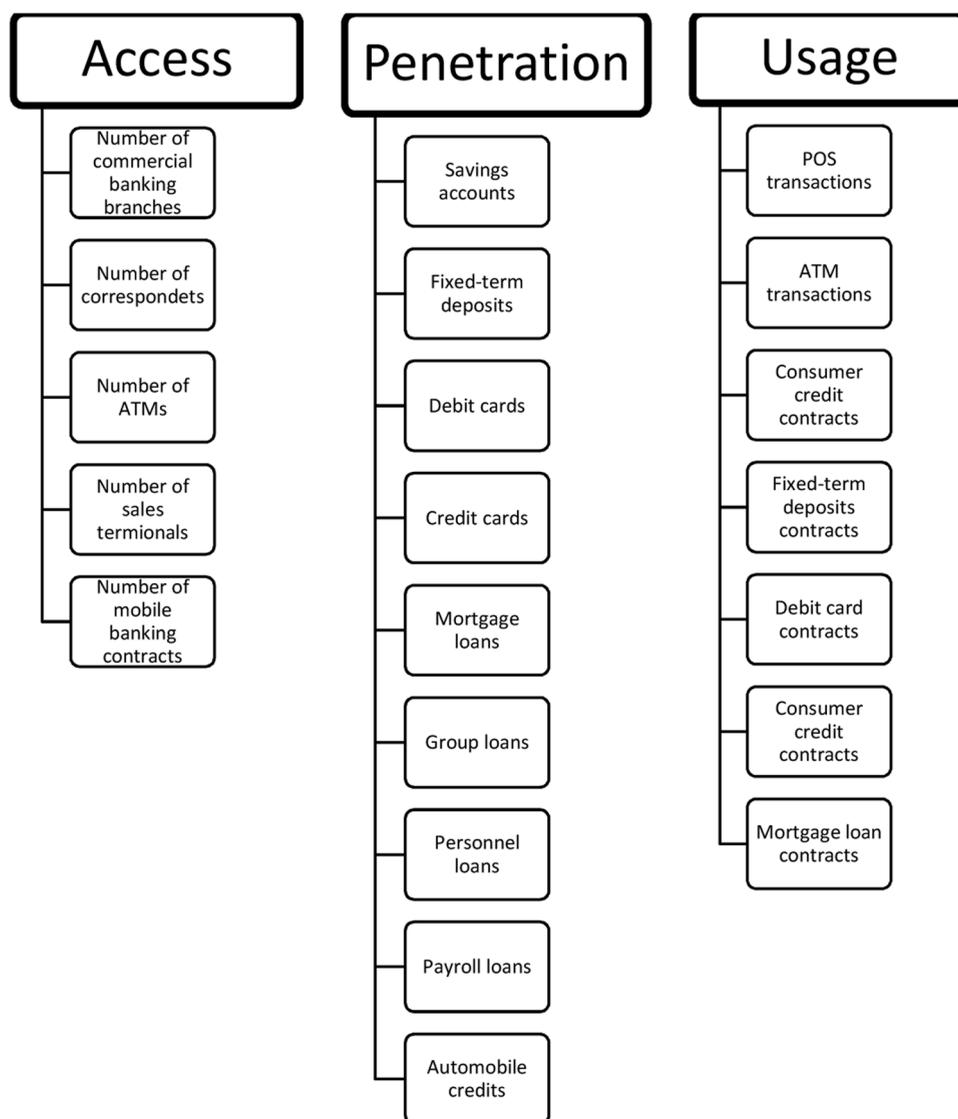


Fig. 1. Dimensions and indicators of financial inclusion

Note: The Figure shows the dimensions of financial inclusion based on Mandira (2010); Zulaica-Piñeyro (2013) and CNBV (2021).

establish goals regarding financial inclusion and education. In these sense, the ENIF contains reliable and standardized information related to the financial inclusion in Mexico. The survey is applied every three years by the CNBV in Mexico and the data is consistent (CNBV, 2024). The indicators of each financial inclusion dimension adopted in this research are described in Fig. 1.

The variables related to the levels of poverty, inequality (inequality in labor income and the Gini coefficient), informality rate and human development levels by state, were obtained from the Subnational Human Development Index 5.0 database (2021), from the indicators published by Mexico: *México ¿Cómo Vamos?* (2021) and from the CONEVAL (2021). The sub-national HDI is a translation of the HDI developed by the United Nations Development Programme [UNDP], at state level (GlobalDataLab, 2021). Finally, the control variables referring to the size of the population and level of debt by state were obtained from the National Institute of Statistics and Geography [INEGI] (2021), UNDP (2021).

3.2. Econometric model and definition of study variables

This research investigates the relationship between financial inclusion and the economic and social development indicators [poverty, inequality in labor income, informality rate and human development] in Mexico. The Eqs. (1) and 2 indicate a regression model, using a two stage least squares (2SLS) model. A relevant problem that may occur between study variables is related to the exclusion of the lagged dependent variables (Y_{it-1}). According to the macroeconomic literature, the dependent variable is normally affected by its past value (Fatás and Mihov, 2003). Therefore, some lagged dependent variables of poverty level, inequality in labor income, Gini coefficient, informality rate, and human development indicators are introduced in the analysis to take into consideration unexplained factors (Arellano and Bover, 1995).

In agreement with Banerjee (2020), economic development reduces poverty levels, increases the human development level, and therefore, the demand for financial services. At the same time, reducing inequality in labor income can lead to greater financial inclusion. In this context, if we have a small number of cross-sections and the outcomes of autoregressive coefficients are modest, the results from fixed-effects estimations are somehow more reliable than the GMM estimators (Anderson and Hsiao, 1981; Bun and Kiviet, 2001; Judson and Owen, 1999). Finally, we have included some control variables in the Eqs. (1) and 2: growth of the Gross Domestic Product [GDP] and public debt linked to poverty and human development performance (Abdelghaffar, Emam, and Samak, 2023). The equations are proposed as follow.

$$PI[\text{poverty, inequality, informality}]_{i,t} = \alpha_0 + \Sigma\beta_1(PI_{i,t-1}) + \Sigma\beta_2FI_{i,t} + \Sigma\beta_3(\text{Control}_{i,t}) + \mu_{i,t} \quad (1)$$

$$HDI[\text{health, education, standard of living}]_{i,t} = \alpha_0 + \Sigma\beta_1(HDI_{i,t-1}) + \Sigma\beta_2FI_{i,t} + \Sigma\beta_3(\text{Control}_{i,t}) + \mu_{i,t} \quad (2)$$

Table 1

Access to banking services by regions in Mexico.

Banking Services (2011)	2011							National Variation (%)
	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	
Number of commercial banking branches	1.46	1.63	1.22	1.69	2.58	1.18	1.45	
Number of correspondents per 10 thousand inhabitants	2.63	3.89	1.92	4.8	2.57	1.79	2.82	
Number of ATMs per 10,000 inhabitants	4.52	5.68	4.2	6.43	8.43	3.14	4.77	
Number of sale terminals per 10,000 inhabitants	66.63	90.94	71.33	71.68	137.66	41.03	70.27	
Number of mobile banking contracts per 10,000 inhabitants	3.41	4.12	4.08	9.55	111.12	2.67	7.68	
Banking Services (2020)	2020 West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	National Variation (%)
Number of commercial banking branches	1.35	1.39	1.13	1.44	2.5	1.06	1.3	-10.3 %
Number of correspondents per 10 thousand inhabitants	5.6	6.95	5.14	7.34	5.01	4.41	5.73	103.2 %
Number of ATMs per 10,000 inhabitants	6.13	7.13	5.5	7.88	12.38	4.37	6.26	31.2 %
Number of sale terminals per 10,000 inhabitants	138.27	186.29	139.37	177.47	384.17	93.59	151.72	115.9 %
Number of mobile banking contracts per 10,000 inhabitants	4026.92	4846.53	4197.52	4351.84	14,827.3	4164.68	4621.87	60,080.6 %

Note: The Table records the descriptive statistics related to access to banking services by regions in Mexico by comparing 2011 vs. 2020. Access to banking services includes: number of commercial banking branches, number of correspondents per 10 thousand inhabitants, number of ATMs per 10,000 inhabitants, number of sale terminals per 10,000 inhabitants, and number of mobile banking contracts per 10,000 inhabitants.

Where:

PI is related to poverty, inequality and informality indicators: population living in poverty, labor poverty, inequality in labor income, Gini coefficient, and informality rate.

HDI is the sub-national human development index, composed by three dimensions: 1) health, measured by life expectancy at birth; 2) education, measured by the adult literacy rate and the combined gross enrollment rate in primary, secondary and tertiary education, and 3) standard of living [measured by the GDP per capita] (Ordóñez-Tovar, 2014). The **HDI** is a multidimensional measurement that goes beyond economic growth and reflects existing inequalities, not only between countries, but also at the sub-national level (Alkire and Deneulin, 2009).

FI is the financial inclusion, which is measured through three dimensions: access, banking penetration and usage of banking services. According to Cámara and Tuesta (2017) the degree of financial inclusion is determined by three factors: usage, barriers and access to the financial system. Similarly, Dircio-Palacios-Macedo et al. (2023a) propose an index composed of various sub-dimensions of access and usage that are determined via a multivariate analysis. Sweta-Goel and Sharma (2017) and Sarma (2015) adopt three dimensions to measure financial inclusion: penetration, availability and access.

Control is a vector for the control variables of GDP growth [the percentage of economic growth per year/federal entity] and public debt [the relation between the nominal value of public debt and the GDP per federal entity] (Chhorn, 2021).

i represents *i*-*nth* cross sectional unit (federal state).

t for the *nth* period of time (year).

$\mu_{i,t}$ is the error term.

4. Results

4.1. Descriptive analysis

Table 1 shows the descriptive related to the access to banking services evolution by regions in Mexico by comparing 2011 vs. 2020. A decrease of 10.3 % is observed in the number of commercial banking branches for every 10,000 inhabitants, going from an average of 1.45 in 2011 to 1.30 in 2020. The regions with the highest number of bank branches in 2020 are Mexico City (2.58) and the Northeast region (1.69), while the region with the lowest number of bank branches is the South (1.22).

The number of correspondents per 10 thousand inhabitants has shown a significant increase of 103.2 % comparing 2011 (2.82) vs 2020 (5.73). The regions with the highest number of correspondents in 2020 are the Northeast (7.34) and the Northwest (6.95) of Mexico. There is also an increase in the number of ATMs per 10,000 inhabitants by 31.2 %, the number of sale terminals per 10,000 inhabitants (115.9 %), and it is the Northeast, Northwest and Mexico City regions that register the highest averages in 2020. It is important to highlight that the number of mobile banking contracts per 10,000 inhabitants has shown an exponential growth of 60,080 % in 2020 vs. 2011, this increase being more evident as of 2014, derived from the intensive use of technologies applied to the financial

Table 2
Banking penetration by regions in Mexico.

Banking Services (2011)	2012							National Variation (%)
	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	
Savings accounts	7.95	6.80	2.65	5.50	36.33	6.58	0.88	
Fixed-term deposits	331.23	191.50	206.04	341.06	663.70	273.51	327.87	
Debit cards	9567.01	11,732.53	8635.29	11,760.83	33,302.65	7783.10	12,572.38	
Credit cards	2371.98	2661.42	2008.30	2801.88	11,607.55	2062.55	2997.63	
Mortgage loans	104.45	134.23	78.44	152.34	495.32	68.05	135.71	
Group loans	202.20	313.30	530.19	354.40	85.91	515.65	303.01	
Personal loans	742.46	815.68	892.69	1409.44	1083.11	931.51	1280.26	
Payroll loans	460.71	614.25	465.92	581.54	663.43	394.49	588.12	
Automobile credits	73.59	69.35	79.71	95.99	150.29	61.88	77.74	
Banking Services (2020)	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	National Variation (%)
Savings accounts	0.02	0.05	0.01	0.02	8.02	1.25	0.50	-43.18 %
Fixed-term deposits	321.16	195.92	196.31	846.72	1001.47	244.91	343.02	4.62 %
Debit cards	13,339.52	14,086.70	11,593.16	16,677.01	43,502.34	10,803.78	13,981.92	11.21 %
Credit cards	2803.85	2809.90	1945.17	2776.62	9536.09	2228.19	2716.19	-9.39 %
Mortgage loans	169.09	191.22	120.56	208.42	316.16	87.78	156.89	15.61 %
Group loans	185.40	295.85	382.73	273.75	201.68	436.02	307.82	1.59 %
Personal loans	1050.97	866.80	1274.80	938.90	1522.03	1301.48	1113.08	-13.06 %
Payroll loans	486.25	565.13	437.09	623.76	761.81	413.08	502.37	-14.58 %
Automobile credits	92.68	105.03	77.87	125.01	190.30	67.67	94.16	21.12 %

Note: The Table shows the descriptive statistics related to banking penetration by regions in Mexico by comparing 2011 vs. 2020. Banking penetration includes: saving accounts, fixed-term deposits, debit cards, credit cards, mortgage loans, group loans, personal loans, payroll loans, and automobile credits.

sector and owing to the confinement measures imposed by the COVID-19 pandemic. Mexico City registers an average of 14,827 mobile banking contracts per 10,000 inhabitants in 2020, followed by the Northwest (4847) and Northeast (4352) regions.

Table 2 shows the findings obtained for the indicators of banking penetration related to deposits and credit services for the years 2011 vs. 2020. As for this dimension, a decrease is observed in the adoption of: savings accounts (−43.18 %), number of credit cards (−9.39 %), personal loans (−13.06 %) and payroll loans (−14.58 %). On the other hand, the financial products that register an increase in their usage in 2020 vs. 2011 are: fixed-term deposits (4.62 %), debit cards (11.21 %), mortgage loans (15.61 %), group loans (1.59 %) and automobile credits (21.12 %). It is evident that the regions with the highest banking penetration services in 2020 are Mexico City, the Northeast and Northwest.

Regarding to the usage of banking services, Table 3 shows the comparison between the years 2011 and 2020. A significant increment of 72.6 % in the number of transactions in POS terminals is shown for every 10 thousand inhabitants in 2020 vs 2011. The regions with the best performance are Mexico City and the Northwest. There is evidence of a 62.8 % increase in the number of savings contracts per 10,000 inhabitants, from an average of 659 in 2011 to an average of 1074 in 2020. The regions that have most adopted this service are the West and Bajío, Northeast and South. The number of term deposit contracts has risen 129.3 %, as has the number of debit cards per 10,000 inhabitants, which registered a growth of 218.9 % in 2020 vs. 2011. The most favored regions in these two indicators are the West and Bajío and Mexico City. The dimension of usage of banking services has been reduced in some services, such as ATM transactions (−20.3 %), consumer credit contracts (−10.5 %) and mortgage loans contracts (−56.1 %). The regions with the greatest usage of banking services are Mexico City, the Northeast, Northwest, South and West, and West and Bajío.

Table 4 shows the descriptive statistics of independent variables: poverty, inequality, informality rate, human development indicators, economic growth and level of debt by region in Mexico for the years 2020 vs 2007. There is a reduction in the population in a situation of poverty (−3.1 %), although labor poverty has increased by 25 %. The regions with the highest levels of poverty are the South (0.58) and the Central South and East (0.55) in 2020. The informality rate has been reduced by 3.8 %, going from 53 % in 2007 to 51 % in 2020. The regions with the highest rates of informality are the South and the Center-South and East.

Regarding performance in terms of inequality in labor income, results show a reduction of 5 %, while the Gini coefficient has risen 9.1 %, which translates into a greater concentration of income among the inhabitants of a region. The regions with the greatest

Table 3

Usage of banking services by regions in Mexico.

Banking Services (2011)	2011							National Variation (%)
	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	
POS transactions per 10,000 inhabitants	8423.99	14,881.47	8148.64	11,970.43	32,520.87	5931.55	10,373.05	
ATM transactions per 10,000 inhabitants	17,072.69	21,349.57	14,940.10	24,663.26	34,850.64	13,744.35	18,396.43	
Consumer credit contracts per 10,000 inhabitants	1622.68	237.24	351.18	654.37	121.53	249.90	659.42	
Fixed-term deposits contracts per 10,000 inhabitants	179.96	38.18	44.21	39.26	18.34	22.36	71.49	
Debit card contracts per 10,000 inhabitants	49.82	0.02	1.62	12.69	0.02	1.13	14.61	
Consumer credit contracts per 10,000 inhabitants	939.00	158.09	177.13	301.52	43.90	208.89	381.37	
Mortgage loan contracts per 10,000 inhabitants	27.33	4.17	4.75	6.49	0.50	2.78	10.00	
Banking Services (2020)	2020							National Variation (%)
	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	
POS transactions per 10,000 inhabitants	13,529.17	25,461.35	9763.20	23,740.82	1,00,719.92	7998.34	17,906.78	72.6 %
ATM transactions per 10,000 inhabitants	15,117.79	16,344.98	11,449.50	19,514.65	22,293.50	11,619.26	14,663.33	−20.3 %
Consumer credit contracts per 10,000 inhabitants	2474.65	437.48	644.89	808.24	417.49	629.49	1073.86	62.8 %
Fixed-term deposits contracts per 10,000 inhabitants	348.76	57.51	116.99	118.30	241.58	96.08	163.92	129.3 %
Debit card contracts per 10,000 inhabitants	95.45	21.01	9.57	78.73	80.44	23.15	46.59	218.9 %
Consumer credit contracts per 10,000 inhabitants	770.49	165.64	184.25	321.04	117.64	179.79	341.50	−10.5 %
Mortgage loan contracts per 10,000 inhabitants	11.29	1.93	2.67	2.52	0.29	1.60	4.39	−56.1 %

Note: The Table registers the descriptive statistics related to usage of banking services by regions in Mexico by comparing 2011 vs. 2020. Banking penetration includes: POS transactions, ATM transactions, consumer credit contracts, fixed-term deposits contracts, debit card contracts, consumer credit contracts, and mortgage loan contracts.

Table 4

Poverty, informality, inequality in labor income and human development by regions in Mexico.

Variables	2007							National Variation (%)
	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	
Population in poverty	0.41	0.31	0.55	0.35	0.28	0.54	0.44	
Labor poverty	0.31	0.20	0.43	0.27	0.21	0.40	0.32	
Informality rate	0.53	0.41	0.60	0.45	0.49	0.63	0.53	
Inequality in labor income	0.38	0.43	0.37	0.37	0.41	0.42	0.40	
Gini coefficient	0.43	0.43	0.47	0.44	0.53	0.41	0.44	
Human development index	0.73	0.76	0.69	0.75	0.81	0.71	0.73	
Health component	0.87	0.88	0.86	0.87	0.89	0.86	0.87	
Quality of life component	0.80	0.82	0.72	0.81	0.83	0.74	0.78	
Education component	0.55	0.59	0.54	0.58	0.70	0.57	0.57	
Economic growth	0.04	0.03	0.02	0.06	0.02	0.04	0.03	
Public debt	0.01	0.02	0.01	0.01	0.02	0.01	0.01	
Variables	2020							
	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	
Population in poverty	0.35	0.29	0.58	0.32	0.33	0.55	0.42	-3.1 %
Labor poverty	0.34	0.30	0.50	0.33	0.41	0.49	0.40	25.0 %
Informality rate	0.49	0.40	0.61	0.41	0.47	0.59	0.51	-3.8 %
Inequality in labor income	0.38	0.37	0.42	0.43	0.35	0.36	0.38	-5.0 %
Gini coefficient	0.47	0.46	0.51	0.47	0.48	0.49	0.48	9.1 %
Human development index	0.77	0.79	0.74	0.78	0.83	0.76	0.77	5.5 %
Health component	0.85	0.85	0.85	0.86	0.86	0.85	0.85	-2.3 %
Quality of life component	0.77	0.77	0.71	0.77	0.80	0.73	0.75	-3.8 %
Education component	0.69	0.74	0.67	0.72	0.84	0.69	0.70	22.8 %
Economic growth	-0.07	-0.07	-0.09	-0.08	-0.12	-0.11	-0.08	-366.7 %
Public debt	0.02	0.03	0.04	0.03	0.02	0.02	0.03	200.0 %

Note: The Table indicates the descriptive statistics related to usage of banking services by regions in Mexico by comparing 2011 vs. 2020. Banking penetration includes: POS transactions, ATM transactions, consumer credit contracts, fixed-term deposits contracts, debit card contracts, consumer credit contracts, and mortgage loan contracts.

inequality in labor income in 2020 are the Northeast (0.43) and the South (0.42), while the regions with the highest concentration of income (Gini coefficient) are the South (0.51) and the Central South and East (0.49).

The HDI shows a positive trend from 0.73 in 2007 to 0.77 in 2020, which represents an increase of 5.5 %. The health dimension decreased by 2.3 % (from 0.87 in 2007 to 0.85 in 2020), the standard of living component was reduced by 3.8 % (from 0.78 in 2007 to 0.75 in 2020), while the education component improved by 22.8 %, going from 0.57 in 2007 to 0.70 in 2020. The highest human development levels are reached in the regions of Mexico City, and Northwest, while the South, Central South, and East and West regions and Bajío registered a lower performance.

Finally, a significant 366.7 % reduction in economic growth is observed comparing 2020 vs. 2007, with the most affected regions being the Central South and East and South. It is observed that public debt increased by 200 % from 2007 to 2020. The most indebted regions are the South (0.04), Northeast (0.03) and Northwest (0.03).

4.2. Correlation analysis

We perform a pairwise correlation in Table 5 to observe the relationship direction between variables and to check whether there is a multicollinearity problem. Correlation analysis is mostly used in the first steps of the construction process to examine the structure and the dynamics of the indicators in the data set (Greco et al., 2019). According to Gujarati (2003), a multicollinearity problem exists when the coefficient value is greater than 0.80. We note that all the coefficient values fell below 0.80. We observe some significant and positive correlations between the financial inclusion variables such as number of correspondents, number of ATMs, POS terminals, saving accounts, fixed-term deposits, debit cards, credit cards, mortgage loans, group loans, personal loans, payroll loans and automobile credits at a significant level of 0.01. In the same way, there is a positive association between public debt and commercial banking branches, correspondents and debit cards. In the case of GDP growth variable, this is related negatively with number of correspondents, POS terminals, and the mobile banking contracts.

Table 5
Correlation analysis.

Study variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
1. Commercial banking branches	1.000																						
2. Correspondents	0.761**	1.000																					
3. Number of ATMs	0.718**	0.736**	1.000																				
4. POS Terminals	0.804**	0.774**	0.741**	1.000																			
5. Mobile banking contracts	0.555**	0.645**	0.714**	0.740**	1.000																		
6. Saving accounts	0.004	-0.229**	-0.014	-0.066	0.131**	1.000																	
7. Fixed-term deposits	0.502**	0.295**	0.542**	0.577**	0.472**	0.088	1.000																
8. Debit cards	0.521**	0.462**	0.661**	0.732**	0.507**	-0.137**	0.585**	1.000															
9. Credit cards	0.598**	0.349**	0.649**	0.637**	0.445**	0.070	0.559**	0.763**	1.000														
10. Mortgage loans	0.201**	0.204**	0.325**	0.339**	0.231**	0.033	0.341**	0.418**	0.562**	1.000													
11. Group loans	-0.360**	-0.222**	-0.346**	-0.329**	-0.162**	-0.080	-0.325**	-0.309**	-0.361**	-0.321**	1.000												
12. Personal loans	0.127*	0.204**	0.177**	0.108	0.047	-0.069	0.110	0.144*	0.085	0.031	0.041	1.000											
13. Payroll loans	0.232**	0.268**	0.454**	0.445**	0.212**	0.115	0.417**	0.706**	0.643**	0.623**	-0.160**	0.156**	1.000										
14. Automobile credits	0.292**	0.335**	0.516**	0.584**	0.399**	0.167**	0.373**	0.676**	0.667**	0.750**	-0.373**	0.174**	0.619**	1.000									
15. Saving deposit contracts	0.064	-0.039	-0.009	0.069	0.162**	0.006	0.148**	-0.026	-0.012	0.059	-0.347**	-0.014	-0.208**	0.088	1.000								
16. Fixed-term deposit contracts	-0.013	0.006	-0.053	-0.015	0.040	-0.139**	0.077	0.018	-0.013	0.037	-0.218**	-0.041	-0.114	-0.008	0.546**	1.000							
17. Consumer credit contracts	-0.003	-0.181**	-0.159**	-0.131*	-0.116*	0.012	0.062	-0.131*	-0.054	0.065	-0.418**	-0.071	-0.227**	-0.099	0.708**	0.575**	1.000						
18. Mortgage loan contracts	0.012	-0.143**	-0.099	-0.089	-0.144*	0.139**	0.036	-0.140**	-0.078	-0.028	-0.212**	-0.073	-0.175**	-0.088	0.473**	0.143**	0.454**	1.000					
19. POS transactions	-0.101	-0.066	-0.148	-0.140	-0.087	-0.084	-0.138	-0.174	-0.258*	-0.234	0.107	-0.078	-0.351**	-0.254	-0.076	-0.143	-0.108	-0.118	1.000				
20. ATM transactions	-0.026	-0.165	-0.140	-0.136	-0.158	-0.152	-0.104	0.015	-0.001	0.022	-0.296*	-0.171	-0.094	-0.099	0.392**	0.377**	0.749**	0.602**	-0.163	1.000			
21. Public debt	0.172**	0.183**	0.109	0.076	-0.011	-0.081	-0.059	0.116*	0.034	0.004	-0.091	0.013	0.036	-0.006	-0.186**	0.043	-0.119	-0.058	0.207	0.176	1.000		
22. GDP growth	0.062	-0.140**	-0.026	-0.113*	-0.266**	0.166**	0.051	-0.025	0.089	0.048	-0.094	-0.040	0.058	-0.147*	-0.078	-0.068	0.106*	0.143**	0.124	0.054	0.077	1.000	

Note: The Table shows the Pearson correlation analysis between the variables of study.

** The correlation is significant at 0.01 level (bilateral).

* The correlation is significant at 0.05 (bilateral). Source: Own elaboration.

Table 6
Access to banking services and poverty, inequality in labor income, informality and human development indicators.

Variables	(1) <i>Population in poverty</i>	(2) <i>Working Poverty</i>	(3) <i>Informality rate</i>	(4) <i>Inequality labor income</i>	(5) <i>Gini</i>	(6) <i>HDI</i>	(7) <i>Health</i>	(8) <i>Standard of living</i>	(9) <i>Education</i>
Commercial banking	-0.936	-0.018	-0.037*	-0.024**	-0.041	0.012**	0.009*	0.006	0.022***
Branches	(-0.50)	(-0.87)	(-1.66)	(-2.04)	(-1.14)	(2.52)	(1.74)	(1.19)	(5.11)
Correspondents	-0.334	0.007	0.004	-0.001	0.016*	0.001	0.000	0.003**	0.004***
	(-0.70)	(1.37)	(0.64)	(-0.49)	(1.78)	(1.02)	(0.26)	(2.00)	(3.76)
Number of ATMs	-4.520***	-0.032***	-0.031***	-0.019***	0.092***	0.009***	0.004**	0.014***	0.009***
	(-6.10)	(-3.84)	(-3.44)	(-4.06)	(6.48)	(5.06)	(2.19)	(6.95)	(4.59)
POS terminals	0.002	-0.000	-0.000	-0.001***	0.001	0.000	0.000	0.000*	0.000
	(0.07)	(-0.84)	(-1.27)	(-3.13)	(1.28)	(0.21)	(0.50)	(1.69)	(0.34)
Mobile banking contracts	-0.003***	-0.000***	-0.000***	-0.000***	0.000***	6.530***	8.500***	5.950**	1.600
	(-3.33)	(-2.49)	(-2.88)	(-2.83)	(2.78)	(2.87)	(3.46)	(2.32)	(0.07)
GDP growth	-142.673**	-1.646***	-2.280***	-1.144***	2.108*	0.389***	0.444***	0.262	0.090
	(-2.14)	(-2.16)	(-2.83)	(-2.72)	(1.64)	(2.35)	(2.49)	(1.41)	(0.63)
Public debt	84.948***	0.432*	-0.051	0.209	-1.220***	-0.343***	-0.343***	-0.185***	-0.406***
	(3.83)	(1.71)	(-0.19)	(1.50)	(-2.86)	(-6.25)	(-5.80)	(-2.99)	(-5.86)
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	160.591***	1.904***	0.862**	0.720***	7.744***	0.328***	0.622***	0.445***	0.387***
	(4.80)	(4.99)	(2.14)	(3.42)	(12.03)	(3.97)	(6.97)	(4.78)	(5.23)
Wald chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Within R ²	0.761	0.599	0.4353	0.5682	0.714	0.699	0.761	0.737	0.817
Observations	256	256	256	256	256	256	256	256	256

Note: The Table analyzes the fixed effect estimations with instrumental variables (2SLS). Instruments: commercial banking branches, correspondents, number of ATMs, sale terminals, mobile banking contracts, GDP growth and public debt. The numbers in parentheses refer to the *z* statistics. ***, **, * indicate the level of significance at the 1 %, 5 %, and 10 % levels, respectively. Source: Own elaboration.

Table 7
Banking penetration and poverty, inequality in labor income, informality and human development indicators.

Variables	(1) <i>Population in Poverty</i>	(2) <i>Working Poverty</i>	(3) <i>Informality rate</i>	(4) <i>Inequality labor income</i>	(5) <i>Gini</i>	(6) <i>HDI</i>	(7) <i>Health</i>	(8) <i>Standard of living</i>	(9) <i>Education</i>
Saving accounts	-0.094 (-0.76)	-0.002* (-1.63)	-0.001 (-0.63)	0.001 (0.79)	0.002 (1.58)	0.000 (1.54)	0.001 (1.57)	0.001*** (3.23)	-0.000 (-0.50)
Fixed-term deposits	0.004 (1.14)	0.000*** (4.44)	-9.150 (-0.32)	-0.000 (-0.48)	-0.000*** (-3.56)	-0.000* (-1.78)	-5.300** (-0.43)	-7.060 (-0.63)	-0.000 (-1.29)
Debit cards	-0.000* (-1.66)	-2.870* (-1.73)	1.370 (1.01)	2.500 (1.47)	3.490 (0.03)	9.720* (2.29)	1.650*** (2.82)	-3.310 (-0.62)	1.620* (1.70)
Credit cards	-0.003** (-2.33)	-0.000*** (-2.52)	-0.000** (-1.92)	8.040 (0.66)	0.000 (1.21)	7.770 (0.25)	6.070 (1.45)	6.110 (1.58)	-8.120 (-1.18)
Mortgage loans	-0.045*** (-4.89)	8.670* (0.09)	-0.000*** (-5.94)	-0.000 (-0.89)	0.000*** (2.61)	0.000 (1.12)	0.000 (0.54)	0.000 (0.98)	0.000 (0.89)
Group loans	-0.001 (-0.38)	-0.000 (-1.37)	0.000 (1.14)	2.910 (0.01)	-4.270 (-0.18)	4.760 (0.63)	1.610 (0.15)	-0.000** (-1.92)	-0.000** (-2.20)
Personal loans	-0.000 (-0.07)	4.200 (0.09)	9.340*** (2.51)	-5.180 (-1.12)	-6.450* (-1.75)	-9.910 (-0.86)	-2.270 (-1.42)	-1.350 (-0.09)	7.950 (0.31)
Payroll loans	-0.016*** (-5.52)	-0.000*** (-4.35)	-0.000*** (-6.06)	-0.000 (0.64)	0.000 (0.81)	0.000*** (4.17)	0.000 (1.54)	0.000** (4.38)	0.000** (2.20)
Automobile credits	-0.074** (-2.18)	-0.001*** (-4.20)	-0.001*** (-3.08)	-0.000 (-0.85)	-0.001** (-1.90)	0.000*** (3.62)	8.370 (0.01)	0.000*** (2.97)	0.000*** (2.54)
GDP growth	-1.652 (-0.03)	-0.365 (-0.59)	0.625 (1.22)	-1.210** (-1.89)	-1.027** (-2.03)	0.159 (1.00)	-0.371* (-1.69)	0.010 (0.05)	0.604 (0.09)
Public debt	8.846 (0.59)	-0.078 (-0.52)	-0.693*** (-5.67)	0.064 (0.42)	0.287*** (2.37)	-0.190*** (-4.98)	-0.250*** (-4.77)	-0.012 (-0.25)	-0.228*** (-2.67)
Region	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Constant	135.268*** (3.52)	1.961*** (5.11)	0.309 (0.98)	1.304*** (3.32)	1.072*** (3.44)	0.273*** (2.79)	0.846*** (6.27)	0.524*** (4.22)	-0.404* (-1.83)
Wald chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Within R ²	0.889	0.858	0.880	0.484	0.638	0.8489	0.664	0.831	0.708
Observations	255	255	255	255	255	255	255	255	255

Note: The Table analyzes the fixed effect estimations with instrumental variables (2SLS). Instrumented: GDP growth. Instruments: saving accounts, fixed term deposits, debit cards, credit cards, mortgage loans, group loans, personal loans, payroll loans, automobile credits, GDP growth and public debt. The numbers in parentheses refer to the z statistics. ***, **, * indicate the level of significance at the 1 %, 5 %, and 10 % levels, respectively. Source: Own elaboration.

Table 8
Usage of banking services and inequality in labor income, informality and human development indicators.

Variables	(1) <i>Population in Poverty</i>	(2) <i>Working poverty</i>	(3) <i>Informality</i>	(4) <i>Inequality labor income</i>	(5) <i>Gini</i>	(5) <i>HDI</i>	(6) <i>Health</i>	(7) <i>Standard of living</i>	(8) <i>Education</i>
Saving deposit contracts	−0.002** (−1.80)	−2.560 (−0.23)	0.000*** (2.53)	−4.120 (−0.69)	4.300 (0.02)	7.460 (0.40)	1.490 (0.62)	1.000 (0.35)	3.330 (1.31)
Fixed-term deposit contracts	−0.031*** (−3.62)	−0.000*** (−4.88)	0.000** (2.06)	−0.000*** (−3.06)	−0.001*** (−3.90)	0.000*** (4.05)	0.000*** (3.03)	0.000*** (3.73)	0.000** (1.91)
Debit card contracts	−0.021*** (−2.41)	−0.000*** (−2.58)	−0.000 (−1.30)	−0.000 (−1.18)	0.000*** (2.66)	0.000* (1.67)	8.540 (0.04)	0.000*** (2.65)	3.000 (0.13)
Consumer credit contracts	−0.009*** (−2.74)	−0.000*** (−2.69)	−0.000* (−1.67)	0.000* (1.80)	0.000 (1.34)	−1.970 (−0.031)	−7.000 (−0.85)	0.000 (1.12)	−0.000** (−1.97)
Mortgage loan contracts	−0.104* (−1.64)	−0.002*** (−2.89)	−0.000 (−1.34)	−0.001*** (−2.61)	0.001 (1.01)	0.000 (1.09)	0.000*** (2.06)	0.000 (0.82)	0.000 (0.18)
POS transactions	−0.000 (−1.59)	−2.210*** (−2.52)	−1.300 (−1.52)	−6.340 (−0.01)	1.280 (0.82)	2.510* (1.69)	3.150* (1.66)	2.330 (1.04)	2.220*** (5.81)
ATM transactions	−0.001*** (−9.03)	−9.660*** (−5.77)	−0.000*** (−6.63)	−1.150 (−1.28)	0.000*** (7.99)	2.500*** (8.80)	1.870*** (5.15)	3.610*** (8.42)	1.043*** (7.48)
GDP growth	−125.971* (−1.79)	−1.579** (−1.98)	−2.037*** (−2.62)	−1.111*** (−2.59)	2.304* (1.62)	0.230* (1.70)	0.389** (2.25)	0.308 (1.51)	0.081 (0.44)
Public debt	36.891* (1.63)	0.167 (0.65)	0.445* (1.77)	0.041 (0.30)	−0.522 (−1.14)	−0.265 (−6.07)	−0.286*** (−5.12)	−0.087 (−1.31)	−0.352*** (−5.99)
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	106.24*** (2.83)	1.378*** (3.23)	4.297** (1.96)	1.079*** (4.73)	9.712 (12.78)	0.452 (6.26)	0.837*** (9.07)	0.729*** (6.68)	0.104 (1.08)
Wald chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Within R ²	0.731	0.5581	0.708	0.445	0.666	0.8021	0.618	0.695	0.864
Observations	287	287	287	287	287	287	287	287	287

The Table describes the fixed effect estimations with instrumental variables (2SLS). Instruments: Saving deposit contracts, fixed-term deposit contracts, debit card contracts, consumer credit contracts, mortgage loans contracts, POS transactions, ATM transactions, GDP growth and public debt. The numbers in parentheses refer to the *z* statistics. ***, **, * indicate the level of significance at the 1 %, 5 %, and 10 % levels, respectively. Source: Own elaboration.

4.3. Econometric analysis

Several econometric analyses between the financial inclusion [access to banking services, banking penetration and usage of banking services] and the poverty, inequality and human development variables were performed. Table 6 shows 2SLS estimations using instrumental variables (IV) to deal with endogeneity/causality issues. In this case, the lag of access to banking services dimension (financial infrastructure) and poverty, informality, inequality and human development indicators. Table 6 shows the econometric results to H1a and H1b.

The independent variable is the financial infrastructure dimension referring to the number of commercial banking branches, correspondents, ATMs, POS terminals and mobile banking contracts, for every 10,000 adult inhabitants. The dependent variables are related to: 1) population living in poverty [column 1], 2) working poor [column 2], 3) informality rate [column 3], 4) inequality in labor income [column 4], 5) Gini coefficient [column 5], 6) human development index [column 6], 7) health component [column 7]; 8) standard of living component [column 8], and 9) education component [column 9]. The control variables included in the models are the GDP growth and the level of public debt per federal entity.

The results show that the number of commercial bank branches reduces the informality rate and inequality in labor income, while enhances the HDI and their health and education components at a significant confidence level. Similarly, there is evidence of a positive and significant relation between the number of correspondents and the indicators of Gini, standard of living, and education. By contrast, access to ATMs reduces the population in poverty, the working poverty, the informality rate, and the inequality in labor income, while increases the Gini indicator, the HDI, and their dimensions of health, standard of living and education.

In the same line, the number of POS terminals decreases significantly the inequality in labor income and increases the standard of living component. The mobile banking contracts have a negative and significant impact over population in poverty, working poverty, informality rate, and inequality in labor income. On the other hand, the access to mobile banking contracts favor the Gini indicator, the HDI and the health and standard of living components. The GDP growth reduces poverty, informality and inequality indicators while increases the HDI performance. Public debt increases population in poverty, working poverty and has a negative effect over the Gini indicator and the HDI indicators.

According to the obtained results, H1a, which establishes that the access to banking services may reduce the poverty, equality, and informality indicators, is not rejected. It is observed that the number of ATMs and the number of mobile banking contracts are the financial services that reduce poverty, informality and inequality. H1b is not rejected, since a positive and significant relationship is shown between the access to banking services (number of ATMs and mobile banking contracts) and the HDI and its components, while reduces the levels of poverty, informality and inequality. It should be noted that the number of ATMs and mobile banking contracts are the elements that generates the greatest favorable effect on the HDI and its dimensions. These results are aligned with those obtained by [Thathsarani et al. \(2021\)](#) which support the effect of financial inclusion on economic growth and human development of eight South Asian countries in the long run but not in the short run.

Table 7 shows the fixed effect estimations with instrumental variables 2SLS to answer the research hypotheses H2a and H2b. The independent variables referred to the dimension of banking penetration [savings accounts, time deposits, debit cards, credit cards, mortgage loans, group loans, personal loans, payroll loans and automobile credits]. The results show that the number of savings accounts reduces significantly the working poverty and increases the standard of living. Similarly, the number of fixed-term deposits decreases the working poverty and the Gini indicator, the HDI ($p = 0.10$) and its component of health ($p = 0.05$). The debit cards penetration reduces in a significant way, the population in poverty and the working poverty, while increases the HDI, and the health and education components. The credit cards decrease the poverty and informality levels, while the mortgage loans motivate the reduction of poverty and informality and increase the Gini indicator. In the same way, the group loans diminish the standard of living and education dimensions. It is shown that the penetration of personal loans increases significantly informality rates and reduces the Gini coefficient. Comparably, payroll loans reduce the population in poverty, working poverty and informality rate, whilst improve the HDI, and its components of standard of living and education. Automobile credits reduce poverty and Gini indicator, and increase the HDI and their components of standard of living and education. Regarding the control variables, it is observed that the GDP growth is significant and has a favorable effect on health component, and reduces inequality in labor income; public debt has a negative impact on the informality rate, the HDI and their components of health and standard of living, while increasing the Gini indicator.

These results lead to not reject H2a, which establishes that a greater banking penetration, the poverty, informality, and inequality levels will be reduced. Some financial services such as debit cards, credit cards, payroll loans and automobile credits reduce poverty, informality and Gini indicators. The H2b is not rejected; payroll loans and automobile credits enhance HDI and their components of standard of living and education.

Table 8 shows the fixed effect estimations with instrumental variables 2SLS to respond to hypotheses H3a and H3b. The independent variables referred to the usage of banking services dimensions [saving deposit contracts, fixed-time deposit contracts, debit card contracts, consumer credit contracts, mortgage credit contracts, POS transactions and ATMs transactions].

The econometric results show that the number of saving deposit contracts significantly increases the informality rate and reduces population in poverty. In addition, the number of fixed-time deposit contracts decreases the poverty levels, the inequality in labor income and the Gini indicator; while increasing the informality rate and the HDI performance. The number of debit card contracts reduces significantly the population in poverty and the working poverty; while enhancing the Gini indicator and the HDI including its dimension of standard of living. The number of consumer credit contracts decreases the population in poverty, the working poverty, the informality rate and the education component; and increases the inequality in labor income. From its part, the number of mortgage loan contracts diminishes the population in poverty, the working poverty and the inequality in labor income, and rise the health component. The number of POS transactions decreases the working poverty indicator, while it shows a favorable effect on the HDI and

its elements of health and education. Similarly, the number of ATM transactions decreases the population in poverty, the working poverty (and the informality rate). On the other hand, it increases the Gini indicator, the HDI and its components of health, standard of living and education. Public debt increases the population in poverty and the informality rate, while inhibits the HDI, particularly, the health and education components.

The previous results lead us to not reject H3a, which establishes that the greater usage of banking services, the lower levels of poverty, informality, and inequality. The usage of financial services such as debit cards contracts, consumer credit cards, mortgage loan contracts and ATMs transactions reduce poverty and informality indicators. H3b, which proposes that a greater usage of banking services, the higher level of human development, is not rejected. It is observed that fixed-term deposit contracts; debit card contracts and ATMs transactions increase the HDI and its components. Consumer credit contracts have a negative effect on the health dimension of the HDI.

5. Conclusions

The objective of this work was to analyze the effect of financial inclusion in its access to banking services, banking penetration and usage of banking services dimensions on indicators of economic and social development (poverty, inequality in labor income, informality rate and human development level) in the states of Mexico, during the 2007–2020 period. Given that financial inclusion is a transversal pillar to achieve the SDGs in the United Nations 2030 agenda, this study contributed to extend the literature by addressing the Mexican context at sub-national level.

The empirical results show that access to banking services, such as the number of correspondents and the number of mobile banking contracts reduces poverty levels and the informality rate. Similarly, a greater number of correspondents, ATMs and mobile banking contracts favor the level of human development and its health component. Regarding the banking penetration, savings deposits and group loans reduce the levels of working poverty and the Gini coefficient, which translates into a decrease in the income concentration. It is evident that a greater banking penetration increases the level of sub-national human development, in its health, standard of living and education dimensions. An increase in the usage of banking services reduces the poverty, informality and inequality indicators and increases the sub-national HDI.

This work is a reference for legislators and policy makers who participate in the development of public policies that promote financial inclusion, and whose objective is to reduce inequalities in terms of poverty and human development in Mexico. The adult population in Mexico continues to resort to traditional banking, with ATMs being the most widely used channel, although in 2020, transfers sent by CoDi increased considerably in number from 38.3 to 154.4 thousand operations (CNBV, 2021). It is necessary to create robust policies and regulatory frameworks that support the adoption of technologies and that guarantee the protection and security of financial services users. Although it is true that Mexico has the leadership in regulatory matters in the Latin American region, with the recent publication of the FinTech Law of 2018, the infrastructure in terms of communications and the internet, particularly for areas in vulnerable conditions and extreme poverty, is deficient. Also, 60 % of adults in Mexico use informal financial instruments [loans from relatives or friends, cash remains the preferred method of payment] (CNBV, 2021b).

Financial inclusion is a challenge for low- and middle-income countries. Financial institutions need to provide innovative and needs-based financial services to financially excluded segments of the population, as demand for these may vary due to differences in culture, customs, beliefs, and income levels, as seen in the different regions of Mexico. The federal government, local governments, the Bank of Mexico and financial institutions need to cooperate mutually to develop the financial services infrastructure and improve the financial services network in rural and urban areas. A concrete and time-bound policy to increase financial literacy in rural areas is essential to increase financial awareness and change financial behavior among low-income people. Efforts should also be complemented by supportive policies such as government subsidy transfers to account holders for effective use of dormant accounts. Economies like Mexico must seek to increase per capita income and access information to minimize the involuntary financial exclusion of large segments of the population (Gupte et al., 2012). Finally, central banks play a strategic role of guarding the appropriate functioning and stability of the payments system and as overall regulators of the financial system (Rojas-Suárez, 2016; Mialou et al., 2017). For instance, central banks may initiate regulatory changes to assess/allow the entrance of new providers of financial services and their networks as the authorization for offering of new products. Furthermore, the key function of central banks is to guarantee the financial stability, which need to be compatible with financial integrity and financial consumer stability. In this regard, central banks' cooperation with banking supervisors and other authorities overseeing the functioning of financial sector is essential to promote a more inclusive financial inclusion.

To conclude, some limitations are recognized and future research is identified. First, the study sample is limited to a period of 13 years and to the 32 Federal Entities, so it is recommended to deepen the analysis at municipal level. It would also be interesting to extend the research to other Latin American countries with similar institutional contexts. The impact of financial inclusion on household income and vulnerability is another important dimension will be linking the micro-level evidence of the benefits of financial inclusion to macro-level goals, such as economic growth and a fall in inequality (Demirguc-Kunt et al., 2017). Second, an important limitation of the research is the scarcity of data that exists on financial inclusion at subnational level, so it is recommended to generate more detailed and updated information to motivate researchers in this area of research. Third, the informal financial networks play an indispensable role in the development of formal institutions. In the Mexican context, the microfinance or the "popular financial sector" provides financial services to lowest-income groups, while cooperative and microfinance institutions mainly attend municipalities with a medium level of financial inclusion (Zulaica-Piñeyro, 2013). The microfinance in Mexico have reduced the poverty levels, mainly in the rural households (Mora-Rivera and Garcia-Mora, 2018). Hence, future research could analyze the effect of microfinance on the financial inclusion and human development levels. Finally, some control variables such as social expenditure are not analyzed in

the research.

CRedit authorship contribution statement

Guadalupe del Carmen Briano-Turrent: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Guadalupe del Carmen Briano Turrent reports administrative support and equipment, drugs, or supplies were provided by Universidad Autónoma de San Luis Potosí. Guadalupe del Carmen Briano Turrent reports financial support was provided by Consejo Nacional de Ciencia y Tecnología. Guadalupe del Carmen Briano Turrent reports a relationship with Universidad Autónoma de San Luis Potosí that includes: employment. There is no additional relationships or activities to declare

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