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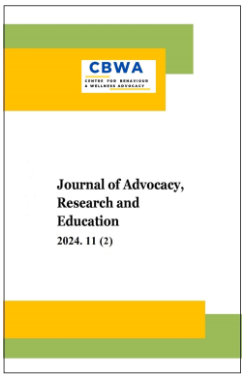

Impact of Financial Inclusion on Human Development Indicators for Women in Mexico

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Abstract

Financial inclusion has become a strategic factor to reduce poverty and income inequality and achieve sustainable economic growth. The objective of this work was to study the impact of financial inclusion (access, owning, and usage of financial services dimensions) on women's human development indicators (health, education, and standard of living) in the Federal States of Mexico. The study sample was made up of 448 observations during the 2007-2020 period, that is, 14 units of analysis per Federal State. The econometric results showed that access to financial services increases the Human Development Index [HDI] and the education sub-index for women. The owning of financial products improved the HDI and its education, health, and standard of living components for women; credit financial instruments, in particular, enhanced human development indicators for women. The usage of the financial services component increased the HDI as well as the education and standard of living sub-indices. This study has practical implications for those responsible for designing and approving public policies and regulations in Mexico regarding financial inclusion and human development from a gender perspective.

Keywords: Financial Inclusion, Gender, Human Development, Inequality, Mexico.

1. Introduction

Financial inclusion has become the dynamic driving force for sustainable economic growth, inequality and poverty reduction (Banerjee, 2020; Dai-Won et al., 2018; World Bank, 2021). Financial inclusion constitutes a fundamental pillar for achieving the United Nations Millennium Development Goals (Chibba, 2009). A higher access to formal financial services reduces the financial vulnerability of the population living in poverty conditions and contributes to smoothing consumption (Chen, Jin, 2017; Tita, Aziakpono, 2017); therefore, financial inclusion is a means to reduce inequality gaps in health, poverty and unemployment (Arner et al., 2020). Furthermore, financial inclusion provides increased resilience by offering an avenue to insure against negative economic shocks (Sakyi-Nyarko et al., 2022).

Financial inclusion is defined as access to different financial products and services or as the proportion of companies and people that use these services (Kim, 2016). By contrast, financial

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exclusion reflects the inability of some social groups to access the financial system of a country, which leads to lower levels of investment due to the absence of credit and the consequent need for people to resort to the informal sector to obtain loans with very high interest rates (Carbó et al., 2005).

The COVID-19 health crisis has generated disruptions in economic and social dynamics, which has led to an increase in the gender gap that already existed in terms of financial inclusion. According to figures from Global Findex (2020), 57.4 % of men have a bank account, compared to 51.4% of women, which means that 304 million women in Latin America do not have an account. The factors that generate this financial gap based on gender refer to the fact that women have lower levels of financial education compared to men (Grohmann, 2016), or because of cultural differences (Organisation for Economic..., 2012).

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 financial services, placing it in the 4th lowest position in Latin America, only above countries such as Haiti, Nicaragua and El Salvador (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 kilometers, while 95 % have fewer than 500 pesos daily purchases are made in cash (United Nations..., 2021). 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., 2018b).

Regarding the gender gap in Mexico, 65 % of women have at least one financial product, while men register 72 %. In addition, the largest gap is registered in rural populations, where only 36 % of women have a savings account, and only 0.7 % participate in investment funds (National Institute of Statistics and Geography [INEGI], 2018). According to recent data from the National Survey of Financial Inclusion [ENIF] 2021, between 2018 and 2021, the COVID-19 pandemic had significant effects on the gender gap, which increased by 11.2 %, particularly the owning of a formal savings account: it registered 56.4 % for men and 42.6 % for women in 2021. The same effect was observed in having insurance, which fell from 23.1 % to 16.0 % in women and from 28.0 % to 26.1 % in men (INEGI, 2022).

Women still earn less, learn less, own less, and exercise less economic power compared to men. This leads to negative consequences that affect their health, schooling, job prospects, and economic independence (Hendriks, 2019). Women also face greater barriers in searching for sources of financing to carry out their entrepreneurial projects (Marlow, Patton, 2005), although the gender gap in having a formal credit showed progress between 2018 and 2021, decreasing by 2.1 % in favor of women (INEGI, 2022).

The objective of this research is to analyze the effect of financial inclusion in the dimensions of access, ownership, and usage of financial services in relation to human development indicators (health, education, and standard of living) of women from the Federal States of Mexico. The study sample is made up of 448 observations during the 2007–2020 period, that is, 14 elements of analysis per State in Mexico. This paper establishes a general research hypothesis: *"the greater financial inclusion on its dimensions of access, owning and usage, the higher indicators of human development for women in the States of Mexico"*.

There are few studies addressing the Mexican context; for example, Masino and Niño-Zarazúa (2020) conclude that the change from cash payments to electronic payments has a favorable effect on savings decisions, the reception of remittances, which in turn, generated important implications for household consumption and risk management decisions. Niño-Zarazúa and Copestake (2008) argue that the variation in the usage of financial services in a low-income region of Mexico City is attributed to differences in socioeconomic variables, such as gender, employment, education and housing situation.

Although the causal relationship between financial inclusion and social and economic development has been approached comparatively between countries and regions, there is no literature with a gender perspective at sub-national level for the case of Mexico. This study is a pioneer in addressing the impact of financial inclusion on the dimensions of the HDI at sub-national level, in a context characterized by high levels of inequality. Mexico has one of the most diverse and robust financial industries in Latin America and a strong presence in the Fintech sector; in 2018 the Fintech Law was enacted and in 2019 the CoDi payment platform began

operations, which are promoters of financial inclusion in Mexico. However, progress in attracting financial services is limited, while the credit penetration of GDP reached just 36.9 % in 2019, a lower figure than its peers in the region. 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).

A balanced panel data and the Generalized Method of Moments [GMM] technique are adopted to perform the econometric analysis. The results show that access to financial services, such as the number of mobile banking contracts, increases the HDI of women, while the number of correspondents and ATMs favor the education sub-index. Regarding the owning of financial services, the results suggest that savings deposits increase the HDI and the dimensión of education; the number of time deposits has a positive impact on the health sub-index for women. Access to a mortgage loan increases the HDI and the education sub-index for the female gender. For their part, group credits have a positive effect on the HDI, as well as the education and health index for women. Women who have personal loans or payroll loans increase the HDI and the standard of living dimension. Car loans favor the standard of living indicator and the health index. In particular, credit instruments are the ones that favor human development indicators for women the most.

In relation to the usage dimension, it is evident that the number of savings deposit contracts increases the HDI for women, as well as the education and standard of living sub-indices; the number of debit card contracts has a positive impact on the education sub-index. These results lead to partial acceptance of the general research hypothesis.

This research contributes to different aspects of financial inclusion and human development. First, strategies and recommendations are identified to increase financial inclusion with a gender perspective. The rate of financial exclusion in Mexico remains one of the highest among OECD countries (Fozan et al., 2017). Second, as far as we know, it is the first comparative study in Mexico at the sub-national level during the 2007–2020 period, which analyzes the impact of financial inclusion dimensions (access, owning and usage) on strategic indicators of human development at the sub-national level. Third, the study has practical implications for those responsible for designing and approving public policies and regulations in Mexico regarding financial inclusion and presents a series of recommendations for the financial sector and local governments themselves to promote financial inclusion and human development from a gender perspective.

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

2. Theoretical Development

In 2015, the new 2030 agenda of the United Nations highlighted the importance of access to financial services in seven of the seventeen Sustainable Development Goals [SDGs], since it constitutes a mechanism to increase the formal economy, reduce banking risks and costs, create more jobs, increase financial stability and the effectiveness of monetary policy, and reduce poverty and inequality (Demirgüc-Kunt et al., 2018a). Previous literature shows that there is a positive relationship between banking and economic growth and the social welfare of the population of a country. However, when half of the population is not banked or does not have the knowledge or access to formal financial systems and services to save or request financing, economic growth and the eradication of poverty and inequality could be compromised, and this is a more distressing scenario in developing or emerging countries (Sharma, 2016).

For the World Bank, financial inclusion is the key factor to reducing poverty and inequality, so it is necessary to develop strategies to increase financial literacy, guarantee the protection of the consumer of financial services and face the challenges of digital finance (Romero-Álvarez et al., 2020). According to Reddy (2017), the goal of financial inclusion is to transform the lives of vulnerable groups by providing access to financial services.

Jong-Hee (2016) refers to financial inclusion as access to financial products and services (credit, savings, payments and insurance) or the proportion of companies and individuals that use these services. Financial inclusion refers to the access and usage of quality, sustainable financial services that comply with the security elements for the population (Cabeza-García et al., 2019),

contributing to greater socioeconomic equality by reducing poverty and enabling the development of financial services and the banking sector infrastructure (Shrivastava, Satam, 2015). 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 this market (Angadi, 2003).

The gender gap in the formal financial system exacerbates inequality and reinforces the economic subordination of women. This has repercussions for growth and sustainable development, which is why the SDGs – as part of the 2030 Development Agenda – endorse in each of their goals the importance of financial services as key elements to combat poverty, promote productivity, innovation and economic growth, guarantee people's well-being, and reduce inequalities (including gender), and act as "catalysts" of development (Girón et al., 2018).

Research Hypothesis

Financial inclusion contributes to economic growth through the creation of value for companies and has positive effects on human development, inequality and poverty indicators (Nanda, Kaur, 2016; Sethi, Sethy, 2019). 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, Inaba, 2020; Bruhn, Love, 2014).

Burgess and Pande (2005) show that opening bank branches reduces poverty in rural areas of India. Financial inclusion is positively associated with economic growth, economic stability, and human development level (Sahay et al., 2015). People who cannot access conventional financial services are exposed to different risks, such as social exclusion, inequality and lack of opportunities to invest or start a business (Sha'ban et al., 2020).

From a gender perspective, Swamy (2014) found that the participation of women in financial inclusion programs increases the level of income and improves family well-being in India. Financial inclusion generates transformative effects for women. For example, when women actively participate in the financial system, they strengthen their skills to manage risk better, smooth consumption in the face of crises, or finance household expenses such as education (Dupas, Robinson, 2013). Women who have the tools to make savings and credit decisions have a positive impact on their economic empowerment, which affects poverty reduction (Holloway et al., 2017).

Financial inclusion increases access to financial opportunities, which motivates women to start a business and earn an income. In the case of women who are heads of households, the additional income is used to cover medical care expenses, which translates into higher health indicators, reduced school desertion, and increased educational levels. Therefore, financial inclusion and human development are mutually related (Datta, Singh, 2019). Women's access to the financial system increases their negotiating and decision-making power and generates greater opportunities to acquire durable goods (Ashraf et al., 2006). Duflo's study (2003) showed that the delivery of targeted cash transfers to women in a digital way improved the dietary diversity and nutritional status of children living in poor households compared to those made up of men. In the context of Nepal, free savings accounts were offered to female heads of households living in slums, which boosted spending on education and food and increased health-related spending (Prina, 2015). In Kenya, the introduction of mobile money reduced the number of households in poverty, particularly those headed by women (Suri, Jack, 2016).

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, Jaramillo-Garza and Rosa (2015) researched the effect of financial inclusion on inequality in income distribution, showing that higher financial inclusion initially leads to higher income inequality, but as financial inclusion increases, income inequality decreases significantly at the municipal level. The discussion above leads us to establish the following research hypotheses:

H1. *The greater financial inclusion in its access dimension, the higher the level of human development for women in the States of Mexico.*

H2. *The greater financial inclusion in its owning dimension, the higher the level of human development for women in the States of Mexico.*

H3. *The greater financial inclusion in its usage dimension, the higher the level of human development for women in the States of Mexico.*

3. Materials and Methods

The study sample is made up of 448 observations during the 2007-2020 period, that is, 14 elements of analysis per State in Mexico. The study variables were obtained from secondary data sources, particularly the databases issued by the National Banking and Securities Commission [NBSC] (2021), the Global DataLab-Subnational Human Development Index 5.0 (2021) and the National Institute of Statistics and Geography [INEGI] (2021). The Subnational Human Development Index [HDI] is a translation of the HDI developed by the UNDP at the state level (GlobalDataLab, 2021). The financial inclusion variables are divided into three categories: access, owning and usage of financial products and services.

The sub-national HDI is an average of the sub-national values of three components: education, health and standard of living, which contain aggregated indicators from household surveys and census data. For the health dimension, life expectancy at birth is adopted as an indicator. For the standard of living, the logarithm of the gross national income per capita, measured with purchasing power parities [PPP] in 2011 US dollars, is used. The educational dimension is measured with two indicators. The first average years of schooling for adults over 25 years of age reflects the current situation with respect to education in society. The second, expected years of schooling, indicates the future level of education of the population. Like the original HDI, the sub-national HDI takes values between 0 and 1; that is, the lowest possible value is 0, and the maximum level is 1 (Smits, Permanyer, 2019). Finally, the control variables referring to the size of the population and level of debt per State were obtained from the INEGI (2021) and the CNBV (2021).

Econometric Model and Definition of Study Variables

Various descriptive and econometric analyses are carried out to discuss the results of the research. The Generalized Method of Moments [GMM] technique is used since the number of cross-sectioned units is greater than the number of available time periods. This technique is parametric in nature and takes into account the endogeneity of the variables. According to Banerjee (2020), economic development reduces poverty levels, and an increase in the human development level increases the demand for financial services. At the same time, reducing income inequality can lead to greater financial inclusion. To overcome these possible problems of causality between the variables, a dynamic panel based on the GMM method with robust standard errors for the states is adopted (Neaime, Gaysset, 2018).

To analyze the relationship between the financial inclusion dimensions and the human development indicators by State, the study variables have been classified into three groups: 1) financial inclusion: access (financial infrastructure), financial products owning and usage of financial products; 2) sub-national human development index and its education, health and standard of living components; and 3) control variables (population size, economic growth, public debt by state, region to which the State belongs, and year of study). The operationalization of the study variables is based on the methodology applied by national and international institutions that issue information on financial inclusion and human development indicators (CNBV, 2021; Global DataLab Subnational Human Development Index 5.0, 2021). The econometric models are proposed as follows:

$$IDH_{i,t} = \alpha_o + \Sigma\beta_1(IDH_{i,t-1}) + \Sigma\beta_2(Access_{i,t}) + \Sigma\beta_3(Control_{i,t}) + \mu_{i,t} \quad [1]$$

$$IDH_{i,t} = \alpha_o + \Sigma\beta_1(IDH_{i,t-1}) + \Sigma\beta_2(Owning_{i,t}) + \Sigma\beta_3(Control_{i,t}) + \mu_{i,t} \quad [2]$$

$$IDH_{i,t} = \alpha_o + \Sigma\beta_1(IDH_{i,t-1}) + \Sigma\beta_2(Usage_{i,t}) + \Sigma\beta_3(Control_{i,t}) + \mu_{i,t} \quad [3]$$

Where:

i represents i-nth cross-sectional unit (federal State); t for the nth period of time (year); *access, owning* and *usage* are the dimensions of financial inclusion; *Control* is a vector for the control variables of population size and public debt. HDI is the sub-national human development indicator and consists of components of health, standard of living, and education. $\mu_{i,t}$ is the error term.

4. Results

Descriptive Analysis

Table 1 shows the descriptive statistics referring to the evolution of financial inclusion in the regions of Mexico by comparing the years 2011 vs. 2020. In the infrastructure of the financial sector

dimension (access), 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 Mexico in 2020 are the Northeast (7.34) and the Northwest (6.95). 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 adoption of technologies applied to the financial sector and owing to the confinement measures imposed by the COVID-19 pandemic. Mexico City registered an average of 14,827 mobile banking contracts per 10,000 inhabitants in 2020, followed by the Northwest (4,847) and Northeast (4,352) regions.

Table 1. Access to financial services by regions in Mexico

Banking Service/2011	**West and Bajío**	**Northwest**	**South**	**Northeast**	**Mexico City**	**Central South and East**	**National**
Number of commercial banking branches	2.7590	.73655	3.2590	.73655	3.7515	.72212	3.2560
Number of correspondents per 10 thousand inhabitants	2.8679	1.07412	3.8120	1.09666	3.8610	1.07260	3.5154
Number of ATMs per 10,000 inhabitants	3.8940	.67652	4.3060	.52241	4.0560	.61776	4.0853
Number of sale terminals per 10,000 inhabitants	2.6320	1.28720	3.1120	1.25363	3.5431	1.15498	3.0953
Number of mobile banking contracts per 10,000 inhabitants	3.5990	.78161	4.0870	.76229	4.5020	.49849	4.0613

Table 1. Access to financial services by regions in Mexico (Continuation…)

Banking Service/ 2020	**West and Bajío**	**Northwest**	**South**	**Northeast**	**Mexico City**	**Central South and East**	**National**	**Var (%)**
Number of commercial banking branches	2.7590	.73655	3.2590	.73655	3.7515	.72212	3.2560	3.2560
Number of correspondents per 10 thousand inhabitants	2.8679	1.07412	3.8120	1.09666	3.8610	1.07260	3.5154	3.5154
Number of ATMs per 10,000	3.8940	.67652	4.3060	.52241	4.0560	.61776	4.0853	4.0853

Banking Service/ 2020	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	Var (%)
inhabitants								
Number of sale terminals per 10,000 inhabitants	2.6320	1.28720	3.1120	1.25363	3.5431	1.15498	3.0953	3.0953
Number of mobile banking contracts per 10,000 inhabitants	3.5990	.78161	4.0870	.76229	4.5020	.49849	4.0613	4.0613

Source: CNBV (2021).

Table 2 describes the results obtained for the indicators of owning financial products (deposits and credit) for the years 2011 vs. 2020. As for this dimension, a decrease is observed in the usage of: savings accounts (-43.18 %), number of credit cards (-9.39 %), usage of personal loans (-13.06 %) and usage of payroll loans (-14.58 %). On the other hand, the financial products that register an increase in their usage in 2020 vs. 2011 are: time 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 usage of financial services in 2020 are Mexico City, the Northeast and the Northwest.

Table 2. Owning of financial services dimension by regions in Mexico

Banking Service/ 2011	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	9,567.01	11,732.53	8,635.29	11,760.83	33,302.65	7,783.10	12,572.38
Credit cards	2,371.98	2,661.42	2,008.30	2,801.88	11,607.55	2,062.55	2,997.63
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	1,409.44	1,083.11	931.51	1,280.26
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

Regarding indicators of the usage of financial services in Popular Savings and Credit Entities [EACP], Table 3 shows the comparison between the years 2011 and 2020. A significant increase 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 1,074 in 2020. The regions that have most adopted the usage of this service are the West and Bajío, Northeast and South. The number of term deposit contracts has increased by 129.3 %, as has the number of debit cards per 10,000 inhabitants, which

registered an increase of 218.9 % in 2020 vs. 2011. The most favored regions in these two indicators are the West and Bajío and Mexico City.

Table 2. Owning of financial services dimension by regions in Mexico (Continuation…)

Banking Service/ 2020	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	Var (%)
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	1,001.47	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	2,803.85	2,809.90	1,945.17	2,776.62	9,536.09	2,228.19	2,716.19	-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	1,050.97	866.80	1,274.80	938.90	1,522.03	1,301.48	1,113.08	-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

Source: CNBV (2021).

The usage dimension has been reduced in some financial services, such as ATM transactions per 10,000 inhabitants (-20.3 %), consumer credit contracts (-10.5 %) and housing credit contracts (-56.1 %). The regions with the greatest usage of these services are Mexico City, the Northeast, Northwest, South and West, and Bajío.

Table 3. Usage of financial services by regions in Mexico

Banking Service/ 2011	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National
POS transactions per 10,000 inhabitants	8,423.99	14,881.47	8,148.64	11,970.43	32,520.87	5,931.55	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	1,622.68	237.24	351.18	654.37	121.53	249.90	659.42
Fixed-term deposits contracts per 10,000 ihabitants	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

Banking Service/ 2011	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National
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

Table 3. Usage of financial services by regions in Mexico (Continuation…)

Banking Service/ 2020	West and Bajío	Northwest	South	Northeast	Mexico City	Central South and East	National	Var (%)
POS transactions per 10,000 inhabitants	13,529.17	25,461.35	9,763.20	23,740.82	100,719.92	7,998.34	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	2,474.65	437.48	644.89	808.24	417.49	629.49	1,073.86	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

Source: CNBV (2021).

Table 4 shows the evolution of the sub-national human development index by regions in Mexico for the years 2007 vs 2020. The HDI increased from 0.73 in 2007 to 0.77 in 2020, which represented 5.5 %. The health component decreased by 2.3 % (from 0.87 in 2007 to 0.85 in 2020), the standard of living dimension shows a decrease of 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 and its three dimensions are registered in the regions of

Mexico City and Northwest, while the South, Central South, and East and West regions and Bajío registered a lower performance.

Table 4. Human development index by regions in Mexico

Sub-national human development index								
Region/ Year	**Human development index**		**Education sub-index**		**Health sub-index**		**Standard of life sub-index**	
	2007	2020	2007	2020	2007	2020	2007	2020
West and Bajio	0.73	0.77	0.55	0.69	0.87	0.85	0.80	0.77
Northwest	0.76	0.79	0.59	0.74	0.88	0.85	0.82	0.77
South	0.69	0.74	0.59	0.67	0.86	0.85	0.72	0.71
Northeast	0.75	0.78	0.58	0.72	0.87	0.86	0.81	0.77
Mexico City	0.81	0.83	0.70	0.84	0.89	0.86	0.83	0.80
Central South and East	0.71	0.76	0.57	0.69	0.86	0.85	0.74	0.73
Mexico	**0.73**	**0.77**	**0.57**	**0.70**	**0.87**	**0.85**	**0.78**	**0.75**

Source: GlobalDataLab 5.0 (2021).

Table 5 describes the human development indicators comparing their evolution between women and men (2017 vs 2019). A lower sub-national HDI was observed for women at 0.75 in 2019 compared to that of men, which registers an indicator of 0.78; an increase of 3 % was observed in this indicator for both women and men comparing 2007 vs 2019. As for the education sub-index, it shows a better performance in 2019 for women, while the health sub-index decreased 1 % for women in 2019, compared to 2007 (0.87 vs 0.86) and for men, it remained at 0.85. The largest gap for women is reached in the standard of living sub-index, which has decreased from 0.71 in 2007 to 0.70 in 2019, while men reached an index of 0.83 in 2007, and decreased in 2019 at 0.80. The previous results suggest that despite the fact that women have higher academic preparation, the standard of living indicator is lower than that of men in Mexico.

Table 5. Evolution of the human development index in Mexico (women vs men)

Sub-national development index								
Region/ Year	**Human development index**		**Education sub-index**		**Health sub-index**		**Standard of living sub-index**	
	2007	2019	2007	2019	2007	2019	2007	2019
Women	0.72	0.75	0.60	0.71	0.87	0.86	0.71	0.70
Men	0.75	0.78	0.60	0.70	0.85	0.85	0.83	0.80
Mexico	**0.73**	**0.77**	**0.57**	**0.70**	**0.87**	**0.85**	**0.78**	**0.75**

Source: GlobalDataLab 5.0 (2021).

Correlation Analysis

A correlation analysis between the access to financial services dimensions and the poverty, inequality and human development variables was made. Significant and positive correlations were obtained between the number of bank branches, the number of ATMs and the number of POS terminals and the HDI and its three components (health, education and standard of living) for men and women (p=0.01): the number of mobile banking contracts, has a positive effect on the HDI and

its education component for men and women (p=0.01). Positive and significant correlations are identified between the number of term deposits and the number of debit cards on the HDI and its components of education and standard of living (p=0.01) in men and women; between the number of credit cards, mortgage loans, payroll loans and car loans on the HDI and its three dimensions of health, education and standard of living (p=0.01) for men and women; the number of personal loans correlates favorably with the HDI and its education component for men and women (p=0.10). The number of group credits is negatively correlated with the HDI and its dimensions (p=0.01). Negative correlations were obtained between the number of housing contracts and the HDI (p=0.10) and the education sub-index for women and men (p=0.05); between the number of POS transactions and the HDI for women (p=0.01) and the HDI for men (p=0.10), as well as with the education and standard of living sub-indices (p=0.05); the contract number for consumer credit is negatively correlated with the HDI for men (p=0.05) and with the education sub-index for men and women (0.05).

Econometric Analysis

Table 6 shows the econometric analysis between the access dimensión and the human development indicators, aiming to respond to hypothesis ***H1,*** which establishes that the greater financial inclusion in its access dimension, the higher the level of human development for women in the States of Mexico. Through the GMM method with robust standard errors, two lags are adopted for each dependent variable and are introduced as instrumental variables in the econometric models.

The dimension of access to financial services refers to the number of commercial banking branches, number of correspondents, number of ATMs, number of POS terminals and number of mobile banking contracts, for every 10,000 adult inhabitants. The control variables included in the models are the size of the adult population and the level of public debt. The dependent variables are: 1) human development index [columns 1 and 2], 2) health component [columns 3 and 4]; 3) standard of living [columns 5 and 6], and 4) education component [columns 7 and 8].

The results show that the number of mobile contracts increases the HDI of women (p=0.01), while for men, there is no significant relationship; POS terminals lower the HDI for women and men. It is evident that the number of correspondents decreases the health sub-index for women (p=0.01) and increases the education sub-index (p=0.01). The number of ATMs increases the education sub-index for men and women (p=0.05). On the contrary, the number of POS terminals has a negative impact on the HDI and its components, regardless of gender (p=0.01). The size of the population increases the health sub-index in women (p=0.01). These results are confirmed by Banerjee (2020) in South Asia.

According to the results obtained, the ***H1 is partially accepted***. It is observed that the access to some financial services, such as commercial bank branches, the number of co-responsible, and mobile banking contracts favor the HDI and its components.

Table 6. The effect of financial inclusion (access) over human development indicators (by gender)

Variable	(1) HDI women	(2) HDI men	(3) Health women	(4) Health men	(5) Education women	(6) Education men	(7) Standard of living women	(8) Standard of living men
L1 (first lag dependent	-0.239	0.065	0.136	0.025	**0.701*****	**0.685*****	-0.239	0.065
variable)	(-1.12)	(0.52)	(0.61)	(0.05)	(9.47)	(6.30)	(-1.12)	(.0.52)
L2 (second lag	**-0.411** ***	**-0.593** ***	0.023	**-0.269****	**-0.134****	**-0.215** ***	**-0.411** ***	**-0.593*****
dependent variable)	(-2.78)	(-5.30)	(0.22)	(-2.14)	(-2.22)	(-5.45)	(-2.78)	(-5.30)
Commercial banking branches	0.003 (0.31)	0.009 (1.07)	**0.010*** (1.67)	-0.003 (-0.50)	**0.037***** (2.61)	0.012 (1.05)	0.003 (0.31)	0.009 (1.07)

Correspondents	0.000	0.001	**-0.002** ***	0.001	**0.005** ***	**0.003***	0.000	0.001
	(0.40)	(0.81)	(-1.55)	(1.09)	(2.44)	(1.63)	(0.40)	(0.81)
Number of ATMs	0.000	-0.000	-0.002	**-0.004*****	**0.006****	**0.006****	0.000	-0.000
	(0.10)	(-0.05)	(-0.83)	(-2.52)	(2.02)	(2.30)	(0.10)	(-0.05)
Sale terminals	**-0.000** ***	**-0.000** ***	**-0.000** ***	**-0.000** ***	**-0.000***	**-0.001****	**-0.000** ***	**-0.000*****
	(-4.48)	(-2.72)	(-2.68)	(-2.64)	(-1.61)	(-2.04)	(-4.48)	(-2.72)
Mobile banking	**5.690** ***	1.840	**2.220***	1.020	**0.000** ***	**8.810*****	**5.690*****	1.840
Contracts	(3.77)	(1.29)	(1.76)	(0.96)	(4.85)	(3.06)	(3.77)	(1.29)
Size of population	-1.250	**-9.070** **	**1.570*****	8.240	6.420	**1.400****	-1.250	**-9.070****
	(-0.21)	(-2.07)	(3.69)	(1.18)	(1.16)	(2.06)	(-0.21)	(-2.07)
Public debt	-0.047	**-0.187** **	0.054	-0.054	0.008	-0.086	-0.047	**-0.187*****
	(-0.37)	(-2.36)	(0.87)	(-0.66)	(0.07)	(-0.92)	(-0.37)	(-2.36)
Constant	**1.178*****	**1.241** ***	**0.719*****	**1.076*****	**0.173*****	**0.284*****	**1.178*****	**1.241*****
	(4.96)	(8.39)	(3.91)	(2.60)	(2.72)	(3.79)	(4.96)	(8.39)
Wald Chi²	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number of instruments	22	22	16	19	20	20	22	22
Observations	228	228	228	228	228	228	228	228

Table 7 shows the econometric analysis to answer research hypothesis **H2,** which establishes that a greater financial inclusion in its owning dimension, the higher level of human development for women in the States of Mexico. The independent variables refer to the dimension of ownership of financial products [number of savings accounts, number of time deposits, number of debit cards, number of credit cards, number of mortgage loans, number of group loans, number of personal loans, number of payroll loans and number of automobile credits]. The control variables included in the econometric models are: population size and level of public debt by State.

It is observed that the number of savings accounts increases the HDI (p=0.01) and its education component (p=0.01), both for men and women, and only has a positive impact for the standard of living component in the case of men (p=0.01). The number of term deposits increases the health component for women (p=0.01) and for men (p=0.05). The number of credit cards favors the HDI of men (p=0.01), although in the case of women, its effect is not significant; it has a negative effect on health (p=0.01) and standard of living indicators (p=0.10) regardless of gender. Having mortgage loans increases the HDI for women (p=0.01), although it decreases the health component (p=0.01), while it increases the education sub-index (p=0.01) for both. Group credits increase the HDI (p=0.01) and the education index (p=0.01) for men and women, increase the health index (p=0.10) and decrease the standard of living indicator (p=0.05) for the case of men.

Having personal loans has a positive effect on the health index (p=0.01) in the case of men, it decreases the education component for women (p=0.10) and for men (p=0.01), and increases the standard of living indicator for women and men (p=0.01). Payroll credits increase the HDI for women (p=0.05), although there is a reduction in its health (p=0.01) and standard of living (p=0.01) components, and an increase in the education component (p=0.01). =0.01) for both. Although car loans increase the standard of living indicator (p=0.01) and the health index (p=0.01) for both men and women, they decrease the education indicator for men (p=0.10). Regarding the control variables, it is observed that public debt has an unfavorable effect on the components of education and standard of living, while the size of the population decreases the component of the standard of living. These results lead us to ***partially accept H2.***

Table 7. The effect of financial inclusion (owning) over human development indicators (by gender).

Variables	(1) HDI women	(2) HDI men	(3) Health women	(4) Health men	(5) Education women	(6) Education men	(7) Standard of living women	(8) Standard of living men
L1 (first lag dependent variable)	**0.456*** (4.95)	**0.364***** (4.54)	**0.351**** (1.90)	0.026 (0.08)	**0.673*** (6.80)	**0.546***** (4.91)	**0.388*** (3.77)	**0.447***** (3.52)
L2 (second lag dependent variable)	**0.340*** (5.75)	**0.281***** (5.77)	0.104 (0.84)	-0.065 (-0.45)	**0.357*** (3.01)	**0.245***** (2.72)	-0.010 (-0.11)	-0.150 (-1.38)
Saving accounts	**0.001*** (2.90)	**0.001***** (2.48)	-0.000 (-0.79)	0.000 (0.89)	**0.001*** (3.04)	**0.001***** (2.85)	0.000 (1.33)	**0.001***** (2.82)
Fixed-term deposits	-3.440 (-0.26)	-0.000 (-1.24)	**0.000*** (2.69)	**9.830**** (2.17)	-0.000 (-1.36)	-0.000 (-1.48)	-2.270 (-0.21)	**0.000**** (2.05)
Debit cards	-2.410 (-0.84)	-2.770 (-1.59)	-3.070 (-1.14)	-1.340 (-0.63)	-1.700 (-1.54)	-7.720 (-0.97)	-8.730 (-1.49)	**-1.060*** (-4.63)
Credit cards	1.050 (1.49)	**1.340***** (2.71)	**-1.050*** (-1.81)	**-1.860*** (-1.75)	1.410 (0.70)	1.330 (0.99)	**-3.180*** (-2.35)	**-3.580*** (-3.88)
Mortgage loans	**0.000*** (2.36)	0.000 (0.81)	**-0.000*** (-2.97)	-0.000 (-1.37)	**0.000*** (2.46)	**0.000*** (4.47)	-0.000 (-1.33)	-9.190 (-0.51)
Group loans	**0.000*** (2.40)	**0.000*** (3.22)	-9.680 (-1.25)	**5.490*** (1.80)	**0.000*** (2.34)	**0.000*** (3.71)	-6.580 (-0.80)	**-0.000**** (-2.23)
Personal loans	2.760 (0.79)	4.250 (1.56)	5.200 (1.41)	**5.050*** (3.63)	**-7.770*** (-1.62)	**-5.140*** (-1.51)	**1.100**** (1.89)	**1.750***** (8.00)
Payroll loans	**0.000**** (1.84)	0.000 (1.43)	**-0.000*** (-3.12)	**-0.000**** (-2.27)	**0.000*** (3.47)	**0.000*** (4.33)	**-0.000*** (-1.66)	**-0.000*** (-4.36)
Automobile credits	0.000 (0.52)	0.000 (1.01)	**0.000*** (7.48)	**0.000**** (2.02)	-0.000 (-0.76)	**-0.000*** (-1.71)	**0.000*** (4.50)	**0.000*** (4.95)
Size of population	3.800 (0.96)	**1.310**** (1.89)	-2.310 (-1.02)	4.010 (1.39)	5.320 (0.81)	**1.340***** (2.35)	**-1.560**** (-2.23)	**-1.800*** (-3.20)
Public debt	-0.070 (-1.18)	-0.071 (-1.09)	0.038 (0.74)	-0.074 (-0.96)	**-0.183**** (-2.21)	**-0.177**** (2.33)	**-0.171**** (-1.94)	**-0.165*** (-2.58)
Constant	0.123 (1.44)	**0.244***** (2.97)	**0.471**** (2.27)	**0.880*** (3.08)	-0.045 (-0.81)	**0.103***** (2.97)	**0.457***** (4.29)	**0.600*** (4.02)
Wald Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Number of instruments	32	32	23	27	29	29	32	31
Observations	259	259	259	259	259	259	259	259

The empirical results show that the number of savings deposit contracts increases the HDI for women (p=0.05) and men (p=0.01); as well as the education and standard of living sub-indexes for women (p=0.01), and the standard of living dimension in the case of men (p=0.01). The number of debit card contracts increases the education sub-index for men and women (p=0.01), although it has a negative impact on the standard of living indicator for women (p=0.01). The number of contracts for consumer credit decreases the HDI for women (p=0.10) and its education and standard of living components (p=0.05). The number of housing credit contracts increases the health index for women (p=0.01) and decreases the standard of living for men (p=0.05). The number of POS transactions increases the HDI for men (p=0.01) and women (p=0.10); although the standard of living component decreases for both (p=0.01). The number of ATM transactions decreases the health and education indicators (p=0.01). The level of public debt has a negative impact on human development indicators (p=0.01). The above results lead us to ***accept H3 partially***.

The results discussed suggest that financial inclusion goes beyond the ownership of bank accounts. To achieve effective financial empowerment, women need access to a much broader range of financial services, such as loans and lines of credit. Access to credit is an important factor in the economic development of a country, since it increases competitiveness, contributes to growth, stimulates the economy and creates sources of employment (IFC, 2011).

Table 8 shows the GMM analysis to respond to the research hypothesis ***H3*** that establishes that a more significant financial inclusion in its usage dimension, the higher level of human development for women in the States of Mexico. The independent variables focus on the dimensions of the usage of financial products [transactions at POS terminals, transactions at ATMs, savings contracts, time deposit contracts, debit card contracts, consumer credit contracts and housing credit contracts]. The control variables included are the size of the adult population and the level of public debt.

Table 8. The effect of financial inclusion (usage) over human development indicators (by gender)

Variables	(1) HDI women	(2) HDI men	(3) Health women	(4) Health men	(5) Education women	(6) Education men	(7) Standard of living women	(8) Standard of living men
L1 (first lag dependent variable)	0.374*** (3.55)	0.062 (0.77)	0.260* (1.69)	0.613*** (8.13)	0.622*** (11.16)	0.613*** (8.13)	0.360*** (5.62)	0.594*** (7.01)
L2 (second lag	0.354 ***	0.336***	0.291***	0.406***	0.360***	0.406***	0.116	-0.006
dependent variable	(6.04)	(4.06)	(3.30)	(10.02)	(7.24)	(10.02)	(1.58)	(-0.07)
Saving deposit contracts	1.940** (2.17)	3.410*** (3.53)	-4.690 (-0.73)	2.970 (1.53)	7.310*** (3.39)	2.970 (1.53)	3.990*** (3.01)	4.100*** (5.20)
Fixed-term deposits	-0.000	5.710	0.000*	-7.350	0.000	-7.350	0.000	0.000
contracts	(-0.90)	(0.19)	(1.66)	(-0.13)	(0.35)	(-0.13)	(0.57)	(1.49)
Debit card contracts	9.010	6.360	2.400	0.000***	0.000***	0.000***	-4.430**	8.620***
	(1.26)	(0.91)	(0.54)	(2.45)	(2.40)	(2.45)	(-1.99)	(3.78)
Consumer credit	-0.000*	-3.890	7.940	-0.000	-0.000**	-0.000	-0.000**	-0.000**

contracts	(-1.75)	(-0.35)	(1.23)	(-0.90)	(-2.09)	(-0.90)	(-1.94)	(-1.98)
Mortagage loan	-0.000	-0.000	0.000***	-0.000*	-0.000	-0.000*	-0.000	-0.000**
Contracts	(-0.55)	(-0.59)	(2.49)	(-1.83)	(-1.29)	(-1.83)	(-0.70)	(-2.12)
POs transactions	3.530*	4.690***	-7.830*	4.030	1.020***	4.030	-1.070***	-1.120**
	(1.76)	(3.37)	(-5.10)	(1.58)	(2.68)	(1.58)	(-5.63)	(-5.12)
ATM transactions	-1.640	-6.430	5.470	-1.180***	-8.500***	-1.180***	5.120	3.260***
	(-1.37)	(-0.61)	(0.81)	(-3.69)	(-3.43)	(-3.69)	(0.48)	(2.65)
Size of population	-1.020*	5.360	1.230***	-2.040	-9.090	-2.040	-1.890***	-7.900*
	(-1.79)	(0.08)	(4.67)	(-0.23)	(-1.15)	(-0.23)	(-3.12)	(-1.74)
Public debt	-0.087*	-0.150***	0.079	-0.215***	-0.256***	-0.214***	-0.104	-0.070
	(-1.81)	(-2.61)	(1.47)	(-2.45)	(-3.19)	(-2.45)	(-1.49)	(-1.15)
Constant	0.213**	0.459***	0.380**	0.011	0.027	0.011	0.409***	0.356***
	(2.27)	(4.76)	(2.26)	(0.20)	(0.59)	(0.20)	(6.34)	(3.95)
Wald Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number of instruments	37	37	25	33	33	33	37	37
Observations	291	291	291	291	291	291	291	291

5. Discussion

The study focused on 32 Mexican states, which reached a total of 448 observations during the 2007–2020 period. A dynamic data panel was used using the GMM technique in order to avoid endogeneity problems between the study variables. Although the results show a significant increase in the dimensions of financial inclusion, access, owning, and usage of financial services, there were major gaps in gender. For instance, women face higher barriers to access to financial services (savings and credit instruments), such as the lack of own financial resources, property titles or other assets that can serve as a guarantee of payment, as well as the absence of financial education, higher interest rates compared with men, or long periods of indebtedness (OECD, 2013).

The econometric results show that access to financial services, such as the usage of mobile banking contracts, increases the HDI for women, while the number of correspondents and ATMs increases the education sub-index. Regarding the owning of financial products, the results suggest that the number of savings accounts increases the HDI and its education component for women, while the number of time deposits favors the level of health. Having access to a mortgage loan increases the HDI and the education sub-index for the female gender. Group credits have a positive effect on the HDI, the education index, and the health index of women. Women who have personal loans or payroll loans increase the HDI and the standard of living indicator. For their part, car loans increase the standard of living indicator and the health index.

In relation to the dimension of usage, the results show that the number of savings deposit contracts increases the HDI for women, as well as the sub-indices of education and standard of living; the number of debit card contracts increases the education sub-index. It is concluded that the dimension of owning financial products, particularly credit instruments, are the ones that favor the indicators of human development in women the most.

This work is a reference for legislators and decision-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 from a gender perspective. Although the global trend is to increase financial inclusion indicators to achieve the SDGs, the adult population in Mexico continues to resort to traditional banking and the usage of cash, although in 2020, transfers sent by CoDi increased considerably in number from 38.3 to 154.4 thousand operations (CNBV, 2021; López-Lefranc, 2019). It is important to promote the adoption of digital finance to reduce the level of financial exclusion, particularly in less favored areas such as the South and Central South and East regions and for women. However, 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.

6. Conclusion

Financial inclusion is a transversal pillar to achieve the SDG of the United Nations 2030 agenda; it contributes to more equitable economic growth, reduces poverty and promotes income equality by providing access to formal financial services. This study contributed to extending the literature by addressing the impact of women's financial inclusion on the economic and social development indicators in the Mexican context at the sub-national level. Women in Mexico face more barriers to formal financial services, and the cost of credit is higher than in other Latin American countries. The consequences of the high level of financial exclusion in Mexico also affect the entrepreneurial environment, especially for women. Considering this, our results showed that the increase in financial inclusion, mainly through credit products, has a positive effect on Mexican women´s human development. This research intends to make a call to policymakers and financial institutions in Mexico by providing evidence that supports the design of strategies and public policies aimed at improving financial inclusion for women and, therefore, better human development indicators. Some strategies to promote women's participation in the economy could include fostering a gender-neutral legal framework for businesses, enforcing equal access to financial services, and pairing targeted financing schemes with other measures such as financial education, professional training and increased access to support programs.

7. Strengths and Limitations

This research identifies strengths and limitations, and based on these, future research lines are proposed in the field of financial inclusion and sustainable development. The strength of the study is that it is a pioneer, at a subnational level, in analyzing the impact of financial inclusion on the human development index from a gender perspective in Mexico. It can be considered a limitation that the study analyzes the 32 Mexican states (including Mexico City), but some of these have a great number of municipalities (like Oaxaca with more than 500), and some have a great disparity (in terms of the economics, social and demographic indicators) within their own municipalities. Therefore, results could be more accurate if the analysis could be carried out at the municipality level. The second limitation of the research is the scarcity of financial inclusion data, from a gender perspective, at a subnational level, so more detailed and updated information generated at the local level could motivate researchers to work on this research line. Based on the above, the following studies are suggested: how financial inclusion motivates women to start their own businesses and how entrepreneurship could affect human development and competitiveness indicators. It would also be interesting to extend the research to other Latin American countries with similar institutional contexts.

8. Declarations

Ethics approval and consent to participate

This study is carried out in accordance with the recommendations of the Code of Ethics of all participating universities: Universidad Autónoma de San Luis Potosí, Universidad Autónoma de Tamaulipas, Universidad Cristóbal Colón and Tecnológico Nacional de México.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Conflict of interest statement

The authors declare no conflict of interest.

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