Does financial inclusion enhance or weaken financial stability? Exploring their relationship in Latin American countries

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Abstract

This study investigates the effect of financial inclusion on financial stability in Latin American countries during the period 2004-2021, since governments in this region have intensified their efforts to promote financial inclusion policies after the global financial crisis. By using a random effects model, a positive significant effect of the financial inclusion index on financial stability, measured by the Z-Score, is observed for 11 Latin American countries during this sample period. This result is robust with the NPL ratio as a dependent variable, which reflects the degree of financial instability. Furthermore, similar findings are obtained when replacing the financial inclusion index with the usage and penetration dimension of financial inclusion. The results, which are consistent with the findings of previous studies, can be mainly explained by three key benefits that financial inclusion brings to financial stability. These include the diversification of bank's loan portfolio, a stable retail base of deposits, as well as the lower costs of funding associated with the growth of retail deposits.

***Keywords*:** Financial Inclusion, Financial Stability, Latin America, Panel Data

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Contents

List of Tables

List of Figures

1 Introduction

Following the 2008 global financial crisis, financial stability gained strong relevance among banking regulators and central banks due to the negative effects that disruptions in the financial system can cause on the real economy. During stress periods, banks tend to tighten their credit standards and restrict the flow of loans to the economy which amplifies the shocks to the economy. Previous studies have argued that the transmission mechanism through which bank deleveraging affects the economy is based on lower investment and consumption of firms and households which affects aggregate demand (Meh, 2011; Chodorow-Reich, 2014; Huber, 2018). In this regard, international banking regulatory standards have focused on macroprudential policies with the aim of mitigating risks in the financial system and preserving its stability. According to the World Bank (n.d.a), a financial system is stable when it dissipates financial imbalances that arise endogenously or as a result of significant adverse and unforeseen events.

In parallel, financial inclusion has been incorporated in the agenda of policymakers in Latin America countries after the global financial crisis (Rojas-Suarez, 2016). As stated by the World Bank (2022), financial inclusion implies that agents have access to useful and affordable financial products and services that meet their needs delivered in a responsible and sustainable way. The importance of financial inclusion to policy makers can be attributed to the following reasons. Cull et al. (2014) states that financial services allow low-income households, who generally work in the informal economy, to build assets, manage risks and smooth consumption, which improves their quality of life. Furthermore, financial services permit these households to invest in assets and education, reducing inequalities and promoting economic growth in the long-term (Mehrotra and Yetman, 2015).

Financial inclusion has been promoted in Latin American countries through various policies, such as the digitalization of financial services, design of financial products for the unbanked population, and financial education (Appendix 1). Moreover, since the last decade, governments in this region have adopted national strategies to promote financial inclusion (Appendix 2). As a result, over the last years, considerable progress has been observed in the number of account holders, which is one of the key indicators of financial inclusion. According to the Global Findex database, launched by the World Bank in 2011, the number of people who hold an account in Latin America increased from 39.4% in 2011 to 72.9% in 2021 (Appendix 3). However, the percentage of account ownership in 2021 in Latin America remains low in comparison to North America (95.5%) and Europe – Economic and Monetary Union (98.5%), as illustrated in Appendix 3. Another key metric of financial inclusion is the credit-to-GDP ratio (Sarma, 2008; Park and Mercado, 2018). As can be observed in Appendix 4, a rapid increase of the domestic credit to the private sector to GDP is observed in this region in the past decade.

An ongoing debate persists in the literature concerning the effect of financial inclusion on financial stability. Some studies argue that financial inclusion has a positive impact on financial stability due to the diversification of bank balance sheets, and the large amount of retail deposits, which are characterized

for its stability (Khan, 2011; Rahman, 2014). On the contrary, other studies state that financial inclusion could produce a rapid expansion of credits and increase financial risks (Hannig and Jansen, 2010; Mehrotra and Yetman, 2015).

For this reason, this study aims to answer the following question: Does financial inclusion positively affect financial stability in Latin America countries? The estimation of this relationship is conducted for the period 2004-2021 in 11 Latin American economies. A positive effect is expected based on the greater diversification of bank's portfolios and the potential for a larger, more stable deposit base that financial inclusion could provide (Khan, 2011; Cull et al., 2012; Rahman, 2014). Furthermore, this study explores how this effect varies in the presence of the global financial crisis and the COVID-19 crisis, separately. Čihák et al. (2016) indicated that during stress periods unexpected losses could arise due to an accelerated expansion of credits; therefore, a weaker positive relationship between financial stability and financial inclusion is anticipated.

The focus of this research is on Latin American countries, as this region has experienced a significant process in financial inclusion since the past decade, as evidenced in the increase of bank account holders and domestic credit to the private sector, when comparing to the U.S. or Europe (Appendices 3 and 4). Given this rapid evolution, it becomes relevant to study whether this fact has led to an increase in financial risks, particularly credit risk due to the considerable expansion of credit or has instead contributed to financial stability as it expected for the previously mentioned reasons. Furthermore, the Center for Global Development - CGAP (2019) indicates that financial systems in emerging economies face specific vulnerabilities in comparison to advanced economies. These vulnerabilities include the risk of sudden economic stop, high macroeconomic and financial volatilities, such as exposure to commodity prices, political risks and sectorial concentration of loans, and weak governance among financial institutions which make the implementation of financial regulatory frameworks, challenging (CGAP, 2019).

Considering these facts, the societal relevance of this study relies on providing insights for policymakers regarding whether financial inclusion enhances or weaknesses financial stability in these countries, whose financial systems are exposed to distinctive challenges compared to developed countries. By understanding the direction of this relationship, policymakers can design policies to promote financial inclusion to benefit households as mentioned before, while ensuring financial stability if the relationship is positive. However, in case of a negative relationship, policymakers should focus on strengthening regulatory frameworks and risk management practices of financial institutions (Sahay et al., 2015).

This research offers two main contributions to literature. First, it attempts to fill the gap in the empirical literature, which has explored the relationship between financial inclusion and stability without focusing on a specific region (Han and Melecky, 2013; Morgan and Pontines, 2014; Čihák et al., 2016; Ahamed and Mallick, 2019). To the best of the knowledge of the author, this study is the first of its kind to focus on Latin America. Second, the interactions between financial inclusion and financial stability during stress

periods are analyzed as mentioned before. By exploring these areas of interest, this study provides policy implications about the interactions between these two concepts in Latin America.

This study begins by introducing the literature on financial inclusion and financial stability measures, as well as their theoretical and empirical relationship. Following this, the hypotheses development is detailed. Subsequently, the research outlines the methodology and data collection, followed by a presentation of the results and their interpretation. Finally, policy implications, limitations and recommendations for further studies, as well as the concluding remarks are discussed.

2 Literature review and Hypotheses Development

2.1 Financial Stability and Financial Inclusion Indicators

2.1.1 Financial Stability

While there is extensive literature about measures for financial stability, a consensus on this topic has not been reached. A simple indicator of financial stability is the Z-Score formulated by Boyd and Graham (1986), which has been widely used in various studies (Boyd and Runkle, 1993; Čihák and Hesse, 2008; Diaconu and Oanea, 2015). The authors explained that the Z-Score is an indicator of the probability of bankruptcy since it estimates the number of standard deviations below the mean that consolidated profits would have to fall to make consolidated equity negative. According to the World Bank (n.d.a), the Z-Score can be applied at a bank level or, by aggregating this measure, at a country level.

A different straightforward approach is the use of the non-performing loan ratio (NPL ratio) as a proxy of financial instability, as it provides a measure of credit risk (Demirgüç-Kunt and Detragiache, 1997; Morgan and Pontines, 2014; Bahadur and Sharma, 2018). Furthermore, other studies have explored the CAMELS framework to incorporate other variables, such as liquidity or capital adequacy, that influence the stability at a bank level (Evans et al., 2000; Popovska, 2014).

As Schinasi (2004) indicates, financial stability is a broad concept that involves three aspects: financial infrastructure, institutions, and markets. In addition, the European Central Bank (2005) considers that financial stability involves identifying sources of risks that could undermine it, which include macroeconomic variables. A group of studies has focused on measuring financial stability by combining banking sector and country-level variables and construct composite indicators. Vintu and Negotei (2018) developed a financial stability index considering bank soundness variables, such as the equity to assets ratio, banking vulnerability variables, which include external and real sector variables, and economic trends. Another method to construct a financial stability index was applied by Čihák et al. (2016). The authors measured financial stability based on the financial sector resilience (solvency, liquidity, and credit risk), volatility (standard deviation of credits and deposits growth) and cost of crisis (loss in income and government intervention to mitigate the crisis).

As financial stability involves different dimensions from the macroeconomic environment to bank performance, the advantage of using composite indicators is that they can cover these dimensions. However, in this study, the Z-Score is used as a measure of financial stability. Furthermore, for robustness check purposes, the NPL ratio is used as a proxy of financial instability since a higher value of this ratio implies a higher credit risk of the bank's portfolio. Both indicators are selected due to their straightforwardness, widespread acceptance in previous literature as financial stability (instability) indicators, and the fact that they properly reflect solvency (Z-Score) and credit risk (NPL ratio).

2.1.2 Financial Inclusion

Similar to financial stability indicators, there are various approaches to measure financial inclusion. According to the World Bank (2015) the key dimensions to consider when evaluating financial inclusion are usage indicators (Sarma, 2008; Camara and Tuesta, 2014), access indicators (Park and Mercado, 2018; Ahamed and Mallick , 2019), which reflect the extent to which financial services reach people, and quality measures (Global Partnership for Financial Inclusion, n.d.), which evaluates whether financial services match client's needs.

In relation to the usage dimension, the World Bank (2022) states that account ownership is a simple indicator for financial inclusion, since holding a bank account is the first step to accessing other financial services such as credits or insurance. In addition, the Global Partnership for Financial Inclusion (GPFI, n.d.) and the Alliance for Financial Inclusion (AFI, 2019) consider the percentage of adults with at least one loan outstanding from a regulated institution as a core usage indicator. Moving to the access dimension, the number of branches or ATM per a certain number of the population is used by the GPFI and AFI. According to the GPFI, quality measures include financial knowledge and disclosure requirements, among other variables.

Although multidimensional indicators may be complex, they provide a more reliable approach to measure financial inclusion. Some studies have constructed an index of financial inclusion by considering relevant dimensions of financial inclusion (penetration, usage and access) and assigned weights to each dimension based on the author's judgment or previous literature (Sarma, 2008; Sarma and Pais, 2008; Sethy, 2016). According to Sarma (2008), this method implies normalizing each dimension to a value between 0 and 1, where 1 indicates the highest achievement in that dimension for a country, and then aggregating them into a single index. Other studies have applied the Principal Component Analysis method to obtain weights for each dimension (Cámara and Tuesta, 2017; Park and Mercado, 2018; Yorulmaz, 2018; Sha'ban et al., 2020; Zhang et al, 2022). Appendix 5 summarizes the various measures of financial inclusion used in previous studies.

2.2 Interactions between Financial Stability and Financial Inclusion

The effect of financial inclusion on financial stability has been the subject of several studies, which have explored this relationship both theoretically and empirically. The aim of this section of the literature

review is to examine the various theoretical frameworks that provide explanations for this relationship and the empirical findings of previous literature.

2.2.1 Theoretical Framework

Theoretical studies have not yet converged on a consensus regarding the explanation of the interactions between financial inclusion and financial stability. While some of these studies provide explanation for a potential contribution of financial inclusion to financial stability (Hannig and Jansen, 2010; Khan, 2011; Cull et al., 2012; Rahman, 2014), others provide argumentation for the possible negative effects that financial inclusion can cause on the latter (Khan, 2011; Mehrotra and Yetman, 2015; Hawkins, 2011).

On the one side, a group of studies believe that this relationship should be positive for the following reasons. Khan (2011), Cull et al. (2012) and Rahman (2014) suggest that financial inclusion contributes to the resilience of the banking systems because it promotes the diversification of bank's portfolios by including a broad number of agents. According to Rahman (2014) a portfolio consisting of many small loans to households and microentrepreneurs will experience fewer losses (lower systemic risk) than a portfolio consisting of few loans to corporate borrowers. On top of that, Hannig and Jansen (2010) state that microfinance clients are likely to have higher repayment debts because a default could restrict their access to the formal sector, which is less costly than the informal sector. In addition, financial inclusion leads to a more stable retail base of deposits since, during stress periods, low-income clients tend to keep their deposits, covered by a deposit insurance scheme, providing liquidity for banks (Khan, 2011; Rahman, 2014).

Regarding the indirect channels through which financial inclusion positively affects financial stability, Khan (2011) argues that the health of households is improved by financial inclusion since it avoids the use of costly loans from the informal sector and facilitate payments. In addition, Rahman (2014) indicates that savings products allow households to smooth consumption and prevent an increase of debt levels during crisis, which is favorable for financial stability. Moreover, Cull et al (2012) mention that as lower income inequality is linked to financial inclusion, greater social and political stability could be expected which contributes to financial stability.

On the other side, some studies argue for a negative relationship between these two policy objectives. Mehrotra and Yetman (2015) suggest two channels through which financial inclusion affects financial stability. First, the authors mention that financial inclusion could lead to excessive credit growth and banks could provide loans to households whose credit quality is low by deteriorating their lending standards, and ultimately affecting the soundness of banks. Second, the authors indicate that the expansion of unregulated parts of the financial sector may be a consequence of financial inclusion. The study explains that because of financial inclusion, small unregulated institutions could expand their business, compromising the effectiveness of financial regulation and increasing systemic risk.

Khan (2011) suggests that reputational risk is another channel through which financial inclusion could negatively affect financial stability. The explanation behind this is that outsourcing activities for financial inclusion, such as identification of borrowers or initial credit evaluation, could not be correctly performed by the outsource agents. Another concern mentioned by the author is the growth of financial innovations, whose consequences during periods of stress may be difficult to predict.

In fact, Khan (2011) and Hawkins (2011) suggest that improper access to financial services was observed before the global financial system when low-income households were inappropriately provided with mortgages. Khan (2011) mentions that during this period an excessive amount of loans were provided, which affected the quality of credit portfolios.

2.2.2 Empirical Evidence

A group of studies have empirically analyzed the relationship between financial inclusion and financial stability across various countries. By using different measures for financial inclusion and stability, most of these studies have explored this relationship in the past two decades without focusing on a particular region. While some studies have found a positive relationship, others have documented an insignificant or negative relationship.

Han and Melecky (2013), one of the first studies to estimate the effect of financial inclusion on financial stability, conducted an OLS regression for 173 economies before and during the global financial crisis (2006-2010) and observed that greater access to bank deposits enhanced the stability of deposit growth (withdrawals). Subsequently, Morgan and Pontines (2014), used the Global Financial Development Database (GFDD) to obtain measures for financial stability, financial inclusion, and macroeconomic variables. Specifically, they used the bank Z-Score and non-performing loans (NPLs) as measures for financial stability and instability, respectively, and small-medium sized enterprises (SME) loans for financial inclusion. They estimated a panel data model for the period 2005-2011 for 168 economies and found that an increase in SME lending led to a reduction in NPLs, contributing to financial stability.

Later, Ahamed and Mallick (2019) used a database of 2,600 banks in 86 economies over the period 2004-2012. The authors estimated the effect of financial inclusion on bank stability with using an aggregate financial inclusion index calculated with the PCA methodology, and the access (bank branches and ATMs) and usage dimension (bank accounts per 1,000 adults), separately. Their findings suggest a positive relationship between the indicators of financial inclusion and financial stability, measured by the bank Z-Score and the volatility of returns. As digital financial services have gained more popularity over the years, Banna and Alam (2021) found that digital financial inclusion contributes to bank stability (measured by the Z-score and Sharpe ratio separately) by using data of 574 banks in emerging Asian countries during 2011-2018.

In addition, Olusegun et al. (2021) studied the relationship between the Z-Score at a bank-level (financial

stability) and three financial inclusion dimensions for Nigeria over the period 2014Q1-2018Q4 with a panel data model. The results revealed that the penetration (number of deposit accounts and loan accounts per 1,000 adults) and availability dimension (number of bank branches) have a positive impact on the Z-Score at a bank-level suggesting that greater deposit mobilization increases bank resilience through a more stable funding.

Abir and Ishaq (2021) found similar results for countries in North Africa between 2004-2016 by using a random effects model and the Z-Score, and loan volume as a financial inclusion measure. Duc Hong et al. (2021) use data of 3071 banks in Asia during the period 2008-2017 and demonstrated that their financial inclusion index positively impacts financial stability (bank Z-Score). They argued that financial inclusion generates more substantial savings that banks can use to finance their lending activity and increase their operational revenues. Furthermore, they mention that banks could increase their operational revenues by targeting underserved groups of the population. More recently, Zhang et al. (2022) showed that, after controlling for macroeconomic conditions, a 1% increase in digital financial inclusion reduced the NPLs by 2.55% based on their estimation of a fixed effect model for the OECD economies during 2004-2017.

Other studies have found a non-positive relationship between these two concepts. Ardic et al. (2013), used deposit account penetration as a proxy of financial inclusion and found no significant correlation with the IMF Financial Soundness Indicators or with financial stability indicators published by the World Bank in 103 economies over the period 2004-2011. The authors noted that while the lack of solid data could explain this result, it could also be an indication of a not straightforward positive relationship. In addition, they recommended further studies to isolate the effects of the global financial crisis, where lower access could be positive correlated with financial stability, as low financial access countries were less affected. Later, Sahay et al. (2015) identified a negative effect of the penetration dimension on bank stability for 128 economies over the period 1980-2013. The explanation provided by the authors is that the greater penetration is linked to an increase in risk-taking and leverage, especially when regulation and supervision is not efficient.

Furthermore, Cihák et al. (2016) performed a non-parametric analysis based on pairwise correlation between measures of financial inclusion and financial stability for 156 economies from the Global Findex database (2011 and 2014). They found that the use of loans by individuals decreases bank's liquidity buffers because of the possible surge of unexpected losses and tail risks that can arise from greater financial inclusion. However, when financial stability is measured as volatility of deposit growth, the authors observed that accounts, savings, payments and credits lower this volatility.

Subsequently, Dienillah et al. (2018) observed an insignificant effect of financial inclusion on financial stability for low-income countries during the period 2004-2014. However, they found a positive relationship between these two variables for upper middle income and high-income countries, associated with a stable base of deposits. Furthermore, Olusegun et al. (2021) noted a negative relationship between the

usage dimension (credits, deposits, and electronic payments to GDP) and financial stability (Z-Score) in Nigeria during the period 2014Q1-2018Q4 (panel data model). They argued that the fact that banks provided credits to risky sectors in this country contributed to this negative relationship. Appendix 6 summarizes the main findings in the previous literature.

In summary, the empirical literature has investigated the relationship between financial inclusion and financial stability for economies in various regions (Ardic et al., 2013; Morgan and Pontines, 2014; Ahamed and Mallick, 2019), in specific countries (Olusegun et al., 2021) or regions such as Asia or Africa (Abir and Ishaq, 2021; Banna and Alam, 2021). However, a gap in the empirical literature has been identified regarding the analysis of the impact of financial inclusion on financial stability in Latin American countries. Moreover, a scarcity in the previous literature exists related to the examination of the dynamics between these two concepts during periods of stress. This research attempts to close this gap by studying how the effect varies in the presence of the global financial crisis and the COVID-19 shock in this region.

2.3 Hypotheses Development

The aim of this study is to investigate in which direction financial inclusion affects financial stability across 11 Latin American countries. The selection of these countries is described in Section 3.2. In this study, financial inclusion is measured with a multidimensional index, whose construction is detailed in Section 3.1.2, and financial stability is measured using the Z-Score. Based on these considerations, the first hypothesis is presented as follows:

H1: Financial inclusion (multidimensional index) has a positive impact on financial stability in Latin American countries.

A positive effect of financial inclusion on financial stability (Z-Score) is expected based on the theoretical relationship between these two concepts and the empirical findings that previous studies have documented in Latin American countries during the period 2004-2021. While there is no consensus in the literature about the direction through which financial inclusion affects financial stability, a positive sign is expected for the following reasons. First, financial inclusion may lead to a larger stable retail deposit base and a more diversified loan portfolio for financial entities, which could explain its contribution on financial stability (Khan, 2011; Rahman, 2014). In addition, financial inclusion could significantly increase deposits which banks can use to generate more loans and increment their operational revenues (Duc Hong et al., 2021). Second, similar empirical findings are expected as the studies that observed a positive relationship between financial inclusion and financial stability (Morgan and Pontines, 2014; Ahamed and Mallick, 2019; Banna and Alam, 2021; Du Hong et al., 2021). In this regard, it is expected that the benefits of financial inclusion on financial stability define its positive relationship, despite its potential negative effects, such as an excessive credit growth and a deterioration of lending standards, or the expansion of unregulated financial services to reach more potential clients (Mehrotra and Yetman, 2015; Khan, 2011). Additionally, as the focus of this research is on Latin American economies, the rapid increase in the

number of bank accounts and domestic credit to the private sector that has been witnessed in this region in the past decade (Appendices 3 and 4) could have led to a larger retail deposit base and diversification of loan portfolios, ultimately contributing to financial stability.

With respect to the examination of the relationship between financial inclusion and financial stability, two hypotheses are formulated:

H2: The effect of financial inclusion on financial stability is weaker when the global financial crisis is considered.

H3: The effect of financial inclusion on financial stability is weaker when the COVID-19 crisis is considered.

It is expected a lower effect of financial inclusion during the global financial crisis based on the explanation provided by Cihák et al. (2016), regarding that financial inclusion could lead to unexpected losses during stress periods because of intensive extension of loans. In this line, similar results are expected for the COVID-19 period as Latin America countries experienced an unprecedent contraction in the GDP and a rise in unemployment (Appendix 7).

Furthermore, three hypotheses are developed regarding the different dimensions of financial inclusion based on the studies of Han and Melecky (2013), Ahamed and Mallick (2019), Olusegun (2021) and Banna and Alam (2021), which analyzed their effect on financial stability separately:

H4: The usage dimension has a positive impact on financial stability in Latin American countries.

H5: The access dimension has a positive impact on financial stability in Latin American countries.

H6: The penetration dimension has a positive impact on financial stability in Latin American countries.

First, while Olusegun et al. (2021) provided evidence that the usage dimension has a negative on financial stability explained by the increase of loans to risky sectors in Nigeria, a positive effect is anticipated for Latin American countries based on the findings of Ahamed and Mallick (2019) and the diversification effects on bank's credit portfolio, along with a more resilient deposit base fostered by financial inclusion (Khan, 2011; Cull et al. 2012; Rahman, 2014). Second, regarding the access dimension, a positive effect on financial stability is expected based on the findings of Ahamed and Mallick (2019) and Banna and Alam (2021). Third, a similar result is expected for the penetration dimension based on Olusegun et al. (2021) and Du Hong et al. (2021). The hypotheses are summarized as follows:

Table 1: Hypotheses Formulation

Hypothesis	Description	Justification
H1	Financial inclusion (multidimensional index) has a positive impact on financial stability for Latin American countries.	Khan (2011), Rahman (2014), Morgan and Pontines (2014), Ahamed and Mallick (2017), Banna and Alam (2021)
H2	The effect of financial inclusion (multidimensional index) on financial stability is weaker when the global financial crisis is considered.	Cihák et al. (2016), and Han and Melecky (2013)
H3	The effect of financial inclusion (multidimensional index) on financial stability is weaker when the COVID-19 crisis is considered.	Cihák et al. (2016), and Han and Melecky (2013)
H4	The usage dimension has a positive impact on financial stability for Latin American countries.	Ahamed and Mallick (2019), Khan (2011), Cull et al. (2012) and Rahman (2014)
H5	The access dimension has a positive impact on financial stability for Latin American countries.	Ahamed and Mallick (2019), and Banna and Alam (2021)
H6	The penetration dimension has a positive impact on financial stability for Latin American countries.	Olusegun et al. (2021), and Du Hong et al. (2021).

3 Methodology and Data Collection

3.1 Methodology

3.1.1 Empirical Model

To estimate the impact of financial inclusion on financial stability, a panel data model is used following Morgan and Pontines (2014), Dienillah et al. (2018) and Banna and Alam (2021):

$$\begin{aligned} Fin.Stability_{it} &= \beta_0 + \beta_1 Fin.Inclusion_{it} + \beta_2 lnGDP_{it} + \beta_3 liq_{it} + \beta_4 inf_{it} + \\ &= \beta_5 ext\_balance_{it} + \beta_6 policy\_ir_{it} + \beta_7 governance_{it} + \beta_8 global fin.crisis_t + \\ &= \beta_9 COVID19_t + \beta_{10} Fin.Inclusion * G.fincrisis_{it} + \\ &= \beta_{11} Fin.Inclusion * COVID19 *_{i\ t} + u_{it} \end{aligned} \tag{1}$$

Where "i" indicates the country and "t" the year. The estimation window extends from 2004 to 2021, as it is detailed in Section 3.2. The dependent variable, financial stability, is measured with the Z-Score (Sahay et al., 2015; Ahamed and Mallick, 2019; Olusegun et al., 2021, Banna and Alam, 2021; Abir and Ishaq, 2021; World Bank, n.d.a). The independent variable of interest is the financial inclusion index, which is used to test H1. Furthermore, to test H2 and H3, the interaction terms, global financial crisis ($fin.inclusion * G.fin.crisis_{it}$) and the COVID-19 period ($fin.inclusion * COVID19_{it}$), are included to explore how the effect of financial inclusion on financial stability varies when the global financial crisis

and COVID-19 crisis are considered. The specific periods defined for the global financial crisis and the COVID-19 shock are detailed in Section 3.1.3.

In addition, financial inclusion could be represented by the access, penetration, or usage dimension, which are defined in the following section. In this line, three additional regressions are conducted with the Z-Score as the dependent variable. In each regression, the financial inclusion index is replaced by the corresponding dimension to test H4, H5 and H6. The Z-Score is used as a measure of financial stability since it has been more widely used in the previous literature to measure financial stability than other indicators (Sahay et al., 2015; Ahamed and Mallick, 2019; Olusegun et al., 2021, Banna and Alam, 2021; Abir and Ishaq, 2021; World Bank, n.d.a).

The details about the construction of the Z-Score and the financial inclusion multidimensional index are provided in the following section, while the description of the control variables and the justification of their inclusion are provided in Section 3.1.3.

To facilitate comprehension, the research strategy is described as follows:

Table 2: Research Strategy

Hypothesis	Description	Model	Estimation
H1	Financial inclusion (multidimensional index) has a positive impact on financial stability for Latin American countries.	1	The dependent variable in this model is represented by the Z-Score and the financial inclusion variable is representedby the financial inclusion index.
H2	The effect of financial inclusion (multidimensional index) on financial stability is weaker when the global financial crisis is considered.	1	The dependent variable in this model is represented by the Z-Score and the financial inclusion variable is represented by the financial inclusion index.
H3	The effect of financial inclusion (multidimensional index) on financial stability is weaker when the COVID-19 crisis is considered.	1	The dependent variable in this model is represented by the Z-Score and the financial inclusion variable is represented by the financial inclusion index.
H4	The usage dimension has a positive impact on financial stability for Latin American countries.	2	The dependent variable in this model is represented by the Z-Score and the financial inclusion variable is represented by the usage dimension (volume of deposits and credits to GDP)
H5	The access dimension has a positive impact on financial stability for Latin American countries.	3	The dependent variable in this model is represented by the Z-Score and the financial inclusion variable is represented by the access index (ATM and bank branches).
H6	The penetration dimension has a positive impact on financial stability for Latin American countries.	4	The dependent variable in this model is represented by the Z-Score and the financial inclusion variable is represented by the penetration dimension (number of bank accounts per 1,000 adults).

3.1.2 Financial Stability and Financial Inclusion Measures

a) Financial Stability Measures

Following previous studies (Čihák and Hesse, 2010; Morgan and Pontines, 2014, Ahamed and Mallick, 2019), the bank Z-Score at a country level is used as a proxy of financial stability. According to Čihák and Hesse (2010), this indicator is inversely related to the probability of insolvency of financial institutions, which implies that a higher value of this measure is associated with a lower probability of insolvency risk. The Z-Score is defined as follow in the GFDD:

$$Z - Score = \frac{\frac{Equity}{Assets}_{it} + ROA_{it}}{\sigma(ROA_{it})} \tag{2}$$

Where $\sigma(ROA_{it})$ represents the standard deviation calculated during the sample period (2004-2021) for each country according to the GFDD and Laeven and Levin (2009), "i" indicates the country and "t" the year. This definition is also used in the studies mentioned earlier. According to Čihák and Hesse (2010), the Z-Score measures the number of standard deviations a return realization would need to decrease to deplete equity, assuming a normal distribution of bank's returns. Therefore, it represents the probability that the value of bank's assets becomes lower than the value of bank's debt (World Bank, n.d.a). For this variable, the natural logarithm is applied, as previous studies also did to reduce its skewness (Beck, 2012; Ahamed and Mallick, 2019). In Appendix 8, descriptive statistics of the Z-Score can be found per country, which shows that this measure exhibits skewness.

In addition, for robustness check purposes, the non-performing loans to gross loans ratio (NPL ratio) at the country level is used as a measure of financial instability, following the studies of Morgan and Pontines (2014), Bahadur and Sharma (2018) and Zhang et al. (2022). As Bahadur and Sharma (2018) pointed out, this variable measures the level of credit risk, while the Z-Score measures overall bank risk. A higher level of this indicator implies a higher credit risk, which leads to an increase in bank fragility. In Appendix 8, descriptive statistics of this measure can be found per country.

b) Development of the Financial Inclusion Index - PCA Methodology

A multidimensional index of financial inclusion is developed to capture its various dimensions in a single measure that provides a complete outlook of the level of financial inclusion in an economy. Three dimensions are used following previous studies (Sarma, 2008; Sethy, 2016; AFI, 2019; GPFI, n.d.;): usage, access (availability) and penetration. In Appendix 9, descriptive statistics per indicator and country can be found.

i) **Usage**: For the usage dimension, the volume of credits and deposits to GPD is considered (Sarma, 2008; Sethy, 2016, Park and Mercado, 2018). According to Sarma (2008), the relevance of this dimension relies on the fact that many agents ("marginally banked") own a bank account but do

not use the banking services.

ii) **Access**: For the access dimension, the number of ATMs per 100,000 adults and the number of bank branches per 100,000 adults is considered (Sarma, 2008; Cámara and Tuesta, 2014); Ahamed Mallick, 2019; GPFI, n.d). Camara and Tuesta (2014) indicated that greater access implies higher financial inclusion since it increases the possibilities for agents to use them. However, the authors mentioned that these variables only capture the degree of accessibility to formal financial services to a certain extent since it does not provide information about the concentration of these points of services.

iii) **Penetration**: Sarma (2008) highlighted that an inclusive financial system is characterized by serving as many users as possible. Dienillah et al. (2018) stated that the proportion of people who hold a bank account could represent the penetration dimension. Accordingly, this dimension is measured with the number of bank accounts per 1,000 adults is used based on Sethy (2016) and Dienillah et al. (2018).

Following Camara and Tuesta (2014), Ahamed and Mallick (2019), Yorulmaz, 2018, Nguyen (2020) and Sha'ban et al. (2020), the Principal Component Analysis (PCA) is applied to build a multidimensional index for financial inclusion. Before applying this methodology, a normalization process is applied to each variable by using minimum and maximum values as previous studies to assure that they are measured in the same scale and facilitate interpretation (Camara and Tuesta, 2014; Sha'ban et al., 2020; Nguyen, 2020). Following Sha'ban et al. (2020). The normalization is described as follow:

$$D_{it}^{n} = \frac{D_{it} - Min(D^{n})}{Max(D^{n}) - Min(D^{n})} \tag{3}$$

Where "n" refers to one of the three dimensions of financial inclusion (D) previously defined, "i" the country and "t" the period. Min(D^n) and Max(D^n) stands for the minimum value of the dimension "n" over the sample period for all the countries and the maximum value of the dimension "n" over the sample period for all the countries, respectively.

The PCA methodology transforms correlated variables into a new set of uncorrelated variables; therefore, its objective is to explain the variance of the data through a few linear combinations of the original database (OCDE, 2008). In the case of financial inclusion measures, Yorulmaz (2018) pointed out that the PCA technique allows to find the statistical importance of each dimension. Therefore, the objective is to obtain weights per dimension based on this methodology rather than assigning weights arbitrarily, and obtain information about the relative importance of each dimension (Camara and Tuesta, 2014). Appendix 10 shows the correlation among financial inclusion dimensions is high, which implies that the

PCA technique will remove redundancies among these dimensions (Ahamed and Mallick, 2019). As Camara and Tuesta did (2014), the number of variables that are used to build a composite index is the same as the number of components in the PCA procedure.

A two-stage PCA is used, consistent with the studies of Camara and Tuesta (2014), Ahamed and Mallick (2019) and Nguyen (2020). The first stage implies creating a composite index for the access dimension as it is measured with two variables: the number of ATM per 100,000 adults and the number of bank branches per 100,000 adults. The PCA is estimated to obtain non-discretionary weights and provide information of the relative importance of each variable within this dimension. The access dimension index is built as follows:

$$\text{Access}_{it} = \gamma_1 \text{ATM}_{it} + \gamma_2 \text{Bankbranches}_{it} \tag{4}$$

Where γ_1 and γ_2 represents the weights for the ATM and Bank branches variable, respectively. Based on the study of Camara and Tuesta (2014), the weights are obtained from the information in the principal components PC1 and PC2 (eigenvectors) and their corresponding eigenvalues. The calculation is described with the following equation:

$$\gamma_k = \frac{\sum_{i=1}^{3} \lambda_i \phi_{ik}}{\sum_{i=1}^{3} \lambda_i}, \quad k = 1, 2 \tag{5}$$

Where λ_i represents the eigenvalues, k the number of variables and ϕ_{ik} denotes for the eigenvectors corresponding to each variable. As Camara and Tuesta (2014) pointed out, the sum of the weights obtained through the PCA procedure is not necessarily equal to 1; therefore, they are normalized to sum 1.

The weights obtained in the first stage of the PCA to build the access index by using the methodology described in equation (5) are shown in Table 3, which are normalized to sum 1. As it was described previously, the weights represent the relative importance of the variables ATM per 100,000 adults and bank branches per 100,000 adults within the access dimension.

Table 3: Access index – PCA Results

Variable	PC1	PC2	Normalized weights
ATM per 100,000 adults	0.7071	0.7071	0.82
Bank branches per 100,000 adults	0.7071	-0.7071	0.18
Eigenvalues	1.2172	0.7828	

As can be seen from Table 3, the access index is mainly driven by the variable ATM per 100,000 adults. The interpretation lies on the capacity of ATMs to provide banking services even in remote areas, which

increases the attraction of the population to use these services due to lower costs of time (queues) and distance traveled to access bank branches (Ehiedu and Onuorah, 2021; Maity and Sahu, 2022; FMO, n.d.).

The second stage of the PCA involves aggregating the three dimensions (access, penetration, and usage) into a single multidimensional financial inclusion index (Cámara and Tuesta, 2014; Ahamed and Mallick, 2019; Yorulmaz, 2018; Sha'ban et. al, 2020; Zhang et al., 2022). Following the normalization procedure, the PCA is conducted based on the following equation (Camara and Tuesta, 2017; Ahamed and Mallick, 2019):

$$\text{Financial Inclusion}_{it} = \omega_1 D_{it}^1 + \omega_2 D_{it}^2 + \omega_3 D_{it}^3 + e_i \tag{6}$$

Where D_{it}^1, D_{it}^2 and D_{it}^3 refers to the access, penetration, and usage dimension in country (i) in the year (t). The access dimension is measured by the access index obtained with the first stage PCA. The financial multidimensional index is built per country and year by using the weights obtained from the PCA methodology.

The following findings and the normalized weights determined by equation 5 were obtained from the second stage of the PCA to build the financial inclusion index:

Table 4: Financial Inclusion Index - PCA Results

Variable	PC1	PC2	PC3	Normalized weights
Access	0.4508	0.8576	0.2478	0.48
Penetration	0.6011	-0.4968	0.626	0.27
Usage	0.6599	-0.1332	-0.7394	0.26
Eigenvalues	1.8540	0.8203	0.3257	

As can be observed from Table 4, the access dimension is the most relevant dimension of financial inclusion. Similar results were found by Camara and Tuesta (2014) and Nguyen (2020). Camara and Tuesta (2014) mentioned that the access dimension is key to financial inclusion as it represents the supply of formal financial services, which is a necessary condition to achieve financial inclusion, but not the only factor at play. The ranking of countries according to the financial inclusion index, access, usage and penetration dimension, separately, can be found in Appendix 11.

To evaluate the validity of the financial inclusion index, the correlation between this index and the percentage of adults with an account at a formal financial institution is calculated per country, following the same logic as Ahamed and Mallick (2019) and Nguyen (2020). This information is available in the Global Findex database from the World Bank for the years 2011, 2014, 2017 and 2021. The World Bank periodically conducted surveys in 123 economies and compiled the information in the Global Findex database. According to the World Bank (n.d.d), a bank account is a first step towards broader financial

inclusion; therefore, it is a reliable indicator to validate the financial inclusion index. Appendix 12 shows that the correlation between the financial inclusion index and the percentage of adults who own an account at a formal financial institution for the years previously mentioned is strong for most of the countries. This serves as evidence for the reliability and accuracy of the financial inclusion index developed for this study.

3.1.3 Control Variables

A group of observable variables that affect financial stability are used as control variables. Following Morgan and Pontines (2014), Banna and Alam (2021), and Zhang et al. (2022), the logarithm of GDP ($lnGDP_{it}$) is included as a control variable. As Morgan and Pontines (2014) suggest, the indicator of liquid assets to deposits and short-term funding (liq_{it}) is considered in the estimations as a measure of the liquidity position in the financial system. The inflation rate (inf_{it}) is used as an additional control variable as Klein (2013) and Olusegun et al. (2021) proceeded, which is an indication of a surge of domestic risks. Additionally, trade openness ($ext\_balance_{it}$) is included in line with Ashraf et al. (2017) and Rahman et al. (2020). Trade openness may allow banks to diversify their loan portfolio between domestic and international firms that sell their products in foreign markets (Ashraf et al. 2017; Rahman et al., 2020). As a governance indicator, a governance index is used as a control variable ($governance$), which is built with the regulatory quality of the government and government effectiveness variables (Das et al., 2004; Ozili, 2018; Pérez-Cárceles et al., 2019; Sarhangi et al., 2021). This index indicates the ability of a government to implement sound policies and design regulations to specific private sectors (Pérez-Cárceles et al., 2014). The PCA methodology, which was detailed in the previous section, is utilized to obtain the weights of each variable in the process of building this index. Appendix 13 provides the results of the PCA technique used to build the governance index.

In addition, the policy interest rate ($policy\_ir_{it}$) is used as a control variable to reflect the stance of monetary policy, consistent with the studies of Porcellacchia (2022) and Grimm et al. (2023). The latter explored the effect of an extended period of low interest policy rates on financial fragility, indicating that interest rates below their natural level could increase risks for the financial sector by a higher credit growth and increasing asset prices. Gross (2018) states that lending interest rates, which are driven by monetary policy, could affect financial stability as it improves the net interest revenue of banks and enhances their capital position. However, these rates could also pose difficulties for over-indebted borrowers, potentially affecting financial stability (Martinez-Miera Repullo, 2021). While in some studies that evaluates the determinants of financial stability, credit expansion is used as a control variable (Morgan and Pontines, 2014; Bahadur and Sharma, 2018), in this research it is not included in the estimations to avoid multicollinearity. This decision is driven by the fact that the financial inclusion index already considers the usage dimension, which is built with volume of credits and deposits to GPD.

Concerning the effects of stress periods in the estimations, a dummy variable for the 2008 global financial crisis is included (Han and Melecky, 2013; Abir and Ishaq, 2021). This dummy variable ($fin.crisis_t$)

takes the value of 1 in 2008 and 2009, and 0 otherwise (De Haas and Van Lelyveld, 2011; Abir and Ishaq, 2021). Furthermore, a dummy variable for the COVID-19 crisis ($COVID19_t$) is included to estimate the effect of this period on financial stability. This variable takes the value of 1 in 2020 and 2021, and 0 otherwise (Heimberger, 2022). In Table 5, the expected signs for the explanatory variables and their justification are detailed.

Table 5: Description of Explanatory Variables

Variable	Study	Measurement	Expected Sign(1)
Financial Inclusion	Khan (2011), Rahman (2014), Morgan and Pontines (2014), Ahamed and Mallick (2017) and Banna and Alam (2021)	Financial inclusion index (PCA Methodology - Model 1), access dimension (Model 2), penetration dimension (Model 3) and usage dimension (Model 4). Details about these measures are found in Section 3.1.2.	+
Ln(GDP)	Morgan and Pontines (2014), Banna and Alam (2021) and Zhang et al. (2022)	Logarithm of GDP expressed in constant 2015 prices in US dollars.	+
Liquid assets to deposits and short-term funding	Morgan and Pontines (2014)	Value of liquid assets to short-term funding plus total deposits (annual %).	+
Inflation	Klein (2013) and Olusegun et al. (2021)	Consumer price index (annual %).	-
Trade openness (ext. balance)	Ashraf et al. (2017) and Rahman et al. (2020)	Exports of goods and services (constant 2015 US$) minus imports of goods and services (constant 2015 US$).	+
Policy interest rate	Gross (2018), Porcellacchia (2022), Grimm et al. (2023)	Policy interest rate set by each central bank.	+
Governance index	Das et al. (2004), Ozili (2018), Pérez-Cárceles et al. (2019) and Sarhangi et al. (2021)	The governance index is built with the PCA methodology based on the indicators of regulatory quality and government effectiveness to obtain one single measure of governance (Appendix 13)	+
Global Fin. Crisis	Han and Melecky, 2013; Abir and Ishaq, 2021	Dummy variable that takes the value of 1 for the years 2008 and 2009 (De Haas and Van Lelyveld, 2011; Abir and Ishaq, 2021).	-
COVID-19	Han and Melecky, 2013; Abir and Ishaq, 2021	Dummy variable that takes the value of 1 for the years 2020 and 2021 (Heimberger, 2022).	-
Fin. Inclusion*G.Fin. Crisis	Cihák et al. (2016)	Interaction term based on the multiplication of the financial inclusion measure and the dummy variable global fin. crisis.	-
Fin. Inclusion*COVID19	Cihák et al. (2016)	Interaction term based on the multiplication of the financial inclusion measure and the dummy variable COVID-19.	-

Expected signs based on previous literature.

3.2 Data Collection

The analysis of the effect of financial inclusion on financial stability is conducted for a sample of 11 countries in Latin America (Appendix 8). As a proxy of the degree of financial stability in a country,

the information to calculate the Z -Score at a country level is retrieved from the information available on the website of the banking regulatory and supervisory agencies in each country for the sample period (2004-2021) to ensure the inclusion of information from all banks at a specific point in time. The Z-Score at a country level is obtained from the Global Financial Development Database (GFDD) published by the World Bank when the information is not available in the first source. Likewise, the non-performing loans to gross loans (%) at a country level (NPL ratio) is obtained from the GFDD. According to the World Bank (n.d.b), this database contains information related to aspects of financial institutions and markets for 214 economies on a yearly basis. This data is available on an annual basis from 2004 to 2021, inclusive. Therefore, the estimations are conducted for that period with yearly information. The 11 Latin America countries were selected due to the size of their economy and the availability of their information in the GFDD[1].

To develop a financial inclusion index, the following information is obtained for the region subject of study from the GFDD: bank accounts per 1,000 adults, number of ATMs and bank branches per 100,000 adults and credit and bank deposits to GDP. This information originates from the Financial Access Survey elaborated by the Information Monetary Fund, which is compiled in the GFDD. In addition, macroeconomic variables that are used as control variables are collected from the World Development Indicators, published by the World Bank. The policy interest rate is obtained from the website of central banks in each country. Furthermore, the regulatory quality and government effectiveness of governments, collected from the Worldwide Governance Indicators, are transformed into a single indicator with the PCA methodology to obtain an indicator of governance (control variable). The panel data is unbalanced since for a few countries, the financial inclusion variables are not available for the earlier years of the estimation window. In Appendix 14, the description of the variables and their source are detailed.

3.3 Descriptive Statistics

The descriptive statistics for the dependent and explanatory variables and the correlation matrix are provided in Table 6 and 7, respectively. In Appendix 8 and 9 descriptive statistics for the Z-Score and the dimensions of financial inclusion can be found per country, respectively.

[1]The information provided by the World Development Indicators, published by the World Bank, was used to identify the largest economies in Latin America according to their real GDP (constant 2015 US$).

Table 6: Descriptive Statistics

Variable(1)	Mean	Std. Dev.	Min	Max	Obs
Ln(Z-Score)	3.0	0.7	1.5	4.6	194
NPL ratio	2.9	1.5	0.7	10.8	195
Fin. Inclusion index	0.4	0.2	0.0	1.0	169
Usage	0.3	0.2	0.0	1.0	196
Access index	0.3	0.2	0.0	1.0	178
Penetration	0.3	0.2	0.0	1.0	176
Ln(GDP)	25.5	1.3	23.6	28.3	198
Liquidity	30.5	13.6	11.0	63.3	184
Inflation	4.7	4.5	-0.7	51.5	180
Ext. balance (trade openness)	0.0	0.1	-0.3	0.1	198
Policy interest rate	7.7	8.5	0.3	59.3	144
Governance index	52.0	17.5	14.7	89.0	198
Global Fin. Crisis	0.1	0.3	0.0	1.0	198
COVID-19	0.1	0.3	0.0	1.0	198

(1) Interaction terms are not included as they change according to the indicator of financial inclusion.
Source: Author's calculation

Table 7: Pairwise Correlation Matrix

Variable (1)	Ln(Z-Score)	Fin. Inclusion	NPL ratio	Ln(GDP)	Liquidity	Inflation
Ln(Z-Score)	1.00					
Fin. Inclusion	0.16**	1.00				
NPL ratio	-0.11	-0.26***	1.00			
Ln(GDP)	-0.22**	0.34***	0.11	1.00		
Liquidity	-0.21***	0.19**	0.15**	0.31***	1.00	
Inflation	-0.14*	0.05	0.11	-0.06	0.24***	1.00
Ext. Balance	-0.28**	-0.05	0.13*	0.30**	0.26**	0.12*
Policy_ir	-0.22***	-0.13	0.17**	0.39***	0.53***	0.37***
Governance Index	-0.21***	0.63***	-0.35***	0.17**	-0.05	0.02
Global Fin. Crisis	0.07	-0.11	0.00	-0.03	0.08	0.11
COVID-19	-0.03	0.22***	-0.06	0.05	-0.01	-0.08

Variable	Ext. Balance	Policy_ir	Governance index	Global Fin. Crisis	COVID-19
Ext. Balance	1				
Policy_ir	0.19**	1			
Governance index	0.08	-0.08	1		
Global Fin. Crisis	0.02	-0.01	-0.01	1	
COVID-19	-0.07	-0.03	0.01	-0.13*	1

(1) ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.
Source: Author's calculation

As can be observed from Table 7, the correlation matrix reveals that the pairwise correlations are below 0.7, suggesting that multicollinearity may not be a potential issue for the estimations (Dormann et al., 2013).

4 Empirical Findings

4.1 Financial Inclusion Index and Financial Stability

The estimations are performed for 11 Latin American economies over the period 2004-2021, which constitutes a panel data. The dependent variable is the bank Z-Score, while the variable of interest is the financial inclusion index, whose impact on the Z-Score is estimated (Model 1). Additionally, financial inclusion is represented by the usage (Model 2), access (Model 3), or penetration dimension (Model 4).

Although the results of the Hausman test suggest a fixed effects model (Appendix 15), a random effects model by using cluster standard errors by country is estimated due to the presence of the variables "global financial crisis" and "COVID-19", which are dummy variables that show little variation over time within each country. As defined in Section 3.1.3, the first variable takes the value of 1 for the years 2008 and 2009, and 0 for the remaining years, while the second variable takes the value of 1 for the years 2020 and 2021, and 0 otherwise. According to Allison (2006), Hahn et al. (2011) and Clark and Linzer (2014), the presence of variables that change little across time may affect the fixed effects estimators and substantially increase the standard errors in the fixed effects model than other specifications. Therefore, in this study, the random effects model is employed with corrections for heteroskedasticity and autocorrelation by using country clusters (Wooldrige, 2018; Ahamed and Mallick, 2019).

The first model to evaluate H1, H2 and H3 is related to the estimation of the effect of financial inclusion, measured by the multidimensional financial index on financial stability, represented by the logarithm of the Z-Score (Model 1). The findings obtained from this model presented as follows:

Table 8: Financial inclusion and Financial Stability - Random Effects

Model 1 - Dependent variable: Ln(Z-Score)				
Variable	Without interaction terms	Crisis*Fin. Inclusion	COVID-19*Fin. Inclusion	Both interaction terms
Fin. Inclusion	2.21*	2.15*	3.30*	3.23*
	[1.31]	[1.29]	[1.71]	[1.67]
lnGDP	-0.24	-0.24	-0.37	-0.37
	[0.29]	[0.29]	[0.29]	[0.29]
Liquidity (liq)	-0.01	-0.01	0.00	0.00
	[0.02]	[0.02]	[0.01]	[0.02]
Inflation (inf)	-0.11*	-0.11*	-0.10**	-0.09*
	[0.06]	[0.06]	[0.05]	[0.05]
Ext. balance	0.12	0.11	0.51	0.5
(ext_balance)	[2.17]	[2.17]	[2.17]	[2.16]
Monetary policy	0.08*	0.08*	0.07**	0.07**
(policy_ir)	[0.05]	[0.04]	[0.03]	[0.03]
Governance	-0.02**	-0.02*	-0.03*	-0.03**
	[0.01]	[0.01]	[0.02]	[0.01]
Global fin. crisis	0.19	-0.26	0.07	-0.57
(globalfin.crisis)	[0.16]	[0.48]	[0.03]	[0.6]
COVID19	-0.19	-0.2	1.05*	1.04*
	[0.3]	[0.27]	[0.6]	[0.6]
Fin.Inclusion*	-	1.05	-	1.51
gfin.crisis		[1.06]		[1.00]
Fin.Inclusion*	-	-	-2.70*	-2.71*
COVID-19			[1.48]	[1.48]
Observations	118	118	118	118
Countries	11	11	11	11
R-squared	0.31	0.31	0.39	0.39
Clustered standard errors	Yes	Yes	Yes	Yes

The estimation is based on random effects regressions. Robust standard errors clustered for countries were applied to calculate p-values and are presented in brackets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8 presents the outcomes of Model 1 with different specifications, depending on the inclusion of interaction terms. As it is noted, in all specifications, financial inclusion has a positive and significant effect at a 10% level on financial stability, supporting H1[2]. The model without interaction terms is used to analyze the coefficients of the control variables. As the financial inclusion index ranges from 0 to 100, its coefficient should be divided by 100 to facilitate interpretation and express the effect of the financial inclusion in terms of a 0.01 change in this index. As the dependent variable is expressed in logarithm terms, the coefficient should be multiplied by 100 to obtain the percentage change. Consequently, a 0.01 increase in the multidimensional financial inclusion index leads to a 2.21% increase in the Z-Score. This result is consistent with several studies that theoretically explained a positive relationship between financial inclusion and financial stability (Khan, 2011; Rahman, 2014; Du Hong et al., 2021) and the ones that empirically observed a significant and positive effect (Morgan and Pontines, 2014; Ahamed and

[2]A fixed effects model is conducted without including the variables that vary little over time (crisis dummies and the interaction terms) to validate the findings obtained from the random effects estimation (Model 1). As can be observed in Appendix 16, the effect of the financial inclusion index on financial stability remains positive and significant at the 1% level.

Mallick, 2019; Banna and Alam, 2021; Du Hong et al., 2021).

One potential explanation for this result is that financial inclusion promotes the diversification of bank's loans portfolio (Khan, 2011; Cull et al., 2012 and Rahman, 2014). In fact, financial inclusion policies are mainly designated for micro, small and medium-sized enterprises, low-income households or women (Bank for International Settlements, 2018; AFI, 2020). These groups face barriers to use financial services such as costs, travel distance, documentation, collateral requirements, etc. (United Nations Conference on Trade and Development, 2021). In this line, Latin American countries implemented policies to address these barriers (Appendix 1). As these groups may typically require smaller loans comparing to corporate firms (Balkenhol and Guézennec, 2013), a diversified portfolio of many small loans may experience fewer losses comparing to a portfolio concentrated in few corporate borrowers (Rahman (2014). Therefore, financial inclusion may allow banks to experience fewer losses, leading to higher performance indicators and the Z-Score, which is positively affected by the ROA.

Another explanation is based on the fact that banks could increase their operational revenues by targeting the vulnerable groups of the population mentioned in the previous paragraph. In this context, banks can pool the larger volume of deposits resulting from financial inclusion and use them to extend loans, thereby increasing their revenue and Z-Score. In addition, deposits are a low-cost funding source (Federal Deposit Insurance Corporation, 2019). Therefore, their margins increase when they finance their core activities with cheap funding sources, which positively impacts bank's solvency and the Z-Score.

Moreover, financial inclusion increases the stable retail base of deposits, which positively affects financial stability. Small amount deposits, covered by insurance schemes, are maintained in the banks during stress periods, providing liquidity to the banking sector. (Khan, 2011; Rahman, 2014 and Duc Hong et al., 2021).

To prove H2 and H3, the specifications of Model 1 with interaction terms are analyzed to evaluate whether the effect of financial inclusion on financial stability is weaker in the presence of the global financial crisis and the COVID-19 period. Therefore, the variables of interest are $fin.inclusion * fin.crisis_{it}$ and $fin.inclusion * COVID19_{it}$.

An insignificant effect of the first interaction term ($fin.inclusion * fin.crisis_{it}$) is observed, opposite to the anticipated outcome, which invalidates H2. It was expected that when considering the global financial crisis in the estimations the effect of financial inclusion on financial stability diminishes due to the unexpected losses resulting from financial inclusion policies that lead to a rapid credit expansion (Cihák et al., 2016). However, the results suggest that this effect does not change. This could be attributed to the fact that, in Latin America, financial inclusion policies aimed at including disadvantaged groups in the formal financial system became more aggressive following this crisis (Rojas-Suarez, 2016). Therefore, it can be an indication that the pace of credit expansion prior to the implementation of these policies

was not accelerated enough to generate unexpected losses during the global financial crisis. Moreover, the global financial crisis has an insignificant effect on financial stability in all model specifications, which could be attributed to the fact that Latin American countries experienced lower vulnerabilities during this crisis due to their strong macroeconomic fundamentals (Martinez, 2010). In particular, a significant improvement in their terms of trade and low unemployment rates were witnessed in these countries in the years before this crisis (Martinez, 2010).

On the contrary, the results demonstrate H3 since it is observed a negative significant effect of the interaction term ($fin.inclusion * COVID19_i t$) on the Z-Score, which implies a lower total effect of financial inclusion on financial stability when the COVID-19 period is considered. This may be an indication that the risks associated with financial inclusion policies implemented after the global financial crisis and, particularly, the accelerated expansion of loans to the private sector (Appendix 1, 2 and 4) materialized during the pandemic. Specifically, the rapid credit expansion generated by financial inclusion, may be translated into unexpected losses in stress periods (Cihák et al., 2016). The strict measures to control the pandemic caused a contraction in the global economic output and an unprecedent rise in unemployment, negatively impacting the income of vulnerable households across the world (IMF, 2020; Bundervoet et al., 2021). In Latin America in 2020, the GDP growth rate experienced its largest drop (-6%) since 2000, while there was a peak in unemployment (Appendix 7). This evidence supports the argument that households, especially those targeted by financial inclusion policies which tend to be more vulnerable, were not able to repay their debts due to this unexpected event that affected their income. This implies that interest margins of banks may have reduced in this period, negatively affecting the banks' ROA, and diminishing the Z-Score. It is worth highlighting that in this specification, only the interaction term is analyzed as its inclusion may affect the interpretation of the COVID-19 dummy variable itself.

Regarding the other control variables which have a significant effect on financial stability in the specification of the model without interaction terms, a negative effect of the inflation rate on the Z-Score was found, as expected. A possible explanation implies that higher inflation may lead to a deterioration of economic conditions, which will affect the capacity of borrowers to repay their debts as real income may decrease (Klein, 2013; Morell. et al, 2022). In addition, Morell et al. (2022) argued that in this context, banks increase provisions as future loan losses are expected, decreasing bank's profitability. Furthermore, Rashid and Khalid (2017) explain that higher inflation could result in withdrawals of deposits by bank's clients, which would increase the cost of funding and reduce the ROA of banks. This will ultimately affect the Z-Score as a decrease in ROA implies a lower value of this measure.

A negative significant effect of the indicator of governance (regulatory quality and government effectiveness) on financial stability was found, contrary to the anticipated outcome. This indicates that greater government capacity to implement regulations is associated with reduced financial stability. Similarly, Sifrain (2021) reported a negative significant effect of regulatory quality on bank stability in Haiti over

the period 1996-2017. They mentioned that many reforms and regulations could act as barriers to the development of financial institutions, such as imposing high reserves requirements which could affect the lending activity of banks and reduce their profitability. In addition, tighter monetary policy, indicated by a higher policy interest rate, has a significant positive effect on the Z-Score, as expected. One potential explanation based on Arnaldo, Pancaro and Żochowski (2020) is that a rise in monetary policy rates would generally lead to an increase in bank's profitability due to the larger increase in lending rates compared to deposit rates. This result goes in line with the findings of Demirguc-Kunt and Huizinga (1998), Borio et al. (2015) and Gross (2018), which provided evidence of the existence of a positive effect of interest rates on interest margins. As the Z-Score is measured with a performance indicator, then it may increase due to the higher interest margins.

4.2 Financial Inclusion Dimensions and Financial Stability

Three additional models are estimated to evaluate the validity of H4, H5 and H6 with the use of a random effects model due to reasons previously explained. The first model replaces the financial inclusion index with the usage dimension (volume of credits and deposits to GDP), while the second model employs the access dimension (access index which combines the number of ATM and bank branches per 100,000 adults) and the third model, the penetration dimension (number of bank accounts per 1,000 adults). The results are reported in Table 9:

Table 9: Dimensions of Financial Inclusion and Financial Stability

Dependent variable: ln(Z-Score)						
Variable	Model 2: Usage dimension		Model 4: Access dimension		Model 5: Pen. dimension	
	Without int. terms	Both int. terms	Without int. terms	Both int. terms	Without int. terms	Both int. terms
Financial Inclusion	3.08**	3.35**	0.81	0.85	1.62*	2.16**
	[1.33]	[1.36]	[2.04]	[2.3]	[0.92]	[0.90]
lnGDP	-0.30	-0.31	-0.09	-0.16	-0.07	-0.09
	[0.20]	[0.2]	[0.28]	[0.31]	[0.16]	[0.17]
Liquidity (liq)	-0.01	-0.01	0.00	0.00	-0.01	-0.01
	[0.01]	[0.01]	[0.02]	[0.02]	[0.00]	[0.00]
Inflation (inf)	-0.01	-0.01	0.00	-0.09*	-0.05	-0.06
	[0.01]	[0.01]	[0.01]	[0.05]	[0.03]	[0.04]
External balance (ext_balance)	0.79	0.88	-1.14	-0.44	2.89	3.14
	[1.51]	[1.6]	[1.80]	[1.96]	[2.94]	[2.65]
Monetary policy (policyir)	0.06*	0.06**	-0.02	0.04*	0.03*	0.03*
	[0.03]	[0.03]	[0.02]	[0.02]	[0.02]	[0.02]
Governance	-0.02**	-0.03**	0.00	0.00	-0.01***	-0.01***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]	[0.00]
Global financial crisis	0.26	0.65**	-1.60	-1.2	0.25	0.17
	[0.23]	[0.29]	[1.35]	[0.82]	[0.26]	0.34
COVID-19	-0.32*	-1.14*	-0.07	0.3	-0.16	0.4
	[0.17]	[0.59]	[0.11]	[0.38]	[0.19]	[0.38]
Fin. Inclusion*g.fin.crisis	-	-1.2*	-	2.73	-	0.83
		[0.65]		[1.93]		[2.14]
Fin. Inclusion*COVID-19	-	-1.14*	-	1.79	-	-1.75*
		[0.59]		[1.99]		[0.34]
Constant	10.97*	11.08**	5.45	6.81	4.83	5.55
	[4.56]	[4.58]	[6.30]	[6.89]	[3.40]	[3.54]
Observations	118	118	118	118	118	118
Countries	11	11	11	11	11	11
R-squared	0.46	0.47	0.12	0.21	0.30	0.32
Clustered standard errors	Yes	Yes	Yes	Yes	Yes	Yes

The estimations are based on random effects regressions. Financial inclusion is represented by the usage, access or penetration dimension depending on the model. Robust standard errors clustered for countries were applied to calculate p-values and are presented in brackets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Regarding the examination of Model 2, as expected, there is a significant positive effect at the 5% level of the usage dimension on financial stability (Z-Score), which proves H4 in both specifications of Model 2 (without interactions and with interaction terms). This result is consistent with the findings of Ahamed and Mallick (2019), who also found a significant positive effect of this dimension on financial stability. As this indicator is measured with the volume of credit and deposits to GDP, the interpretation of this result could be based on the diversification benefits for the loan portfolio of banks that financial inclusion may provide (Khan, 2011; Cull et al. 2012; Rahman, 2014). Furthermore, the increase in the volume of deposits raises a low-cost source of funding for banks that can use to increase their interest margin and increases the stable retail base of deposits (Duc Hong et al., 2021; FDIC, n.d.). When observing the specification with the interaction terms, a lower significant effect of the usage dimension on the Z-Score is

detected when considering the interaction of this variable with the global financial crisis and the COVID-19 period, separately. This may indicate that vulnerable households may face difficulties repaying their debts in both crisis periods leading to a decrease in bank's interest margins and lower Z-Score. It is important to note that in this specification, only the interaction term is analyzed as its inclusion may affect the interpretation of the crisis dummy variables themselves.

An insignificant effect of the access index on financial stability is documented in Model 3 regardless of the specification, which invalidates H5. Opposite to the studies which found a positive significant effect (Ahamed and Mallick, 2019, and Banna and Alam, 2021), the result indicates that the number of ATM and bank branches does not positively impact financial stability. As indicated by Camara and Tuesta (2014) while the supply of financial services is a necessary condition to promote financial inclusion, it is not the only factor at play. According to the World Bank (n.d.c), it is possible that some individuals and firms have access to financial services, but they opt to not use them. This may explain why the benefits of financial inclusion are not strong to positively affect financial stability when only this dimension is considered.

A positive significant effect of the penetration dimension on financial stability is detected at the 10% level in both specifications of Model 4 (without interaction terms and with interaction terms), which confirms H6. The penetration dimension is measured with the number of bank accounts per 1,000 adults. This outcome may strengthen the argument related to the benefits of the large volume of deposits on interest margins of banks and the larger stable retail deposit base on financial stability, resulted from financial inclusion policies (Khan, 2011; Rahman, 2014, Du Hoc et al., 2021). This result is consistent with the findings of Olusegun et al. (2021). In addition, it can be observed from the model with interaction terms, that the effect of the penetration dimension on financial stability does not vary in the global financial crisis, but it is lower when the COVID-19 crisis is considered. A higher penetration of bank accounts may translate into higher lending activity, which in stress periods could deteriorate the stability of banks.

4.3 Robustness Check

The NPL ratio, as an indicator of financial instability, is used as a dependent variable to test the robustness of the main estimations (Model 1). A higher level of the NPL ratio indicates an increase in credit risk of the financial institutions, which weakens their financial stability. Therefore, the NPL ratio moves in the opposite direction compared to the Z-Score, serving as a contrasting measure. Results of the robustness test are provided in Table 10:

Table 10: Model 1 - Robustness Check

Model 1 - Dependent variable: NPL-ratio				
Variable	Without interaction terms	Crisis*Fin. Inclusion	COVID-19*Fin. Inclusion	Both interaction terms
Financial Inclusion	-2.01***	-1.86**	-1.9***	-2.1***
	[0.62]	0.80	[0.73]	[0.79]
ln(GDP)	0.54***	0.53***	0.54***	0.53***
	[0.21]	[0.20]	[0.20]	[0.19]
Liquidity (liq)	0.00	0.00	0.00	0.00
	[0.01]	[0.01]	[0.01]	[0.01]
Inflation (inf)	-0.04	-0.05**	-0.05**	-0.06**
	[0.03]	[0.02]	[0.03]	[0.02]
External balance	2.49	2.50	1.59	1.94
(ext_balance)	[6.38]	[6.41]	[6.01]	[6.35]
Monetary policy	-0.01	-0.01	-0.01	0.00
(policyir)	[0.01]	[0.01]	[0.01]	[0.01]
Governance	-0.01	-0.01	-0.01	-0.01
	[0.01]	[0.01]	[0.01]	[0.01]
Global fin. crisis	-0.14	-0.84	-0.08	-0.71
(globalfin.crisis)	[0.59]	[1.13]	[0.64]	[0.96]
COVID-19	0.36	0.36	-0.89	-0.97
	[0.41]	[0.40]	[0.16]	[0.64]
Fin.Inclusion*	-	3.81	-	2.08
gfin.crisis		[3.02]		[1.15]
Fin.Inclusion*	-	-	3.61*	3.84*
COVID-19			[2.18]	[2.31]
Constant	-9.61*	-9.35*	-9.71**	-9.30**
	[4.99]	[4.78]	[4.76]	[4.67]
Observations	118	118	118	118
Countries	11	11	11	11
R-squared	0.30	0.33	0.32	0.33
Clustered standard errors	Yes	Yes	Yes	Yes

The estimation is based on random effects regressions. Robust standard errors clustered for countries were applied to calculate p-values and are presented in brackets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

It can be observed from Table 10 that the financial inclusion index reduces the NPL ratio, which implies that it contributes to financial stability. Therefore, the results of Model 1 are validated and H1 is confirmed in the robustness test. Using the same logic for the interpretation of the coefficient previously described for the first model, a 0.01 increase in the financial inclusion index reduces the NPL ratio, which is expressed in percentages, by -0.02. This outcome can be explained by the diversification benefits for bank's portfolio that financial inclusion can provide as mentioned before when the results for model 1 were discussed (Khan, 2011; Cull et al., 2012 and Rahman, 2014). Moreover, as financial inclusion policies are usually designated to micro-enterprises, a possible explanation for this result could be that microfinance clients are likely to have higher repayment debts to secure their access to financial services in the formal sector (Hannig and Jansen, 2010). On top of that, financial inclusion may have a positive impact on the financial health of households, which enhances financial stability (Khan, 2011).

In the analysis of H2, it can be observed from the model that considers only the interaction term $fin.inclusion * Gfin.crisis_{it}$ and from the model that considers both interaction terms, that the interaction term $fin.inclusion * Gfin.crisis_{it}$, which tests whether the impact of financial inclusion changes when the global financial crisis is considered, has an insignificant effect on the NPL, which contradicts H2. This outcome is similar to the one obtained with Model 1. The explanation for this result is that, in Latin America, most financial inclusion policies were implemented after the global financial crisis.

In relation to H3, it is confirmed in the robustness test since the negative effect of financial inclusion on the NPL ratio diminishes when the COVID-19 pandemic is considered due to positive significant coefficient at the 10% level of the interaction term ($fin.inclusion * COVID19_{it}$) in the model that only considers this interaction term and in the model with both interaction terms. This indicates that the credit quality of households may have deteriorated due to a reduction in their income in this tail event, which caused losses for banks.

A brief analysis of the impact of the control variables on the NPL ratio that have a significant effect is provided based on the model without interaction terms to not affect the interpretation of the variables. A negative significant effect of the logarithm of the GDP on the NPL was found, opposite to the expected result (Table 5). However, it is worth mentioning that according to Huljak et al. (2020) and the IMF (2020), the NPL ratio tends to react with a lag to changes in the GDP, which may explain this outcome. The other control variables show an insignificant effect on the NPL ratio in this specification. The insignificant effect of the inflation rate on the NPL ratio invalidates the argument previously mentioned in the analysis of Model 1 regarding that higher inflation may affect the capacity of borrowers to repay debt as economic conditions. This may be an indication that this effect is ambiguous since higher inflation may reduce the real value of outstanding loans, but it may also reduce the real income of borrowers in the context of sticky wages (Klein, 2013).

In Table 11, the robustness tests for the estimations of the effect of financial inclusion on financial stability are presented. The usage dimension shows a significant negative effect on the NPL ratio, implying a lower credit risk for banks and higher financial stability. Therefore, H4 is confirmed in the robustness check. With respect to the penetration dimension, it has an insignificant effect on the NPL ratio, which indicates that H6 is not validated through this procedure. However, the penetration dimension is measured by the number of bank accounts per 1,000 adults, while the NPL ratio represents the riskiness of bank's portfolio. This suggests that there may not be a direct channel through which this variable affects the NPL ratio, specially in stable periods. Further research may be needed to explore this relationship. Regarding the access dimension, it was found that this variable does not have a significant influence on the Z-Score, invalidating Hypothesis 5 (H5) in the main estimations (Model 4). Furthermore, the access dimension shows an insignificant effect on the NPL ratio.

Table 11: Dimensions of Financial Inclusion - Robustness Check

Dependent variable: NPL ratio						
Variable	Model 2: Usage dimension		Model 4: Access dimension		Model 5: Pen. dimension	
	Without int. terms	Both int. terms	Without int. terms	Both int. terms	Without int. terms	Both int. terms
Financial Inclusion	-1.52***	-1.69*	-1.33	-1.58	1.72	1.11
	[0.56]	[0.87]	[1.05]	[1.84]	[1.25]	[1.32]
lnGDP	0.48***	0.46**	0.34**	0.37*	1.64	0.17
	[0.15]	[0.16]	[0.15]	[0.19]	[0.13]	[0.14]
Liquidity (liq)	0.01	0.00	0.01	0.01	0.02**	0.02
	[0.01]	[0.01]	[0.02]	[0.02]	[0.01]	[0.01]
Inflation (inf)	0.08***	-0.06	0.08***	0.08***	-0.02	-0.03
	[0.02]	[0.03]	[0.02]	[0.02]	[0.04]	[0.04]
External balance (ext˙balance)	-4.07***	-4.37**	-4.9***	-4.90***	-2.81*	-2.71
	[0.88]	[1.93]	[1.32]	[1.34]	[1.71]	[1.98]
Monetary policy (policyir)	-0.10*	-0.03	-0.04	-0.04	0.00	0.00
	[0.06]	[0.05]	[0.05]	[0.05]	[0.02]	[0.02]
Governance	-0.01	-0.01	-0.01*	-0.01*	-0.03**	-0.03**
	[0.01]	[0.01]	[0.01]	[0.01]	0.01	[0.01]
Global financial crisis	0.49***	0.84	0.64**	0.97*	0.08	-0.87
	[0.15]	[0.88]	[0.31]	[0.59]	[0.42]	[0.81]
COVID-19	-0.40	-0.38	-0.37	-0.51	-0.21	-2.21
	[0.32]	[0.24]	[0.30]	[0.52]	[0.22]	[0.79]
Fin.Inclusion*g.fin.crisis	-	3.81***	-	-1.18	-	6.26
		[1.44]		[1.33]		[4.71]
Fin.Inclusion*COVID19	-	1.14**	-	0.52	-	3.65***
		[0.52]		[1.62]		[2.07]
Constant	-8.57***	-8.57***	-5.78*	-6.44	-0.93	-0.99
	[3.26]	[3.31]	[3.39]	[4.30]	[2.44]	[3.06]
Observations	118	118	118	118	118	118
Countries	11	11	11	11	11	11
R-squared	0.46	0.50			0.28	
Clustered standard errors	Yes	Yes	Yes	Yes	Yes	Yes

The estimations are based on random effects regressions. Financial inclusion is represented by the usage, access or penetration dimension depending on the model. Robust standard errors clustered for countries were applied to calculate p-values and are presented in brackets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

5 Discussion and Conclusions

One of the primary objectives of this study is to provide insights for policy makers in Latin America concerning the impact of financial inclusion on financial stability. Most of the hypotheses related to the effect of financial inclusion on financial stability were supported by the results (Table 12). Therefore, the financial inclusion index, the usage dimension (volume of credits and deposits to GDP) and the penetration dimension (bank accounts per 1,000 adults) positively impacts financial stability. Furthermore, the COVID-19 crisis diminishes the effect of financial inclusion on financial stability. Based on these results, the following section describes the policy implications related to increasing financial inclusion to not only enhance the stability of financial institutions, but also strengthen the financial health of households. Later, limitations and recommendations for further studies, and concluding remarks are detailed.

Table 12: Summary of Findings

Hypothesis	Description	Model	Result	Previous research supporting the results
H1	Financial inclusion (multidimensional index) has a positive impact on financial stability for Latin American countries.	1	Confirmed	Khan (2011), Rahman (2014), Morgan & Pontines (2014), Ahamed & Mallick (2017), Banna & Alam (2021), Du Hong et al. (2021)
H2	The effect of financial inclusion (multidimensional index) on financial stability is weaker when the global financial crisis is considered.	1	Rejected	No prior evidence to the best of the knowledge of the author
H3	The effect of financial inclusion (multidimensional index) on financial stability is weaker when the COVID-19 crisis is considered.	1	Confirmed	Cihák et al. (2016), Han & Melecky (2013)
H4	The usage dimension has a positive impact on financial stability for Latin American countries.	2	Confirmed	Ahamed & Mallick (2019) and Olusegun et al. (2021)
H5	The access dimension has a positive impact on financial stability for Latin American countries.	3	Rejected	No prior evidence to the best of the knowledge of the author
H6	The penetration dimension has a positive impact on financial stability for Latin American countries.	4	Confirmed	Ahamed & Mallick (2019), Khan (2011), Cull et al. (2012) and Rahman (2014)

5.1 Policy Implications

This study aims to provide insights for policy makers and banking regulators concerning financial inclusion policies. The greater inclusion of the population into the financial system is positively associated to the stability of the financial system in Latin American countries during the period of 2004-2021. Furthermore, the empirical findings suggest that the usage of financial services and the penetration of bank accounts play a relevant role in strengthening financial stability. In light of these results, it is advisable for Latin American governments to maintain financial inclusion policies on their agendas and to consider the following crucial observations.

Specifically, regarding policies to increase the penetration of bank accounts, Hannig and Jansen (2010) state that promoting bank accounts should be a priority when establishing financial inclusion policies as it enhances household's capacity to manage vulnerabilities during crisis periods, provides diversification to the funding base of financial institutions and deeper financial systems enhance economic resilience. The Global Findex database reveals that Latin America (73%) is still behind in the statistics of account ownership compared to North America (95%) and Europe – Economic and Monetary Union (98.5%). Chile has achieved an 87% in the proportion of the population above 15 years old who hold an account, according to this database, which is the highest percentage among Latin American countries (Appendix

17). The availability of the account "Cuenta RUT" of BancoEstado, a public bank in Chile, is a key factor contributing to the high level of bancarization in this country (Latin American Association of Development Financing Institutions, 2017). The product, which is also available online, is designed for women aged 12 and above and men aged 14 and above. To open the account only an identification is required, and it enables customers to receive and make payments, make digital transactions and contactless payments. This serves as an example for other countries in the region, which demonstrates the relevance of designing financial products tailored to the needs of the population with the aim of increasing financial inclusion.

Furthermore, concerning the usage dimension, it is essential to establish financial education programs, which improve people's understanding of financial products, to increase the appropriate use of them (Atkinson and Messy, 2013; Hasan et al., 2021). Thereby, ensuring the benefits associated with enhancing households' capacity to effectively manage economic shocks.

While the access dimension has an insignificant impact on financial stability, and the quality dimension has not been investigated in this study, it is relevant to consider the dimensions altogether when promoting financial inclusion. Table 13 displays policies to increase financial inclusion through the penetration, usage, access, and quality dimensions. They are not only relevant for Latin America, but also for other regions which are behind in financial inclusion indicators according to the Global Findex database (2021), such as Sub-Saharan Africa or South Asia.

Table 13: Policies to Promote Financial Inclusion

Dimension	Policies to promote financial inclusion	Source
Penetration	Available financial products tailored to the needs of the target groups such as women, rural households, young people, etc.	Latin American Association of Development Financing Institutions (2017)
	Governments policies to establish that bank digital accounts (digital) should be the channel to receive government transfers.	Ampudia and Ehrmann (2017)
Usage	Financial education programs to increase the understanding of financial services among the population.	Atkinson and Messyv (2013); Hasan et al. (2021)
	Increase trust in financial institutions: A strong consumer protection framework.	Demirgüç-Kunt et al. (2021)
Access	Promote access in rural areas by increasing agent correspondent networks and branchless banking.	International Finance Corporation (2011)
	Enabling digital identity infrastructure to eliminate access barriers to financial services caused by lack of documentation in low-income countries.	Appaya and Varghese (2019); World Economic Forum (2023)
Quality	Enhance transparency of the information, specifically fees and charges to enable customers to compare products.	Perez and Titelman (2018); European Banking Authority (2022)

Additionally, even though a positive effect of financial inclusion on financial stability was found for the sample of countries during the period 2004-2018, it is relevant to mention three key aspects to ensure financial stability during the process of financial inclusion according to Roa (2016). Particularly, they are: adequate regulation and supervision of new financial inclusion instruments and institutions, effective financial consumer protection policies and financial education programs. The author highlights the importance of focusing attention on the regulation and supervision of credit intermediation outside the traditional banking system. Khan (2011) suggests that the consequences in stress periods of the expansion of financial innovations may be difficult to predict. According to the Inter-American Development Bank (2021), the number of Fintech platforms grew by 112% from 2018 to 2022, contributing to financial inclusion through the digitalization of financial services (Organization for Economic Cooperation and Development, 2020 Giudice et al., 2021). However, some countries, such as Argentina and Guatemala, lack a specific regulatory framework for fintech (Consortium Legal, n.d.; Floid, 2023).

It is worth to highlight that the effect of financial inclusion on financial stability was observed to be lower during the COVID-19 crisis for the 11 Latin American countries. The process of financial inclusion may lead to excessive credit growth and the provision of loans to low-income households, which are highly vulnerable to shocks (Mehrotra and Yetman, 2015; Roa, 2016). Therefore, banking regulators and supervisors should focus on evaluating the lending standards of financial institutions, especially during expansion phases of the financial cycle.

5.2 Limitations and Recommendations

In this study, financial stability, the dependent variable, is represented by the country Z-Score, which has been widely used in previous studies (Čihák and Hesse, 2010; Morgan and Pontines, 2014; Ahamed and Mallick, 2019; Duc Hong et al., 2021). According to the World Bank (n.d.), the popularity of this measure arises from its inverse relationship with the probability of a financial institution's insolvency (the probability that the value of its assets becomes lower than the value of its debt). However, it is relevant to acknowledge the limitations of this indicator. Beck and Laeven (2006) indicate that the Z-Score measures risk in a single point of time and does not capture the probability of consecutive negative profits. Furthermore, the authors state that the calculation of the Z-Score is based on accounting information, whose quality may vary across countries. The World Bank (n.d.a) mentions that the quality of this indicator depends on the underlying accounting and auditing framework of the bank. Moreover, the Z-Score does not consider the risk that a default in one financial institution may cause loss to other institutions in the financial system (interconnectedness risk) as it is a measure which examines each financial institution individually (World Bank, n.d.a). Therefore, further studies could consider developing a financial stability index that covers the dimensions or factors that influence this variable. According to previous literature, financial stability encompasses financial institutions soundness variables, risks affecting the financial system and the economic environment (Schinasi, 2004; European Central Bank, 2005; Čihák et al., 2016).

Regarding the financial inclusion index, it is relevant to note that the construction of this index does not incorporate the quality dimension of financial inclusion. The World Bank (2015) considers that quality is a relevant dimension of financial inclusion since it represents whether financial products and services match client's needs, the range of options available to customers, and client's awareness and understanding financial products. This dimension could be measured by the degree of financial knowledge or disclosure variables, among other variables (GPFI, n.d.). However, the World Bank database, used for obtaining data related to the financial inclusion dimensions, does not include information on these specific variables. To address this limitation, further studies may consider obtaining this information from the banking regulatory or supervisory authorities in each country depending on its availability.

Furthermore, as this study focuses on Latin American countries, the results cannot be extrapolated for other regions since the literature review provides mix explanations and findings of the effect of financial inclusion on financial stability (Hannig and Jansen, 2010; Khab, 2011; Morgan and Pontines, 2014; Olusegun, 2021). To validate the findings, further studies could explore the relationship in other regions and consider different timeframes.

Moreover, other studies could examine the reverse causality between financial stability and financial inclusion. Demie and Lindelwa (2023) indicate that financial stability could result in economic shocks and lower income, which leads to financial exclusion of vulnerable groups. The authors empirically find that financial stability positively affects financial inclusion for the Sub-Saharan African countries for the period 2000-2019. They explained this result by the fact that stable financial institutions provide proper products, increasing financial inclusion. Future research could investigate the casual relationship between these two variables.

5.3 Concluding Remarks

This study analyzes the relationship between financial inclusion and financial stability for 11 Latin American countries during the period 2004-2021. In addition, this study examines whether this effect varies during crisis periods, as accelerated credit growth could lead to unforeseen losses for banks during such periods (Cihák et al., 2016). After the global financial crisis, governments in this region have included financial inclusion policies in their agendas as it allows households to build assets, manage risks and smooth consumption (Cull et al., 2014). As a result, these countries experienced a significant increase in the number of bank account holders and domestic credit to private sector to GDP ratio.

Previous literature has not reached a consensus regarding the direction of the effect of financial inclusion on financial stability. On the one hand, a group of studies argues that financial inclusion promotes the diversification of banks' loan portfolios, reduces the costs of funding for banks, and improves the financial health of households, ultimately contributing to financial stability (Khan, 2011; Cull et al., 2012; Rahman, 2014; Duc Hong et al., 2021). On the other hand, previous literature suggests that financial inclusion may lead to a rapid credit growth and the deterioration of lending standards, increasing credit risk in financial

institutions (Mehrotra and Yetman, 2015; Khan, 2011). Another consequence could be the expansion of unregulated parts of the financial sector and financial innovations (Mehortra and Yetman, 2015).

A positive significant effect of the financial inclusion index, constructed with combining the usage, access and penetration dimension of financial inclusion into a single indicator, on financial stability for 11 Latin American countries during the period 2004-2021, as expected. Furthermore, the financial inclusion index was replaced per each dimension separately. As anticipated, a significative positive effect of the usage and penetration dimension on financial stability was reported. The explanation for this result relies on the potential benefits that financial inclusion may bring to financial stability mentioned in the previous paragraph. Contrary to the expected outcome, an insignificant effect of the access dimension was observed. The latter result can be attributed to the fact that while the supply of financial services is a necessary condition to meet financial inclusion targets, it is possible that some agents have access to financial services without use them (World Bank, n.d.), which dissipates the transmission channel through which the benefits of financial inclusion impacts financial stability.

When adding an interaction term in the estimations that accounts for the variation in the effect of financial inclusion on financial stability in the presence of the global financial crisis an insignificant effect was found. Contrary to the expected outcome, this finding suggests that the effect of financial inclusion on financial stability does not vary during the global financial crisis. An explanation for this result could be that financial inclusion policies became more aggressive after this crisis. However, a lower effect of financial inclusion on financial stability is observed when the COVID-19 period is considered, as anticipated. This indicates that the rapid increase in loans resulting from financial inclusion policies may lead to losses for banks and lower interest margins, as vulnerable households could not meet their obligations during this unexpected shock.

Based on the results, policy insights were provided to increase financial inclusion while enhancing the stability of financial institutions. First, policymakers in Latin America should focus on designing financial products tailored to the needs of the population and financial education programs with the aim of increasing financial inclusion. Secondly, to guarantee a sustainable financial inclusion process, it is crucial to establish a regulatory framework for financial innovations to enhance financial stability. Financial innovations are rapidly growing and serve as a channel to increase financial inclusion with the digitalization of financial services. In addition, regulators should carefully review bank lending standards during credit booms to avoid a significant increase in losses for banks in crisis periods.

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7 Appendix

Appendix 1: Financial inclusion policies in Latin America

Country	Year	Examples of policy implementations for financial inclusion in Latin America
Argentina	2010	Universal Free Account: No costs associated to the account. It is available for any person (above 18 years old), who does not hold another account.
	2013	Lower transfer fees: The Central Bank of Argentina set limits on the fees to transfer funds.
Brazil	2013	Financial Education: "Programa Cidadania Financeira" was launched.
Chile	2006	CuentaRUT: Basic transactional account launched by BancoEstado (public bank). By the end of 2016, 46% of debit cards corresponded to CuentaRUT.
Colombia	2017	Financial Education: Colombia implemented a financial education program for school teachers.
Costa Rica	2019	The recipients of "Avancemos", a government transfer program, started to receive their payments via a debit card.
Ecuador	2016	National financial inclusion survey.
	2018	The regulatory framework for electronic payments platforms is published.
El Salvador	2016	National survey to assess the level of financial education in the country.
	2019	Creation of the National Council for Financial Inclusion and Education.
Mexico	2011	Creation of the National Council for Financial Inclusion to coordinate financial inclusion policies with the government.
	2018	Financial digital services: Law to regulate financial technology institutions.
Paraguay	2016	Financial education programs for recipients of "Tekopora", a government transfer program.
Peru	2014	Modelo Peru: Policy with the aim of expanding mobile banking and e-money.
	2015	Financial Education: Peru implemented a financial education program for school teachers.
Dominican Rep.	2014	Regulatory framework for microcredits.
	2015	Regulatory framework for financial consumer protection.
Uruguay	2014	Financial Inclusion Law: Incentives to non-cash payments (lower taxes when paying with debit cards, electronic money instruments, etc.).

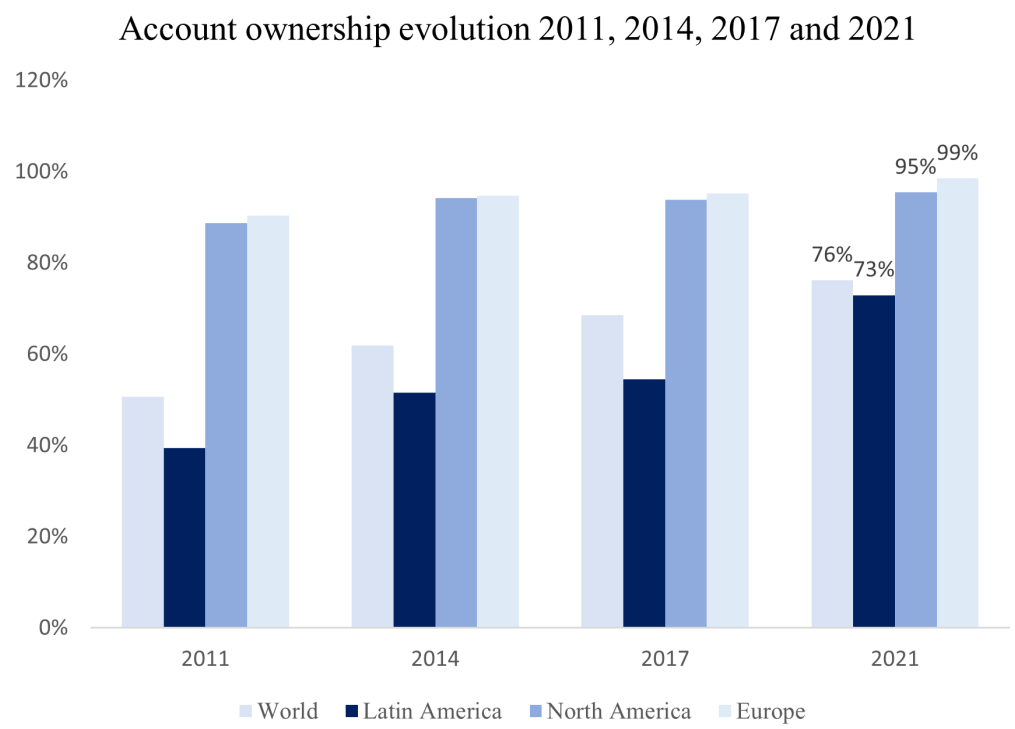
Source: Tuesta et al. (2015), BancoEstado (2017), Organization for Economic Cooperation and Development, 2020, Dabla-Norris et al. (2015) and AFI (2018)

Appendix 2: Implementation of national financial inclusion strategies in Latin America

Year of approval	Country
2012	Brazil
2013	Ecuador
2014	Paraguay
2014	Uruguay
2015	Peru
2016	Colombia
2016	Mexico
2019	Argentina
2019	Guatemala
2021	El Salvador
2022	Dominican Republic

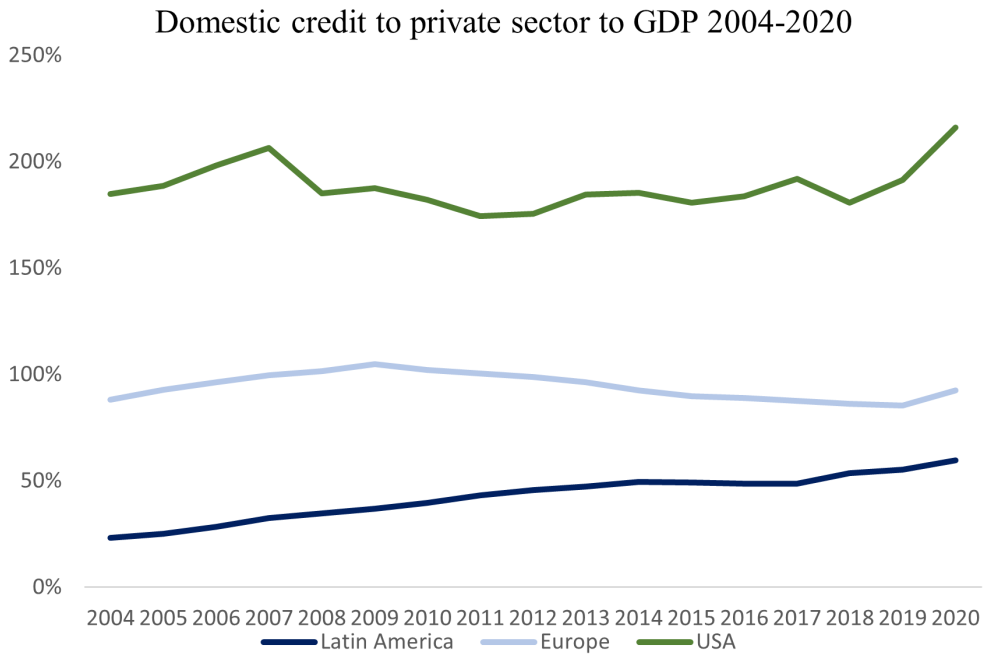
Source: Mexican National Council of Financial Inclusion (2020) and OECD (2020)

Appendix 3: Account Ownership Evolution



Source: Global Findex database

Appendix 4: Domestic Credit to Private Sector to GDP



Source: World Development Indicators - World Bank

Appendix 5: Financial Inclusion Measures

Study	Dimension	Indicators
GPFI (2022)	Usage	% of adults with an account at a formal financial institution.
	Usage	Number of depositors per 1,000 adults or number of deposits accounts per 1,000 adults.
	Usage	Number of borrowers per 1,000 adults or number of outstanding loans per 1,000 adults.
	Access	Number of branches per 100,000 adults.
	Quality	Financial knowledge score.
	Quality	Disclosure index.
	Quality	Index reflecting the existence of formal internal and external dispute resolution mechanisms.
	Quality	Average cost of opening a basic current account.
Sarma (2008)	Normalization index	Bank penetration: Number of people having a Bank account. Availability of banking services: Number of ATM/bank branches per 1,000 inhabitants. Usage: Credit and deposit volume as a % GDP.
Morgan and Pontines (2014)	Single indicators	SME outstandings loans as a proportion of total outstanding loans of commercial banks. Number of SME borrowers as a proportion of total borrowers from commercial banks.
Camara and Tuesta (2017)	PCA index	Usage: Account, savings and borrowing. Access: Bank branches, agents and ATMs. Barriers: Distance, trust, costs and documents.
Park and Mercado (2018)	PCA index	Access: % adult population with financial accounts and proportion of adults with credit and debit cards. Availability: Bank branches and ATMs per 100,000 adults. Usage: Share of adults who borrowed and saved from a formal institution and credit-to-GDP ratio.
Dienillah et al. (2018)	Normalization index	Penetration: Number of bank accounts per 1,000 adults. Availability: Number of bank branches per 100,000 adults. Usage: Outstanding loans as a % GDP and deposits as a % of GDP.
Yorulmaz (2018)	PCA index	Penetration: Number of branches, number of ATMs, deposit accounts per 1,000 adults and credit accounts per 1,000 adults. Usage: Deposit-income ratio, credit-income ratio, life insurance premium volume to GDP.
Ahamed and Mallick (2019)	PCA index	Access: Number of bank branches and ATMs per 100,000 inhabitants. Usage: Number of bank accounts per 1000 inhabitants.

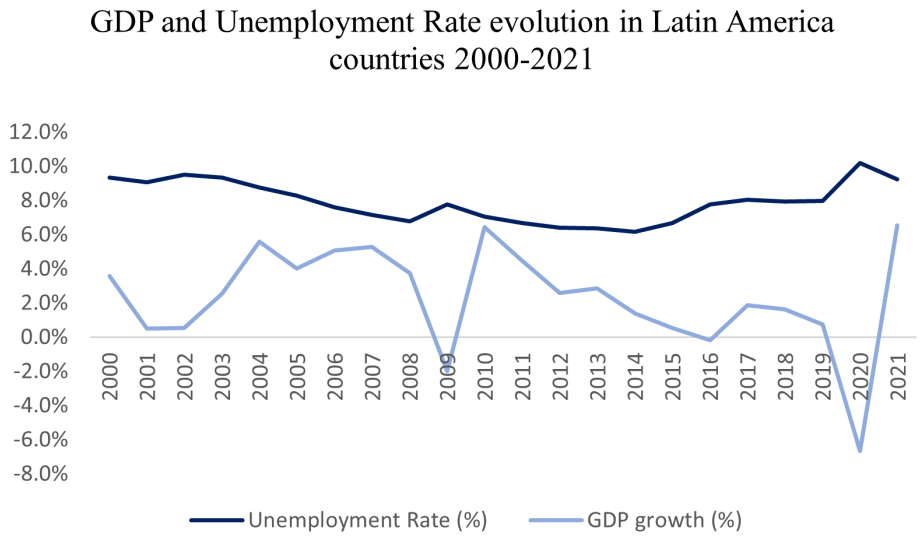
Study	Dimension	Indicators
Sha'ban et al. (2020)	PCA Index	Access: Number of bank branches and ATMSs per 100,000 adults. Outreach: number of depositors accounts and loans accounts per 1,000 adults. Usage: bank deposits and domestic credit to private sector by banks, scaled by GDP.
Zhang et al. (2022)	PCA index	Savings: Deposit accounts with commercial banks per 1,000 adults. Account ownership: ATM per 100,000 adults as a proxy of people who have an account. Penetration: Bank branches per 100,000 adults.

Appendix 6: Empirical Findings

Study	Data	Methodology	Findings
Han and Melecky (2013)	173 countries during the period 2006-2010	OLS estimation	Greater access to bank deposits enhanced the stability of deposits growth before and during the global financial crisis.
Ardic et al. (2013)	103 countries during the period 2004-2011	System-GMM panel estimator (country-level)	An increase of share of lending to SMEs in total banking positively affects bank stability (lower NPLs).
Morgan and Pontines (2014)	168 countries during the period 2005-2011	System-GMM panel estimator (country-level)	An increase of share of lending to SMEs in total banking positively affects bank stability (lower NPLs).
Sahay et al. (2015)	128 countries during the period 1980-2013	Generalized Methods of Moments (country-level)	The penetration dimension has a negative effect on bank stability, measured with the Z-Score.
Cihák et al. (2016)	103 countries during the period 2004-2011	Non-parametric analysis	Use of loans by individuals decreases bank liquidity buffers (financial stability proxy). However greater accounts, savings, payments and credits for individuals lower the volatility of deposit growth.
Dienillah et al. (2018)	Low-income countries during the period 2004-2014	Panel data fixed-effects (country-level)	A financial inclusion index built by the authors has a non-significant effect on financial stability. The authors used an aggregate indicator for financial stability.
Ahamed and Mallick (2019)	2,600 banks in 86 economies during the period 2004-2012	OLS estimator (bank-level)	A financial inclusion index built by the authors, financial access dimension and usage dimension have a positive effect on Bank Z-Score and the negative value of returns volatility.
Olusegun et al. (2021)	Nigeria during the period 2014Q1-2018-Q4	Panel data	The penetration (number of deposit accounts and loan accounts per 1,000 adults) and availability dimension (number of bank branches) have a positive impact on the Z-Score at a bank-level. However, a negative effect of the usage dimension (credits, deposits and electronic payments to GDP) on financial stability was observed.
Banna and Alam (2021)	574 banks in emerging Asian countries during the period 2011-2018	Panel data fixed-effects (bank-level)	The financial outreach dimension (number of ATMs and mobile agent outlets per 100,000 adults and per 1000 km2) has a positive effect on bank stability measured with the Bank Z-Score and Sharpe ratio.

Study	Data	Methodology	Findings
Duc. Hog et al. (2021)	3071 banks in emerging Asia countries during the period 2008-2017	Generalized Methods of Moments (bank-level)	The financial inclusion index (PCA methodology) positively impacts financial stability (bank Z-Score). They argued that financial inclusion generates more substantial savings that banks can use to finance their lending activity and increase their operational revenues.
Abir and Ishaq (2021)	Countries in North Africa during the period 2004-2006	Panel data random effects model	Positive relationship between the Z-Score (financial stability) and the loan volume (financial inclusion).
Zhang et al. (2022)	OECD economies during the period 2004-2017	Panel data fixed-effects (country-level)	A financial inclusion index built by the authors has a negative effect on NPLs (measure of bank stability).

Appendix 7: GDP and Unemployment Rate Evolution



Source: World Development Indicators - World Bank

Appendix 8: Descriptive Statistics – Financial Stability Measures

Bank Z-Score					
Country	Mean	Std. Dev.	Min.	Max.	Skewness
Argentina	7.40	1.19	4.84	9.32	-0.11
Brazil	16.28	1.17	14.53	18.55	0.12
Chile	8.67	0.85	6.65	9.80	-0.93
Colombia	5.60	0.66	4.32	6.47	-0.48
Costa Rica	19.77	1.18	17.44	21.50	-0.50
Dominican Republic	33.01	1.98	30.65	38.15	1.14
Ecuador	10.55	0.58	9.30	11.42	-0.66
Peru	17.08	1.44	14.66	20.30	0.55
Paraguay	16.18	1.12	14.54	18.72	0.71
Uruguay	6.11	1.03	4.12	7.86	-0.01
El Salvador	22.66	2.77	19.02	28.54	0.73

NPL-ratio					
Country	Mean	Std. Dev.	Min.	Max.	Skewness
Argentina	3.28	2.29	1.40	10.70	2.40
Brazil	3.24	0.45	2.24	4.20	0.06
Chile	1.76	0.65	0.70	2.90	-0.19
Colombia	3.36	0.72	2.50	4.80	0.68
Costa Rica	1.80	0.35	1.20	2.43	0.27
Dominican Republic	3.22	1.69	1.54	7.30	1.07
Ecuador	3.90	0.90	2.95	6.40	1.81
Peru	3.99	1.71	2.20	9.50	2.37
Paraguay	2.95	2.35	1.10	10.80	2.77
Uruguay	2.34	1.34	1.00	5.60	1.30
El Salvador	2.41	0.71	1.57	3.90	1.10

Source: Author's calculation based on the GFDD

Appendix 9: Descriptive Statistics – Financial Inclusion Measures

Number of ATMs per 100,00 adults				
Country	Mean	Std. Dev.	Min.	Max.
Argentina	31.69	22.65	1.87	62.45
Brazil	110.78	6.09	96.56	118.44
Colombia	37.07	5.97	25.31	42.43
Costa Rica	52.83	17.45	25.47	78.80
Dominican Republic	31.76	6.39	19.27	40.73
Ecuador	27.92	12.80	8.06	44.67
Peru	58.69	46.45	10.61	126.71
Paraguay	23.38	4.91	12.82	29.91
Uruguay	87.25	81.24	27.82	261.91
El Salvador	30.71	5.32	20.45	37.24

Number of bank accounts per 100,00 adults				
Country	Mean	Std. Dev.	Min.	Max.
Argentina	841.21	273.88	477.33	1357.19
Brazil	550.51	98.97	380.15	665.09
Colombia	1365.08	243.19	1036.72	1803.51
Costa Rica	1048.90	234.53	642.40	1456.13
Dominican Republic	738.02	81.37	583.53	873.51
Ecuador	599.11	194.84	339.57	944.31
Peru	596.52	275.10	234.62	1099.82
Paraguay	228.61	171.55	53.35	561.25
Uruguay	730.35	249.19	339.49	1101.77
El Salvador	769.04	182.72	424.31	1058.01

Volume of deposits to GDP				
Country	Mean	Std. Dev.	Min.	Max.
Argentina	19.74	1.58	17.05	21.90
Brazil	58.20	8.28	46.93	76.01
Colombia	21.73	4.47	14.89	31.01
Costa Rica	26.23	5.09	21.03	41.08
Dominican Republic	21.33	3.52	17.20	30.41
Ecuador	29.87	8.16	20.11	48.33
Peru	33.34	7.03	21.72	46.67
Paraguay	21.92	8.45	12.19	8.45
Uruguay	42.12	5.38	35.22	54.91
El Salvador	49.48	4.99	44.51	64.82

Source: Author's calculation based on the GFDD

Appendix 10: Correlations - Financial Inclusion measures

Country	Access and availability	Access and usage	Availability and usage
Argentina	0.97	0.25	0.14
Brazil	0.23	0.56	-0.67
Colombia	0.77	0.76	0.74
Costa Rica	0.77	0.76	0.55
Dominican Republic	0.79	0.25	0.78
Ecuador	0.36	0.96	-0.17
Peru	0.95	0.95	0.86
Paraguay	0.81	0.92	0.76
Uruguay	0.81	0.65	0.68
El Salvador	0.60	-0.26	0.31

Source: Author's calculation based on the GFDD

Appendix 11: Ranking of countries based on financial inclusion measures

Country	Penetration	Usage	Access	Fin. Inclusion Index
Argentina	0.40	0.07	0.28	0.36
Brazil	0.21	0.71	0.44	0.67
Chile	1.00	1.00*	0.21	0.61*
Colombia	0.46	0.35	0.20	0.44
Costa Rica	0.45	0.45	0.33	0.57
Dominican Rep.	0.19	0.20	0.18	0.23
Ecuador**	0.26	0.34	0.15	0.31
Peru	0.34	0.40	0.39	0.55
Paraguay	0.17	0.37	0.11	0.25
El Salvador	0.21	0.52	0.14	0.35
Uruguay	0.31	0.34	1.00	1.00

*Information available: 2020.
*Information available: 2019.
Source: Author's calculation based on the GFDD

Appendix 16: Correlation between the financial inclusion index and the percentage of adults with a bank account obtained from the Global Findex database (World Bank)

Country	Correlation
Argentina	0.91
Brazil	0.46
Chile	0.98
Colombia	0.89
Costa Rica	0.96
Dominican Republic	0.86
Ecuador	1.00
Peru	0.97
Paraguay	0.98
El Salvador	0.78
Uruguay	0.80

Source: Own elaboration based on the GFDD and the GLobal Findex databse

Appendix 13: Governance Index – PCA Results

Variable	PC1	PC2	Normalized weights
Regulatory Quality	0.7071	0.7071	0.58
Government effectiveness	0.7071	-0.7071	0.42
Eigenvalues	1.7294	0.2706	

Source: Own elaboration based on the World Governance Indicators database

Appendix 14: Sources - Data Collection

Code	Variable	Category	Description	Source(1)
GFDD.AI.01	Bank accounts per 1,000 adults	Financial Inclusion	Number of bank accounts (commercial banks) per 1,000 adults.	Financial Access Survey - IMF
GFDD.AI.25	ATMs per 100,000 adults		Number of ATMs per 100,000 adults.	Financial Access Survey - IMF
GFDD.AI.02	Bank branches per 100,000 adults		Number of bank branches per 100,000 adults.	Financial Access Survey - IMF
GFDD.OI.02	Banks deposits to GDP (%)		The total value of demand, time and saving deposits at commercial banks or other financial institutions that accept transferable deposits as a share of GDP.	International Financial Statistics - IMF
GFDD.DI.14	Domestic credit to private sector to GDP (%)		Financial resources provided to the private sector.	International Financial Statistics - IMF
GFDD.SI.01	Bank Z-Score	Financial Stability	It captures the probability of default of a country's commercial banking system.	Bankscope (2000-14) and Orbis (2015-21), Bureau van Dijk (BvD)
GFDD.SI.02	Bank non-performing loans to gross loans (%)		Ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio).	Financial Soundness Indicators Database - IMF
GFDD.SI.06	Liquid assets to deposits and short-term funding (%)	Control variables	This ratio represents the value of liquid assets (easily converted to cash) to short-term funding plus total deposits.	Bankscope (2000-14) and Orbis (2015-20), Bureau van Dijk (BvD)
NY.GDP.MK	real GDP (Ln)		GDP expressed in constant 2015 prices in US dollars.	World Development Indicators - World Bank
FP.CPI.TOTL	Inflation (%)		Inflation measured as the consumer price index.	World Development Indicators - World Bank
NE.EXP.GFS.KD and NE.IMP.GNFS.KD	External balance (%)		Exports of goods and services (constant 2015 US$) minus imports of goods and services (constant 2015 US$) .	World Development Indicators - World Bank

Code	Variable	Category	Description	Source(1)
-	Policy interest rate	Control variables	Policy interest rate set by central banks in each country in December of each year.	Central banks' website of each country
-	Regulatory Quality (0-100) and Government effectiveness		Regulatory Quality: This indicator captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Government effectivenes: This indicator captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	Worldwide Governance Indicators

(1) The World Bank compiled information from these sources and included it in the World Development Database (financial inclusion and stability variables).
Source: GFDD, World Bank Development Indicators and Worldwide Governance Indicators and Central banks's website.

Appendix 15: Hausman Test Results

Hausman Test	
chi2(11)	60.11
p-value	0.00

Appendix 16: Fixed Effects Model

Fixed effects model	
Variable	Ln(Z-score)
Financial Inclusion Index	2.95***
	[0.68]
lnGDP	-0.26***
	[0.07]
Liquidity (liq)	-0.01
	[0.01]
Inflation (inf)	-0.10***
	[0.04]
External balance (ext_balance)	-0.86
	[1.04]
Monetary policy (policy_ir)	0.02
	[0.04]
Governance	-0.03***
	[0.01]
Constant	11.10***
	[1.95]
Observations	118
Countries	11
R-squared	0.19
Clustered standard errors	Yes

Appendix 17: Account Ownership - Latin America 2021

Country	Account ownership (%)
Chile	87.1%
Brazil	84.0%
Uruguay	74.1%
Jamaica	73.3%
Argentina	71.6%
Bolivia	68.9%
Costa Rica	68.5%
Ecuador	64.2%
Colombia	59.7%
Peru	57.5%
Paraguay	54.4%
Dominican Republic	51.3%
Panama	45.0%
El Salvador	35.8%
Nicaragua	26.0%

Source: Global Findex 2021