Macroprudential implications of sustainable guidelines and regulations in the banking sector

(Draft)

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1 Introduction

Financial stability is a necessary condition that economies should maintain to pursue economic development (Schinasi, 2004). A stable financial sector helps an economy grow, absorb adverse economic shocks, and reduce economic and social impacts (Allen, 2011; Jiang et al., 2019). However, recently, financial regulators and academic studies have emphasized the impact of sustainability related concerns, such as climate change, on financial stability (Carney, 2015; Dafermos et al., 2018). Consequently, managing climate related impacts on financial stability through financial sector sustainability regulations and guidelines (FSSRG) might have a positive impact on financial stability.

Research on the impact of FSSRGs on firms' financial performance and financial stability is relatively recent. Current academic literature addresses China's Green Credit Policy (Cui et al., 2018; Zhang et al., 2011). Also, Bangladesh is occasionally studied after introducing the Environmental Risk Management (ERM) guideline (Weber & Chowdury, 2020). Furthermore, other studies address the impact of voluntary codes of conduct in the financial sector, such as the Equator Principles or the UNEP Financial Initiative. For instance, Scholtens and Dam (2007) did not find any differences in the financial performance of Equator Principles banks and other banks.

Some of the benefits of FSSRG might provide benefits such as risk reduction (Weber, 2017) and higher performance of the financial industry (Dam & Scholtens, 2015; Monasterolo & Raberto, 2018). Consequently, an increasing number of financial regulators have been introducing FSSRG (Zadek & Robins, 2016) that should address both, financial industry sustainability impacts and financial stability (Weber, 2017; Weber & Feltmate, 2016), which has led towards benefits in terms of social, economic, and environmental impacts (Weber, 2017) whether the assumptions that FSSRG have a positive effect on the financial sector's stability is still an open question that will be addressed in this study.

However, research that covers the impact of FSSRG in the Latin American region is scarce. Between 2008 and 2018, six countries in Latin America, Brazil, Colombia, Ecuador, Mexico, Panama, and Peru, incorporated FSSRG in their financial systems. These policies helped banks adopt sustainable practices in their organizational culture and business practices (Oyegunle & Weber, 2015; Weber & Oni, 2015). What is this open, however, is how FSSRG influence the financial stability in the region?

Consequently, this research paper aims to understand the macroprudential implications of FSSRGs. Based on financial stability and systemic risk theory (Acharya, 2009; Benoit et al., 2017). The research question is whether FSSRG have a positive impact on the financial stability on countries in Latin America.

The study analyzed FSSRG in Latin America, including data from 149 banks. We used a dynamic panel data analysis to compare the stability of banks operating in countries with and without FSSRGs and guidelines between 2008 and 2018.

We found that FSSRGs have a positive and significant impact on the financial stability of banks in Latin America. We conclude that banks that operate in countries with FSSRG have a higher level of corporate sustainability practices (Weber, 2017), reduce financial risk from activities with the potential to detriment the environment and society (Cui et al., 2018).

The study results build on existing research regarding the importance of climate mitigation policies in the banking sector (Battiston et al., 2017) and financial stability through FSSRGs (Weber, 2017; Zadek & Robins, 2016), and provides several contributions to the academic literature. First, this study provides a better understanding of the financial implications of FSSRG. Second, these results contribute to the knowledge about the impact of FSSRG in Latin America. Third, this study broadens the theory on financial stability and systemic risk (Acharya, 2009; Benoit et al., 2017) by adding FSSRGs as an additional factor, which can develop into an empirical foundation to build a theoretical framework connecting financial stability and sustainability, following previous theories on financial stability.

The remainder of this paper is structured as follows: Section 2 consists of a review of the literature on sustainable finance, financial stability, financial regulations, and their linkage. The methodology and methods used to analyze the data will be explained in Section 3, followed by the results section in Section 4. Finally, Section 5 presents a discussion of those results and Section 6, the concluding remarks of the study, followed by the study's bibliography.

2 Background

The following sections describe the academic literature on financial stability, sustainable finance, sustainable finance effects on banking risk and financial stability, and sustainable and traditional regulations in the financial sector as macroprudential policies. A rationale for FSSRGs as an evident and necessary macroprudential policy is presented. We explain the increasing challenges of sustainability-related financial risks and the potential for sustainable finance to diminish this systemic risk. Additionally, we introduce the main theories that explain systemic risk sources and the primary regulations and guidelines to avoid financial instability. Finally, we present the central hypothesis of this research paper based on the identified literature gap.

2.1 Sustainability and Financial Stability

Literature linking sustainability and financial stability is relatively new (Battiston et al., 2017; Cui et al., 2018; Ryszanka, 2016). Failure to address sustainability risks, such as climate change, can materialize into external shocks and systemic risk (Ryszanka, 2016). Therefore, markets' timing and ability to respond to external environmental and societal shocks are crucial to preserving financial stability (Battiston et al., 2017). Hence, FSSRG might help to decrease the exposure to sustainability risks.

Other studies have shown the detrimental implications on the financial system that arise from climate risk (Dietz et al., 2016; Klomp, 2014; Scott et al., 2017; Skidmore, 2001) as well as the systemic risk that it carries (Campiglio et al., 2018; Dietz et al., 2016; Rozenberg et al., 2013). The size and scope of climate-related catastrophes, the development level of the financial markets, and acerbity of financial regulations play a crucial role when determining the impacts of a natural disaster on a

country's financial system (Klomp, 2014). Climate change and social-political responses also create a detrimental effect on the financial sector through transitional and physical risks (Scott et al., 2017). Such risks include a substantial threat to the liquidity (Klomp, 2014), asset value (Dietz et al., 2016), the rate of non-performing loans, the portfolio allocation, economic activity, and, consequentially, the financial system and systemic stability. Households are potentially affected because of the exposure of pension funds and pension schemes to climate risk (Monasterolo et al., 2017).

Additionally, there is a positive correlation between household savings rates and damages caused by natural disasters (Skidmore, 2001). Because of an increase in their frequency caused by climate change, natural disasters decrease financial stability, and the efficiency of economic policies that do not consider sustainability risks is small if climate related damages influence the economy (Dafermos et al., 2018). However, considering sustainability risks through socially responsible investment might help funds to manage these risks (Nofsinger & Varma, 2014).

With the increase of climate related risks, carbon externalities should be considered to assess and manage the financial stability (Rozenberg et al., 2013). Thus, societies need to avoid excessive economic losses and keep their financial system stable (Campiglio et al., 2018) while shifting to a low-carbon economy or face the irreversible economic consequences of climate change and natural disasters (Dietz et al., 2016). Hence, financial regulators and supervisors can create incentives for the financial sector to reduce the climate exposure of their portfolio through the reduction of their exposure to high emitting industries (Monasterolo et al., 2017).

2.2 Sustainable Finance

Sustainable practices in financial institutions address risks and opportunities arising from (un(sustainable development for the financial industry as well as positive and negative impacts of the financial sector on sustainable development (Dam & Scholtens, 2015; Weber & Feltmate, 2016). Sustainable finance practices to manage risks for the industry are sustainable credit risk management (Weber et al., 2010), and reducing the climate exposure of lending portfolios (Weber et al., 2010). Sustainability related opportunities might be socially responsible investment products (Scholtens et al., 2008). Positive sustainability impacts of the financial industry might occur through issuing green bonds (Reichelt, 2010) and impact investing (Jackson, 2013). Negative impact might arise by financing unsustainable projects, such as coal power plants (Sarro, 2012).

Simulations show that green public policies can promote green growth by influencing firms' expectations and the credit market. Green sovereign bonds represent a short-term win-win solution, while green fiscal measures have higher immediate distributive effects that induce negative feedback on the economy (Monasterolo & Raberto, 2018). Therefore, financial institutions and central banks must contemplate and account for environmental risks. Research suggests that modern finance is transitioning towards sustainability due to external shocks, such as climate change, water insecurity, low carbon markets, and new financial products and incentives (Ryszanka, 2016; Weber, 2005). Furthermore, financial institutions' disclosure of sustainable measures and practices is critical (Weber, 2012). However, it is essential to increase transparency and to standardize indicators as well as

reporting (ElAlfy et al., 2020). To support these goals, institutional activities that support guidelines and regulations might help.

2.3 Banking Regulations and Financial Stability

Policymakers mainly use regulations in the financial sector to guarantee the industry's financial stability through adjusted financial capital provision and financial risk supervision (Acharya, 2009). Studies recommend creating incentives for the banking sector, such as prudential regulations and supervision, to develop institutional bank stability (Anginer & Demirguc-Kunt, 2014). Prudential regulations and supervision have been resulting in higher quality loans and lower moral hazard (Shehzad & De Haan, 2015), as well as limiting the engagement of banks in non-interest income activities (Bermpei et al., 2018) and systemic risk (Acharya et al., 2017). However, other studies have shown concern towards financial institutions being too big to fail. The 2007-2009 subprime crisis demonstrated the risk these financial institutions represent. Their expectations of being partially restored by monetary authorities in case of a crisis (Tabak et al., 2013) compromises the stability of the global financial system.

Regulations that incorporate capital requirements and supervisory power reduce non-performing loans and credit risk (Agoraki et al., 2011), and financial institutions tend to be cautious of possible financial implications and financial uncertainties from financial regulations (Dam & Scholtens, 2015). These findings and the change of behaviours in the industry have increased financial regulations (Barth et al., 2013).

Furthermore, regulatory effectiveness correlates with a country's institutional quality. Regulations in countries with weak institutions are associated with higher corruption in the lending process with no similar beneficial effects on stability (Barth et al., 2013). Also, regulations alone have no control over financial crises; policymakers must consider other mechanisms, and preventive measures should be considered at the institutional level (F. Allen & Gu, 2018). Hence, political stability is essential to increase the benefits of capital regulations and activities restrictions over the bank's stability and developing economies would benefit from capital regulation and special monitoring in terms of bank stability (Bermpei et al., 2018).

Until recently, financial supervision and regulation did not include any non-financial sustainability considerations. This changed, however, with the rise of climate related financial impacts on the financial sector (Campiglio et al., 2018), and with the introduction of green finance and sustainable finance (Weber & Feltmate, 2016).

2.4 Financial Stability and FSSRGs

The amount of existing literature that evaluates climate change and other sustainability issues repercussions on financial stability is scarce since most of it is based on direct effects on banks and other financial institutions (Cui et al., 2018; Dam & Scholtens, 2015; Weber, 2017; Weber et al., 2015). It suggested, however, that it is imperative to adopt the necessary measures to protect the financial stability on the background of climate change and other environmental and societal risks the financial industry is exposed to (Battiston et al., 2017).

Regulatory standards also play an essential part in the application of sustainable practices in financial markets. Nowadays, financial markets are vigilant of the uncertain financial implications that result from environmental regulatory interventions as the demands for stricter environmental regulations increase (Bauer & Hann, 2012). Central Banks and governments implement FSSRGs in the hope that these policies increase the financial stability, foster green economic development, and enhance both, the financial and environmental performance of the financial industry (Weber, 2017). Policies such as green credit policies can increase the financial industry's corporate sustainability and create a more stable and profitable financial sector (Weber, 2017). For instance, several countries, such as China, Brazil, and Bangladesh, have adopted FSSSRG to reduce the carbon exposure of the financial industry (Zadek & Robins, 2016). Some academic studies have already analyzed the effect of FSSRG.

Studies on the Environmental Risk Management (ERM) Guidelines in Bangladesh suggest that the integrations of sustainability criteria in credit risk assessment helps lenders to better predict credit risks (Weber et al., 2015), and that banks that perform better with regard to corporate sustainability also have a better financial performance (Weber & Chowdury, 2020).

China's Green Credit Policy in China addresses both environmental and financial performance, creating institutional pressure on the Chinese Financial system (Cui et al., 2018). The starting year of the Green Credit Policy was 2007. The State Environmental Protection Administration (SEPA), the People's Bank of China (PBOC), and the China Banking Regulatory Commission (CBRC) published a joint policy on implementing FSSRG and managing credit risks (Aizawa & Yang, 2010) (Aizawa & Chaofei, 2010; China

Banking Regulatory Commission, 2012). Consequently, banks had to allocate more investment towards green industries as well as constrain investments in polluting industries. The regulation is mandatory for all Chinese banks regardless of ownership structure and thus cover government owned banks, joint-stock banks, and credit unions (China Banking Regulatory Commission, 2012).

To support the transformation to a greener economy Chinese banks introduced environmental policies, strategies, and assessment systems to evaluate credit clients (Chan-Fishel, 2007). Subsequently, additional guidelines were put in place to support the development of the Green Credit Policy. In 2009, the China Banking Association issued guidelines on corporate social responsibility, asking banks to take on environmental responsibility in supporting national industrial policies and environmental policies. The CBRC issued a formal document entitled the Green Credit Guideline in 2012. The guideline encouraged "banking institutions to, by focusing on green credit, actively adjust credit structures, effectively fend off environmental and social risks, better serve the real economy, and boost the transformation of an economic growth mode and adjustment of economic structures" (China Banking Regulatory Commission, 2012, p. 1).

By the end of 2015, China's financial institutions provided a total of $1.24 trillion in green credit. Furthermore, it was announced that the NPS of green loans was lower than the average of all loans (China Banking Regulatory Commission, 2016). Hence, it seems that the policy achieved its goal to increase both environmental performance and financial stability (Chih, Chih, & Chen, 2010).

Overall, research found that Banks in countries with FSSRG engage in more corporate social responsibility (CSR) activities and self-regulation (Chih et al., 2010). The relevant politics of green

finance can ease the financing bottleneck that the government faces to some degree combined with reform and innovative financial tools. The policies include two aspects: first, the reform and innovation of existing financial tools, an exploration of the type of fiscal policy and the feasible way to raise money for green finance development; second, the reform of existing fiscal revenue management and distribution policy, namely the efficiency and direction in the use of monetary funds (Wang & Zhi, 2016).

During the last 20 years, Latin America has seen notable socio-economic improvement. During this period, several countries in the region exhibited a degree of macroeconomic stability, probably never seen since their independence (Bittencourt, 2012). Indeed, 16 Latin American countries have managed to sustain one-digit inflation rates with stable growth rates in the established study period (2008-2018). Also, some Latin American countries started building a sustainable legal framework (Oyegunle and Weber, 2015), including environmental and social risk management practices, project finance, and other aspects regarding sustainability in the financial sector (see Table 2.1). Though South American countries have introduced FSSRG (see Appendix 1 for a more detailed description of the regulations and guidelines), there is no research on the effect of these policies in the financial stability. This paper addresses this gap.

Table 2.1: Financial Sector FSSRG in Latin America

Country	Key Policies	Policy Aim	Date Established
Brazil	Protocolo Verde	Sustainable Finance Practices	1995
	Regulation N° 3,545	Protection of the Amazon Biome	2008
	Regulation N° 3,813	Sugarcane investment	2009
	Regulation N° 3,876	Slave labour	2010

	Regulation N° 3,547	Good practices that mitigate environmental and social risks	2011
	Regulation N° 4,327	Social and Environmental Responsibility for financial institutions	2014
	Regulation N° 4,557	Social and Environmental Responsibility for financial institutions	2017
Colombia	Protocolo Verde	Green Finance	2012
Ecuador	Protocolo de Banca Sustentable.	Green Finance	2016
Mexico	Protocolo de Sustentabilidad de la Banca	Sustainable Banking Requirements	2016
	Green Bonds Principles	Green Finance	2018
Panama	Protocolo de Finanzas Sustentables de Panamá	Green Finance	2018
Peru	Resolution N° 1928-2015	Regulation for Social and Environmental Risk Management	2015
	Document SBS N° 01-2015	Enhanced due diligence in the regulation of socioenvironmental risk management for financial firms	2015
	Guía de Bonos Verdes para el Perú.	Green Bonds Guidelines	2018

2.5 Theoretical Framework

Two theories stand out in the literature that attempt to explain systemic risk and the implications of economic policies on a country's financial stability. First, the theory of systemic risk and design of prudential bank regulation describes systemic risk and the importance of a regulatory body to create policies that avoid systemic risk. This theory, introduced by Acharya (2009), "incorporates the likelihood of default by banks on deposits, financial externalities from the failure of one bank on other banks, regulatory incentives, and the interaction of these features" (pp. 228). The theory includes a normative and a systemic feature. The positive component of the theory defines systemic risks and its

equilibrium. Meanwhile, the normative component designs regulations to alleviate inefficient systemic risk (Acharya, 2009).

The theory, within its positive feature, models the concept of systemic risk-shifting, the choice of correlation across assets between different banks given the existence of limited liability and a negative externality of default by banks (Acharya, 2009; Acharya et al., 2017; Jensen & Meckling, 1976; Stiglitz & Weiss, 1981). In other words, banks decide to invest in the same assets to reduce the effects of negative externalities (Benoit et al., 2017). The firms' lack of liability nullifies the limits of correlation that banks would compromise as they prefer to survive with the crisis, as they benefit from this correlation thanks to bailouts (Farhi & Tirole, 2012). Furthermore, the theory explains specific regulations that should be avoided (Farhi & Tirole, 2012). It describes a regulatory framework that includes a bank closure policy and capital requirements to reduce the chances of a massive bank bailout scenario (Acharya, 2009), liquidity requirement or, equivalently, of a cap on short-term debt (Farhi & Tirole, 2012). Integrating FSSRG into the regulatory framework should increase the quality of risk supervision if the FSSRG are addressing material risks for the financial sector.

An important source of systematic risk is the tail risk, which has increased as a source of risk capable of creating contagion and amplification effects since the introduction of new capital requirements of Basel III (Benoit et al., 2017). These capital requirements create incentives for banks to substitute reasonable risk with tail risk, which is not considered in the regulatory framework. The increase towards tail risk provides lower financial institutions losses in the short term, but the adverse effects are significant in a financial crisis scenario. Studies show that banks' inclination towards tail risk

instead of regular risk diminishes the benefits of capital requirements during periods of economic instability (Perotti et al., 2011). Also, there is a significant influence from securitization activities on tail risk. These activities increase exposure to tail risks through contracts between intermediaries that would improve welfare. The significant amount of contracts that securitization facilitates makes the banking system fragile during economic crises (Gennaioli et al., 2013).

3 Research Objective and Questions

Though several studies have shown the effects of regulations on financial stability, and other studies have shown the effect of FSSRG on the credit risk, studies that analyze the effect of FSSRG on the financial stability do not exist yet. Therefore, the objective of this study is to understand the connection between FSSRG and the financial stability of the financial sector. Consequently, our research question analyses whether FSSRG have a positive effect on the financial stability of the financial sector.

4 Methods and Data

The following section explains the data and the methods of the study. methods used in this study, including data manipulation and quantitative analysis.

To evaluate the relationship between financial stability and FSSRGs we applied a dynamic panel data analysis using a two-step generalized method of moments.

4.1 Data

The sample data for this study consists of an unbalanced panel data of 149 banks from a comprehensive international data set from 18 countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, Puerto Rico, Uruguay, and Venezuela between 2008 and 2018. There were three main criteria to choose the countries for the samples. First, the countries must be in Latin America and the Caribbean; Second, the countries must belong within the highest 20 countries regarding GDP per capita in 2018; and third, these countries bank's data must be accessible financial data. Therefore, this study uses 1240 cross-sectional segments (see Table 3.1).

Table 3.1: Data Coverage

Row Labels	Number of Banks	Number of Observations
Argentina	12	102
Bolivia	10	68
Brazil	10	100
Chile	10	101
Colombia	10	85
Costa Rica	10	102
Dominican Republic	10	59
Ecuador	4	32
Guatemala	9	37

Honduras	10	61
Mexico	9	99
Panama	10	102
Paraguay	10	82
Peru	10	109
Puerto Rico	2	19
Uruguay	7	34
Venezuela	6	48
Grand Total	149	1240

The bank-level variables' data collection consisted of a mixture of manual compilation from the bank's annual report and consolidated financial statements, mainly the Balance Sheet and Income Statements. The bank-level variables gathered were total assets, total liabilities, total loans, and total income after taxes. Additionally, the data analysis process includes financial and macroeconomic variables as control variables. These indicators are the Gross Domestic Product (GDP) and Inflation (using the GDP deflator), which were obtained through the International Monetary Fund (IMF) database.

Additional calculations, such as the Z-scores, the return of assets (ROA), the equity-to-assets ratio, and the loan loss provision to total loan ratio have been conducted. We used the latter because

Bermpei et al. (2018) found that the loan loss provision to total loan ratio has a significant effect on bank stability.

To assess the level of financial stability for each bank each year, we use the Z-score. This indicator is prevalent in empirical studies to determine the level of a banks' financial stability (Beck et al., 2007; Bermpei et al., 2018; Boyd & Runkle, 1993; Čihák & Hesse, 2010; Demirgüç-Kunt et al., 2008; Laeven & Levine, 2009). It represents the value that measures the solvency risk of a bank by relating its capital level to the variability in its returns, or "the number of standard deviations that a bank's return on assets has to fall for the bank to become insolvent (Anginer & Demirguc-Kunt, 2014, pp.628) . Hence, Z-score is defined as:

$$Z_{it} = \frac{ROA_{it} + EA_{it}}{\sigma ROA_{it}}$$

Where, Z_{it} stands for the Zscore of the bank i in the year t, ROA_{it} stands for the return of assets of the bank i in the year t; represents the equity-to-assets ratio of the bank i in year t, and σROA_{it} year t.

The ROA_{it} is calculated by dividing the net income of a bank by its total assets after taxes. Furthermore, EA_{it} consists of the ratio obtained when dividing a bank's total shareholder equity by its total assets. Finally, to calculate σROA_{it} while avoiding disturbances or bias given by the time-frame used, this study will use three-year rolling time windows following the methodology by (Bermpei et al., 2018).

This study uses a categorical dichotomic variable to compare banks that operate in countries with and without FSSRG. The values for these variables are either 1 or 0, depending on the existence of FSSRG. We gathered the data regarding the existence of FSSRG in each country by reviewing the 2018 Sustainable Banking Network (SBN) Global Progress Report (World Bank, 2018). Additionally, we looked through the existing FSSRG of the countries used in the sample that did not appear in the SBN's report were to cover any outdated information form the SBN's report.

Several control variables are used further in the research to control exogenous effects that could affect the dependent variable. All the control variables are continuous variables that represent ratios of either financial or macroeconomic data.

The bank-level control variables used in this research are the equity to asset ratio, total asset growth, capital to asset ratio, Return on Assets (ROA), loan loss provision to loan loss ratio. The equity to asset ratio is measured by the ratio of the total equity to total assets, and it represents the bank's capitalization, which is expected to have a neutralizing effect on the bank risk-capital regulation nexus (Acharya et al., 2017; Delis et al., 2012). The total asset growth is used to control for bank growth and its connection to higher risk (Bermpei et al., 2018; Demirgüç-Kunt & Huizinga, 2010), measured by subtracting a bank's total assets from the value of the previous year. Loan loss provision to total loss ratio is be used as a proxy of the bank's loans, calculated by the ratio of the bank's loan-loss provision to the total loans.

The macroeconomic control variables are the growth of the gross domestic product (GDP growth) and the inflation rate. GDP growth will cover the effect of economic conditions, calculated by

subtracting the gross domestic product of a country in a specific year with the value of that variable the previous year and finally divided by the GDP of the previous year. The inflation rate embodies a proxy for monetary conditions, using the GDP deflator. The values for these indicators were collected from the database of the IMF (IMF, 2020).

This research paper uses a dynamic panel data analysis to study the influence of FSSRG on the countries' systemic financial stability in the region. The main difference between a regular panel data analysis and a dynamic panel analysis is the inclusion of a lagged dependent variable as an independent variable. One of the most reliable methods to estimate parameters for a dynamic panel analysis is the Generalized Method of Moments (GMM). A GMM method consists of a parametric method for estimating parameters in statistical panel data. The model proposed to estimate this relationship is:

$$ZScore_{i,t} = \alpha_{i,t} + \beta_1 Zscore_{i,t-1} + \beta_2 g_{i,t} + \beta_3 X_{j,t} + \beta_4 B_{i,t} + \beta_5 SFR_{j,t} + \varepsilon_{i,t} \quad (3.11)$$

Where, $Zscore_{i,t}$ is the the bank's financial stability measure for the bank i and year t; $\alpha_{i,t}$ is the constant value for the bank i and year t; $Zscore_{i,t-1}$ is the bank's financial stability measure lagged for one year for the bank i and year t; $X_{j,t}$ is the macroeconomic control vector for the country j and year t; $B_{i,t}$ is the vector of bank-specific control variables for the bank i and year t; $SFR_{j,t}$ is the categorical variable for banks in a country with or without FSSRGs for the country j and year t.

The model includes a lagged dependent as an independent variable, given the possible persistence of a bank's stability (Agoraki et al., 2011; Bermpei et al., 2018). The control-vectors smooth the

macroeconomic and financial components. Therefore, the control variables will address the differences shown between the countries regarding their economic development and stability that affect the performance, and consequently, the ROA. Lastly, to identify the validity of the model, several tests are applied, including the Wald tests for the joint significance of the regressors, the second-order autocorrelation (AR(2)) of the residuals test, and the Sargan test for overidentification.

5 Results

The following section presents the results of the statistical analyses. The first subsection describes the descriptive statistics of the variables used in the study. Second, this section presents the result of the dynamic model using a GMM method.

5.1 Descriptive Statistics

The descriptive statistics for all the indicators used during this research can be found in Table 4.1. The data analyzed consists of 1639 observations with one dependent variable Z, two independent variables, *SFR* and $g_{i,t}$, and five instrumental variables, *ROA*, *A/E*, *LLP/TL*, *dGDP*, and the inflation rate, in a timeframe of 11 years.

Table 5.1: Descriptive Statistics

	Mean	Median	Minimum	Maximum	Std. Dev.
g	0.0156	0.0101	-0.4398	0.8264	0.0526
E/A	0.1072	0.0959	-0.9444	0.9993	0.0863
ROA	0.0148	0.013	-0.0301	0.1224	0.0112
LLP/TL	0.0414	0.0273	-0.1199	1.5034	0.0896
dGDP	0.07	0.0678	-0.2662	0.3764	0.1022

Inflation	6.683	4.676	-4.6206	41.119	7.4243
Z Score	72.72	40.743	0.298	1682.5	115.94

First, the dependent variable $Z\,score_{i,t}$ has a mean of 72.72 and a standard deviation of 115.94, reaching its lowest value was 0.2.8 and its highest at 1682.5. The Z-score has 399 missing values, the highest number of missing values for any variable in the dataset.

Furthermore, the independent variable, SFR, has 1,639 observations. For this sample, 1,291 are 0s or, in other words, come from countries that do have FSSRGs (78.77% of the total sample). Regarding the 1s or the data points from countries that enforce these types of policies, there are 348 observations (21.77% of the total sample). There are no missing values for this variable. Lastly, the independent variable $g_(i,t)$ has a mean of 3.7342 and a standard deviation of 1.1956, reaching its lowest value was -1.1289 and its highest at 10.7520.

The correlation between the variables is presented in Table 4.2. The correlations are relatively low, indicating the independence between the variables.

Table 5.2: Correlation Coefficients

	g	E/A	ROA	LLP_TLR	dGDP	Inflation	Z Score
g	1	-0.0353	-0.0148	-0.0194	0.2423**	-0.0508	-0.0448
E/A	-0.0353	1	0.1948**	-0.0462	-0.0107	0.0332	0.2424**
ROA	-0.0148	0.1948**	1	0.0742**	0.0254	0.2994**	-0.0562
LLP/TL	-0.0194	-0.0462	0.0742**	1	-0.0157	0.0854**	-0.0209
dGDP	0.2423**	-0.0107	0.0254	-0.0157	1	0.0365	-0.0046
Inflation	-0.0508	0.0332	0.2994**	0.0854**	0.0365	1	-0.1007**

Z Score	-0.0448	0.2424**	-0.0562	-0.0209	-0.0046	-0.1007** 1

**, ** indicate significance at the 95%, and 99% level, respectively.*

5.1.1 Sustainable Finance Regulation Categorical Variable

Table 4.4 presents the FSSRG. 1 indicates the presence and 0 indicates the absence of such a policy in a particular year.

Table 5.3: Dichotomic Variable for FSSRGs in Latin America

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Argentina	0	0	0	0	0	0	0	0	0	0	0
Bolivia	0	0	0	0	0	0	0	0	0	0	0
Brazil	1	1	1	1	1	1	1	1	1	1	1
Chile	0	0	0	0	0	0	0	0	0	0	0
Colombia	0	0	0	0	1	1	1	1	1	1	1
Costa Rica	0	0	0	0	0	0	0	0	0	0	0
Dom. Rep.	0	0	0	0	0	0	0	0	0	0	0
Ecuador	0	0	0	0	0	0	0	0	1	1	1
El Salvador	0	0	0	0	0	0	0	0	0	0	0
Guatemala	0	0	0	0	0	0	0	0	0	0	0
Honduras	0	0	0	0	0	0	0	0	0	0	0
Mexico	0	0	0	0	0	0	0	0	1	1	1
Nicaragua	0	0	0	0	0	0	0	0	0	0	0
Panama	0	0	0	0	0	0	0	0	0	1	1
Paraguay	0	0	0	0	1	1	1	1	1	1	1
Peru	0	0	0	0	0	0	1	1	1	1	1
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0

Uruguay	0	0	0	0	0	0	0	0	0	0	0
Venezuela	0	0	0	0	0	0	0	0	0	0	0

0 represents the inexistence of FSSRG.

1 represents the existence of FSSRG.

5.1.2 Dynamic Panel Data Analysis

The models shown in table 4.5 illustrate the Two-Step GMM Dynamic Panel Data Analysis results that explain the influence of FSSRG on banks financial stability. This model includes a lagged dependent variable, $Zscore(-1)$, as an independent variable to explain the financial stability continuity and gradual changes in banks and financial institutions in the following year (Bermpei et al., 2018; Jiang et al., 2019). The panel regression consisted of 1031 observations within 143 cross-sectional units and 11-time series.

The dependent variable used in the model is $Zscore_{i,t}$, while the independent variables are $SFR_{i,t}$ and $g_{i,t}$. The other variables, ROE, A/E, ROA, LLP/TL, and dGDP, are used as control variables. Finally, the dependent variable's lagged value is defined as $Zscore\ (-1)$ and consists of the $Z-score$ delayed by one year for each bank.

The dichotomic independent variable $SFR_{i,t}$ showed a positive relationship with the dependent variable in the models 1 to 8.

Moreover, the growth of the total assets of each bank showed a negative relationship with the Z-score. The parameters' value increased as more bank-related instrumental variables were added, and the variable lost statistical significance when the country-based instrumental variables were included in the model (see Table 5.4).

The diagnostic tests of the Wald statistic are all significant, rejecting the null hypothesis for all models. Consequently, the test implies that the explanatory variables used for these models are valid.

The second-order autocorrelation of the error terms test provided as output the p-values 0.7612, 0.7698, 0.5954, 0.5896, 0.6499, 0.4134, 0.4394, and 0.3820 for the models 1 to 8, respectively. None of the values has a value under 0.05. Therefore, the test fails to reject the null hypothesis, so the moment conditions are correctly specified, and the original error is uncorrelated.

The Sargan test is used to search for overidentification from the model's parameters. the models 7 and 8's outcome p-values are 0.0341 and 0.0493, respectively. These values imply that the test rejects the null hypothesis for the last models, which affects the validity of the instruments for those models. However, the value of most of the Sargan test p-values in the rest of the models are greater than 0.05, failing to reject the null hypothesis of the test and, therefore, proving the validity of the instruments used for those models.

Table 5.4 Dynamic Panel Model using 2-step Generalized Method of Moments

	-1	-2	-3	-4	-5	-6	-7	-8
Variables	**Z**	**Z**	**Z**	**Z**	**Z**	**Z**	**Z**	**Z**
Zscore (-1)	0.2049***	0.2033***	0.1676***	0.1672**	0.1616***	0.1358**	0.1360**	0.1414**
	-0.0705	-0.0709	-0.0584	-0.0587	-0.0585	-0.0587	-0.0582	-0.0585
SFR	22.1588***	22.1253***	21.6187**	21.471**	21.0879**	20.5332**	16.7295*	18.7669**
	-8.3801	-8.5144	-8.7416	-8.9	-9.2283	-9.9347	-9.7304	-9.2877
g		-66.8118**	-10.7936	-9.0666	-10.5172	-42.4789	-45.6591	-52.0403
		-30.7947	-48.2179	-48.3624	-51.0713	-29.0491	-28.6044	-28.7824
ROA			301.235**	306.796	312.514	390.35	385.3380***	
			-153.479	-154.94	-153.148	-146.839	-147.718	
A/E				-199.445**	61.6652**	33.9535***	295.155	383.937***
				-333.431	-367.591	-405.873	-458.454	-143.853
LLP/TL					-2.1723	-1.8652	0.391	
					-35.7711	-31.7769	-32.7699	
dGDP						-2.41697	-9.9197	
						-31.9131	-32.8319	
Inflation							-1.1613***	-1.0525***
							-0.3516	-0.263
Constant	46.5530***	47.5049**	18.2171	20.7906	17.4296	13.9167	19.641	21.7314
	-5.1897	-5.2467	-14.5944	-12.6577	-12.783	-11.6214	-11.7864	-12.6278
Wald (joint) test	24.7804***	32.0764***	43.5989***	44.001***	42.8395***	55.179***	72.1172***	73.569***
AR (2)	0.7612	0.7698	0.5954	0.5896	0.6499	0.4134	0.4394	0.382
Sargan test	0.1119	0.106	0.0634	0.0528	0.1349	0.067	0.0341	0.0493
	1031	1031	1031	1031	1031	1031	1031	1031
	56	57	58	59	60	61	62	62
	143	143	143	143	143	143	143	143

Standard errors are reported in parentheses.

***, *** indicate significance at the 95%, and 99% level, respectively.*

6 Discussion

This research study demonstrates a relationship between FSSRGs and financial stability for banks in Latin America. The results also show that sustainable finance practices have a significant effect on banks' financial stability. This evidence is indisputable in the dynamic panel data analysis using a 2-step GMM model.

The dynamic panel model (table 4.8) evidences a significant positive relationship between a bank's financial stability and environmental policies in the banking sector. The model shows a positive relationship for all the coefficients of the lagged dependent variable and the *Zscore* while being statistically significant. This positive relationship implies that banks have higher financial stability when they operate in countries with FSSRGs. The results also show that a precedent history of financial stability can increase the chances of maintaining its stability. Consequently, following the hypothesis, financial stability between banks operating in countries with and without FSSRGs display a significant difference.

These findings contribute a clearer understanding of sustainable legislation's implications in the banking industries on financial institutions' financial stability. The study results build on existing research regarding the importance of climate mitigation policies in the banking sector (Battiston et al., 2017). Similarly, this research relates to other studies that found that FSSRGs create a more stable financial sector (Weber, 2017; Zadek & Robins, 2016). Furthermore, the results are consistent with research that has found lower systemic risk and asset price volatility due to climate risk-related legislation (Battiston et al., 2017). These results build on existing evidence of sustainability regulation in the banking sector, creating stability in the Chinese financial sector (Cui et al., 2018), and contribute by including results from the Latin American banking industry.

Additionally, this research aligns with studies that found positive impacts of evaluating sustainable policies in the financial sector. Some of these studies include the Green Credit Policy in

China and its relationship with positive financial performance (Cui et al., 2018; Weber, 2017). Another example is the environmental risk management guidelines in Bangladesh, which provide significant insight into banks' negative performance (Weber & Oni, 2015). FSSRGs have also shown a positive impact on the carbon footprint of a bank's portfolio (Zadek & Robins, 2016), as well as an increase of corporate social responsibility (CSR) activities and self-regulation in the financial industry (Chih et al., 2010).

Furthermore, previous research focused on the adverse effects of climate and social risks on individual and systemic perspectives (Campiglio et al., 2018; Rozenberg et al., 2013), credit risk (Bauer & Hann, 2012), and financial performance (Dam & Scholtens, 2015; Weber & Oni, 2015). In contrast, considering that FSSRG increase sustainable practices in banks (Weber, 2017), these results demonstrate that the banking sector's sustainable practices promote financial stability. Consequently, this research addresses a gap in the academic literature between sustainable finance, financial stability, and macroprudential regulations. Additionally, most previous empirical research on sustainable finance aimed to study countries like China, Bangladesh, and Nigeria (Jiang et al., 2019; Weber, 2012; Weber & Oni, 2015). In contrast, this research mainly researched countries in Latin America, which addresses another gap in the literature that links sustainability and financial studies.

Moreover, this study's results represent an opportunity for scholars in economics, financial stability, and sustainability management. These results should be considered when studying the connection between financial stability, systemic risk, and sustainable finance practices. In contrast with popular theories on financial stability that consider the correlation of financial institutions' portfolios as a source of systemic risk (Acharya, 2009), these results show the implications that social and environmental risks have to control systemic risk. Therefore, these results represent an empirical groundwork for developing a theoretical framework that includes financial sustainable practices and FSSRG on systemic risk and financial stability, following literature on climate risk and economic stability (Skidmore, 2001).

Regarding the limitations of the study, the lack of availability in the Latin American region may challenge the results' reliability. Accounting and financial information from banks in Latin America is limited to online databases. Therefore, the data collected was obtained manually on the banks' websites. This data collection methodology increases the chances of typing errors and attrition bias for large data sets. Additionally, each country has different regulations regarding the finance and accounting information that must stay public. Further research involving optimized data collection methods is required.

This study analyzed the biggest banks in each country according to their assets. The banks used in the data sample are either international banks or local financial institutions of significant size regarding their assets. Therefore, the results of this study may apply for big banks, although the reliability of the implications in this study may be different for small and medium-sized banks.

The methodology applied consists of measuring financial exposure by comparing the bank's solvency risk using the banks' scores in Latin America. Therefore, these results should be analyzed as a marginal contribution to the financial sector's systemic risk in the region. Other systemic risk and financial soundness indicators should be used in further research to better understand macroprudential environmental legislation's implications in the financial sector. Some indicators that could be used include CoVar, the First-to-Default probability, Systemic Expected Shortfall, and systemic loss distribution.

The analysis exclusively evaluated a sustainable regulatory framework in the banks where the banks analyzed to operate regarding sustainability management. These regulations were imposed by governments or central banks, or a group of banks that had a sustainable initiative. However, most of the banks studied the global nature implies that these corporations' internal policies may be followed across borders. Therefore, banks operating in countries without legislation that enforces sustainability in the banking sector might be using sustainable finance practices. As the analysis ignores individual indicators of sustainability, the conclusions exclude the impact of individual banks.

Future research should evaluate individual actions and sustainable disclosures from specific financial entities.

Finally, the results provide empirical evidence to reject the null hypothesis stated previously in the second chapter. Consequently, the evidence accepts the alternative hypothesis stating that the existence of FSSRGs has a significant effect on the financial stability of banks in Latin America.

7 Conclusion

The following section will provide the concluding remarks of this master's thesis, covering the author's perspective on the main implications, both practical and academic, and the main limitations and research opportunities that arise.

This thesis analyzed the impact of FSSRGs on the financial stability of banks in Latin America. The financial stability of 149 banks in 17 countries from 2008 to 2018 was quantified and tested with several quantitative analysis methods. These included a dynamic panel regression using a two-step GMM model. Based on the quantitative analysis of the leading banks of the countries studied, the main conclusion of this thesis is that FSSRGs show a significant positive impact on the financial stability of the banks in the financial sector.

This research studied the connection between sustainable finance practices and financial stability. A sustainable finance practice consists of a bank's strategy to reach sustainable development. A sustainable finance strategy includes both organizational behaviour and business decision-making strategies. The investigation concentrates on countries in Latin America, highlighting the inclusion of sustainability practices in the legal framework of the financial sector of Brazil, Colombia, Ecuador, Mexico, Peru, and Paraguay. The literature suggests that strategies that aim to develop the economy, society, and environment can strengthen financial stability.

Furthermore, the literature review presents a case to demonstrate the positive and significant influence of FSSRGs on a bank's financial stability. The literature review shows that policymakers continuously consider using regulations to control financial stability and systemic risk. Additionally, the literature shows that sustainable practices in the financial sector promote economic development and financial stability. The connection between financial stability and sustainable finance seems logical, though research regarding this connection is scarce, evidencing a literature gap.

Therefore, the methodology for this study compares banks operating in countries with and without FSSRGs. This analysis consists of a dynamic panel regression using a 2-step GMM model. The results show a significant relationship between FSSRGs and financial stability.

Based on these conclusions, future research should consider some factors. By only analyzing accounting figures, a layer of risk was assessed and evaluated. Hence, the quality of the analysis is relevant for institutional risk. However, financial stability analysis still needs to be developed within sustainability management, especially towards the implication of sustainable policies over systemic risk. More research is needed to evaluate the impact of sustainable measures and its effect on systemic risk, evaluating several systemic risk related indicators such as the CoVar indicator, the First-to-Default probability, Systemic Expected Shortfall (SES), distribution of systemic loss, and other financial soundness indicators endorsed by the FMI.

Additionally, the implications of introducing this kind of policy should also be analyzed. The time of application and characteristics of the policies is imperative for the entire economy, as shocks coming from climate change could be early forecasted and, consequently, mitigated to reduce the implications over households and financial firms (Skidmore, 2001). The cost of adaptation and transition of new FSSRG needs to be studied to understand the short-, medium-, and long-term implications of said policies and critical aspects to ensure a successful adaptation of firms and households.

This study also consists of data from an entire continent where the most prominent banks from selected countries were analyzed. This type of quantitative analysis could bring some bias given economic, social, political, and other factors over the accounting data used to estimate each bank's financial stability. Country specific mixed methodologies and case studies could be applied within the Latin American region to evaluate the macroprudential implications of FSSRG. This way, any international bias that could disturb the analysis can be minimized as much as possible.

Finally, this thesis evidences a link between financial stability and FSSRGs. Therefore, Central Banks and governments should consider the potential risks of environmental externalities on the financial system. Also, firms that have not yet adopted sustainable policies should consider the results of this thesis, given the resilience aspects that environmental institutions provide to firms that prevail in the results.

This research also contributes to the academy by filling a research gap regarding Latin American financial sustainability and the relationship between financial stability and FSSRGs. Additionally, this study evidences the effect of sustainable finance practices on financial stability. Finally, this masters' thesis provides an empirical framework to develop a theory on financial stability and sustainability.

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9 Appendix: South American FSSRG

9.1.1 Brazil

Brazil was the first country in Latin America to commit the financial sector to develop sustainable practices. The sustainable FSSRG on the financial sector consist of the Green Protocol (Protocolo Verde in Portuguese) and six regulations later introduced. The introduction of the social and environmental framework into the banking system started in 1995 with the Green Protocol to stand up to environmental and social challenges that jeopardized water resources, preservation of biodiversity, sustainable management of forest, human labor rights, diversity, and local culture (Ministerio do Meio Ambiente, 1995).

The initiative resulted from the action of five banks, Banco Nacional de Desenvolvimento Economico e Social (BNDES), Caixa Econômica Federal (Caixa), Banco Do Brasil, Banco da Amazônia, and Banco do Nordeste do Brasil, in partnership with Brazil's Ministry of Environment (Ministerio do Meio Ambiente in Portuguese). Later, four resolutions were introduced by the Brazilian National Monetary Council (Conselho Monet'ario Nacional in Portuguese) to address environmental, social, and governance issues in the sector: Resolution N°3,545 (2008) regarding the protection of the Amazon biome; Resolution N°3,813 (2009) for Sugarcane investment, regulation N°3,876 (2010) for Slave labor, and Resolution N°3,547 (2011) to ensure governance and risk management by an internal capital adequacy assessment process (International Finance Corporation, 2018). In 2014, the Central Bank of Brazil introduced the Resolution N.4,327 detailing the principles to create good practices that mitigate environmental and social risks (2014). Additionally, Resolution N.4,557 follows up the last one in 2017, requiring financial institutions to create structures for capital and risk management, including socio-environmental risks.

9.1.2 Colombia

The FSSRG in Colombia started with the Green Protocol (Protocolo Verde in Spanish) on June 7th, 2012, signed and initiated by the Ministry of Environment and Sustainable Development and ASOBANCARIA (Banking Association). It consists of voluntary guidelines to cope with ESG issues for financial institutions to implement projects and further risk management analysis and ecoefficiency, including loans and investment programs. Later, the protocol was followed in 2017 by General Guidelines for the Implementation of Environmental and Social Risk Analysis, a complimentary that guided banks towards the correct implementation of the Green Protocol. Initially, 12 banks signed the document voluntarily, and so far, 22 banks have signed, and 11 have implemented the environmental and social risk management system (International Finance Corporation, 2018)

9.1.3 Ecuador

The financial market in Ecuador joined the sustainable initiative thanks to the nation's Banking Association (ASOBANCARIA) in 2016 with the implementation of the Sustainable Banking Protocol (Protocolo de Banca Sustentable in Spanish). This protocol provides the signing parties with voluntary strategies to promote investment that encourage sustainable practices and sustainable internal controls within signing financial institutions and create investment and credit risk assessment methods that include environmental and social risks (ASOBANCARIA, 2016). Being a signing member of the protocol is voluntary, and ten commercial banks initially signed it, with now 13 signing financial institutions.

9.1.4 Mexico

Mexico's FSSRG consist of two key policy documents: The Bank's Sustainability Protocol (Protocolo de Sustentabilidad de la Banca in Spanish) and the Green Bond Principles MX. First, the Bank's Sustainability Protocol, launched by the Banking Mexico Association (ABM) in 2016. The protocol, signed by 189 commercial banks and five development institutions, declares the global challenges that climate change represents and the Mexican commitment to face them. This document incorporates five strategic principles to reach its objectives: internal sustainability policies

institutionalization, environmental and social risks management in the investment and credit processes; sustainable investment; efficient use of resources in internal processes; and monitoring and dissemination of the guild's sustainability practices and policies. Second, the Green Bond Principles MX was published in 2018 by the Climate Finance Advisory Group (CCFC, in Spanish). The principles consist of a set of requirements for Mexican green bond issuers to provide them guidance during the green bond issuance process. These guidelines include the use of proceeds from the issuance, evaluation, and project selection process, emission proceeds management, annual reporting, and external evaluation and review (CCFC, 2018).

9.1.5 Panama

Panama's effort to create a sustainable finance market stated by joining the Sustainable Banking Network (SBN) in January 2018. Later, the publication of Panama's Sustainable Finance Protocol (Protocolo de Finanzas Sustentables de Panama' in Spanish) was published in July 2018 by the Sustainable Committee of the Panama Banking Association (ABP or Asociacion Bancaria de Panama in Spanish). The protocol intends to improve the financial sector in terms of competitivity, reputation, risk reduction, market diversification, and sustainable development. Additionally, the document highlights the importance of creating and disclosing all green finance products, including green bonds, credit cards, green lines of credit, and others. Initially, sixteen commercial banks signed the document. Other actions taken by the ABP include training and workshops regarding green finance products. Furthermore, the efforts to sign and follow the protocol voluntary; thus, there is no supervision enforced nor financial or non-financial incentives for banks from the government to join the protocol.

9.1.6 Peru

The development of FSSRG in the Peruvian financial sector started with the initiative of the Superintendence of Banking and Insurance (SBS or Superintendencia de Bancos, Seguros y AFP in Spanish) in 2015 with the approval of the Resolution N. 1928-2015: Regulation for Social and

Environmental Risk Management; and the Document SBS N. 01-2015: The role of enhanced due diligence in the regulation of socio-environmental risk management for financial firms. The first establishes the minimum requirements regarding social and environmental risk management. It highlights specific steps that financial institutions need to mitigate social and environmental risks from loans and credits provided, as well as the procedures and formats for quarterly reports of the institution. The second document published complements and describes the regulation mentioned above. It objectively clarifies the role of each institution, group of people, and entity to provide better guidance for the compliance of the regulation. Besides, it summarizes relevant international sustainable finance norms to banks within the country, including the UN's Guiding Principles on Business and Human Rights, ISO26000, the OECD Guidelines for Multinational Enterprises, IFC Performance Standards, Equator Principles, and UN Principles for Responsible Investment. Following this regulation, the SBS published in 2018 a Green Bonds Guidelines for Peru (Guía de Bonos Verdes para el Perú in Spanish), a guide created to develop the green bonds market in Peru. Additionally, this guideline provides a step by step process recommended by the SBS on how to create and emit a green bond. It details the complete process, including the creation, evaluation process, bond emission, and disclosure.