UNIVERSIDADE FEDERAL DO RIO DE JANEIRO INSTITUTO COPPEAD DE ADMINISTRAÇÃO

André Guilherme Pinto Bandeira de Mello

# The relationship between Financial Stability and transparency in social-environmental policies.

Rio de Janeiro

2022

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Dissertação de Mestrado apresentada ao Instituto COPPEAD de Administração, da Universidade Federal do Rio de Janeiro, como parte dos requisitos necessários à obtenção do título de Mestre em Administração.

ORIENTADOR: Prof.Dr. Claudio Oliveira de Moraes

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## Resumo

O Bank for International Settlements (BIS) alerta sobre o possível impacto das mudanças climáticas nos bancos e afirma que a divulgação do banco (transparência) é relevante para a estabilidade financeira. Com base nessas ideias, este estudo analisa, por meio de relatórios socioambientais, se os bancos com maior transparência nas políticas socioambientais salvaguardam melhor a estabilidade financeira no Brasil. Para isso, desenvolvemos uma abordagem abrangente por meio de uma regressão de Painel de Dados com mais de 40 bancos brasileiros de 2011 a 2019. Nossos resultados sugerem que Bancos com maior transparência tendem a ser menos arriscados em relação a dificuldades financeiras. Além disso, os resultados indicam que os formuladores de políticas que incentivam os bancos a divulgar políticas sustentáveis podem melhorar a estabilidade fina.



**Palavras-chaves**: Sustentabilidade, estabilidade financeira, finanças verdes, transparência, terceiro acordo de Basileia

**Abstract**

Bank for International Settlements (BIS) alerts the possible impact of climate change on banks and states that the bank's disclosure (transparency) is relevant to financial stability. Based on these ideas, this study analyzes, through social-environmental reports, whether banks with higher transparency in social-environmental policies better safeguard financial stability in Brazil. For that, we developed a comprehensive approach through a Data Panel regression with over 40 Brazilian banks from 2011 to 2019. Our results suggest that Banks with higher transparency tend to be less risky regarding financial distress. Furthermore, the results indicate that policymakers encouraging banks to disclose sustainable policies may improve financial stability.

**Keywords**: Sustainability, financial stability, green finance, transparency, Basel III accord.

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**Sumário:**

## 1. Introduction

The subprime crisis in 2008 roused concern regarding tail risks, which happens when unpredictable events come to reality. These events are called Black Swans by Nassim Taleb (2008). They should comprehend the following characteristics: it is an outlier with extreme impact and, after the occurrence, is predictable and explainable (Runde, 2009). Inspired by this rationale, the Bank of International Settlement coined the Green Swan phenomenon (Bolton et al., 2020). They are nature-related events that may lead to more significant challenges since they are more problematic than Black swans. To provide further arguments and help the debate if climate risks and Green Swans represent potential issues for financial stability, so being transparent towards those subjects might help prevent financial distress, this article uses a panel data regression with the goal to understand if transparency in social-environmental policies can mitigate financial distress.

According to Networking for Greening the Financial System - NGFS (2022), banks can play a leading role in mitigating environmental changes, which can be crafted by Green Swans and other types of risks related to climate change. For instance, if the financial system starts to neglect funding to companies or industries intensive in devastating the environment (or carbon-intensive), those enterprises' activities would suffer a revamp to readjust their endeavors into a more social-environmentally approach. In other words, banks should embrace sustainability in their workflow NGFS (2022). Consequently, these movements tend to modify and preserve the environment, crafting a meaningful change in climate and social risks. On the other hand, United Nations Environment Program Finance Initiative – UNEPFI (2016) suggested that social and environmental risks pose as new challenges for financial institutions and not pursuing paths to mitigation can lead the world to an unprecedented crisis propelled by events related to climate issues. Considering this landscape, banks, policymakers, and the entire financial system should learn how to cope with events associated with climate change and how to mitigate them.

After the subprime crisis and the concerning financial distress it caused, the Basel III accord presented the idea of a market discipline that could lead to a sound financial system. However, for market discipline, financial institutions must be transparent with regularity and standardization in their reports (Basel Committee, 2004). Moreover, the

Basel Committee (2022) shares the same beliefs for social-environmental issues and suggests that reporting risks related to climate is paramount to managing environmental issues. Additionally, according to BIS, supervisors expect disclosures from banks on their exposers on risks related to environmental and social risks to prevent financial distress. By doing so, transparency in social-environmental policies gains a spotlight on discussions concerning the financial system.

Social-environmental policies as well as greening the financial system should be a worldwide endeavor. Some countries, however, such as Brazil, have their potential for sustainable policies spotlighted due to their green territory and diverse natural ecosystem. According to the Convention on Biological Diversity, it is estimated that 15-20% of the world's biodiversity is currently in Brazilian territory.[1] Besides green potential, Brazil is a developing country with a well-developed financial system. Additionally, the Central Bank of Brazil demands financial institutions to have a social-environmental responsibility policy. These characteristics make Brazil one of the best laboratories for studying the relationship between transparency in social-environmental policies and financial stability.

This study analyze whether banks with higher transparency in social-environmental policies better safeguard financial stability in Brazil. To our knowledge, no previous work links financial stability with social-environmental transparency specific to banks in Brazil, making this study unique. The results indicate a positive relationship between transparency in banking disclosure policies and financial stability with a panel data regression. In other words, transparency may enhance financial stability in a large emerging country with a green potential.

This article is divided as following: section 1 presents the introduction. Section 2 displays an in-depth analysis of Financial Stability, Transparency, and Banking. Section 3 presents the methodology as well as the data used in this article. Section 4 presents the empirical results through a data panel analysis regarding the transparency in a social-environmental policy and financial stability. Section 5 discloses the robustness check. Section 6 shows further analysis by debating if a shock on transparency in social-

[1] Data presented by Convention on Biological Diversity see: https://www.cbd.int/countries/profile/?country=br#:~:text=In%202006%2C%20through%20a%20participatory,with%20the%20Aichi%20Biodiversity%20Targets.

environmental policies might bring more financial stability. Section 7 presents this article's conclusions.

## 2. Financial Stability, Transparency, and Banking

Financial stability has gained much more attention in the literature and among policymakers since the subprime crisis. This attention reflects the number of studies devoted to understanding what enhances financial stability (De Mendonça and De Moraes, 2019; Montes et al., 2021; De Moraes and Costa, 2022; Amidu and Wolf, 2013, Tabak et al., 2015). Despite the different approaches to defining Financial Stability that have emerged, this work uses the definition offered by the Central Bank of Brazil – CBB (2022). Financial stability is when the financial intermediation fully functions without any crisis or difficulty in honoring its obligations while fulfilling its social duty. Thus, to capture this idea we use a comprehensive approach by diversifying the measurements of financial stability, all backed by the literature, which are: Z-score with regulatory capital, Z-score using leverage, and the voluntary Capital Buffer.

Z-score is often used in the banking literature to measure the risk of insolvency, first introduced as a risk measure by Roy (1952). According to Lepetit and Strobel (2013), Z-score can reflect insolvency probability in financial institutions. There are different standards for Z-score, and we follow two of them in this study: Lepetit and Strobel (2013) calculated it with capital adequacy ratio (CAR), while Fazio et al. (2015) used this Z-score to evaluate financial stability in Brazil, which in this work will be represented as Z-Score1. Fu et al. (2014) and De Moraes and Costa (2022), however, calculated it differently by using, instead of CAR, a ratio between equity and total assets. In this work this ratio is called Leverage (LEV). This manner will be represented as Z-score2 and it presents, under the assumption of a bank with stable returns, how many standard deviations the return must diminish to drain equity (Čihák and Hesse, 2010). Thus, despite having the same formula and, in both proxies we are desiring a higher value, they present different ideas. In both methods, ROA represents the return on assets, and the standard deviation is calculated in both cases, according to Boyd et al. (2006).

$$Z1 \equiv \frac{ROA + CAR}{\sigma ROA} \quad (01) \qquad Z2 \equiv \frac{ROA + LEV}{\sigma ROA} \quad (02)$$

Another financial stability proxy used is the voluntary capital buffer (03), which is how much above the minimum required by regulators a bank maintains as additional capital to be used in stress periods (Bis, 2010). It is studied in many relationships with macroprudential tools, as a proxy for financial stability. Montes et al. (2021) presented capital buffer behavior throughout countries, thus placing a high capital buffer as a source of banks being protected against economic downtrend. Further, De Mendonça and De Moraes (2019) argue that the higher the capital buffer, the lower the solvency risks. Hence, banks with higher voluntary Buffer are less susceptible to a crisis once they possess more capital to resist under challenging times, preventing banks from getting sanctioned by the regulatory agency. The calculation is the ratio between the capital adequacy ratio kept by banks and the minimum required by regulation.

$$Buffer \equiv \frac{CAR}{minimum\ required} \quad (03)$$

Nowadays, all stakeholders in financial stability consider climate change impacts. For instance, NGFS (2020) suggested two possible types of bank risks related to climate that can harm banks and countries' financial stability: Physical risks representing risks that occur due to climate-related events such as storms, hurricanes, and other events that could be categorized as Green Swans. Javadi and Masum (2021) suggested a physical impact when presenting the relationship between drought risk and the cost of borrowing for US firms. This relationship implies that banks are aware and price those risks. The second stream commented on is the transitional risk, which is the consequences related to transitioning to a greener economy. Following, Lee et al. (2022) adds in the literature that banks exposed to climate risks may be affected negatively in liquidity creation.

As a result of this scenario, the relationship between the environment and banks entered the spotlight in the literature, so the academia enlarged the efforts to understand it by producing studies with different countries, datasets, and objectives (Murè et al., 2020;

Miralles-Quirós et al., 2019; Weber, Scholz, and Michalik, 2010), thus the importance of banks in changing the current economy into a greener one, as well as sizing, acting, and mitigating these risks, due to how much is at stake when considering climate changes in the equation is highly accepted. Consequently, those organizations tackling these problems are now not only relevant, but essential. Hence, a new stream of research emerged by compiling the idea of the Basel III accord's third pillar that discusses how transparency can mitigate financial distress and the relevance of sustainable banking policies (Khan et al, 2020; Nobanee and Ellili, 2016; Buallay, 2018).

Measuring transparency is not a straightforward task. The literature, policymakers, and society should be aware of how diverse transparency can be and how banks, as well as other enterprises, might craft ways of not establishing a meaningful policy. In this sense, De Moraes et al. (2022), inspired by Horváth and Vaško (2016), created the Social-environmental transparency index (SETI). This index has the lowest score of 0 and the highest score of 9 and was built around four different angles: The general framework, which comprehends the corporate environmental conditions to develop social and environmental transparency, the report's standardization, what is being reported, and what is shown on their website. By doing so, the index comprehends different parameters and ideas, including ones comprehended in Global Reporting Indicators (GRI), the Sustainability Accounting Standards Board (SASB), and Task Force on Climate-Related Financial Disclosures (TCFD).

We use the Social-environmental transparency index (SETI) developed by De Moraes and Graupiuna (2022) as our proxy for transparency in climate policies. Table A.1 in the appendix is presented the details of SETI. SETI has 9 different parameters and, except for the GRI parameter that has three possibilities (0, 0.5, and 1), all of them have a binary result of 0 or 1. In the general framework, the first category has the goal to measure the corporate environment to craft social and environmental policies. It has three parameters, so its total goes from 0 to 3. The second one is report, in other words, disclosure tools for those policies, with two parameters so the score goes from 0 to 2. The third one is the reporting standards. Though it is important to disclosure this information, well-accepted patterns of disclosing must be followed. This category has three different considerations, so the score goes from 0 to 3. Lastly is the website category, which

indicates the company's willingness to have an exclusive communication channel for those policies, and it has only one parameter, the total score goes from 0 to 1.

According to De Moraes et.al (2022), it is possible to understand some bank characteristics that explain greater transparency in social-environmental policies. For instance, larger banks present a higher score through all years observed. Another evidence found is the causal relationship between SETI and the bank's risk measures. Finally, the results indicate the impact of the regulator on enforcing banks' transparency. Our study aims to amplify the analyses to understand if transparency towards social-environmental policies enhances Brazilian financial stability, which can indicate the best of the two worlds, compromise with sustainability and stability.

## 3. Data and Methodology

To understand the relationship between transparency in social-environmental policies and Financial Stability, an Unbalanced Panel was prepared with over 40 Brazilian banks from 2011 to 2019 with annual data, thus gathering from bank websites and the Central Bank of Brazil (CBB).[2] This selection acquires more than 95% of the total assets of the financial system in Brazil and has as its theoretical foundation on the Basel Committee for Banking Supervision (BCBS) recognition of the proportionality in supervision. For that, not all banks should have the same degree of importance in supervision. The CBB divides the Brazilian financial system into five segments considering banks' significance and the risk posed to the financial stability in Brazil. Consequently, this study only uses banks from segments one to three because segments four and five do not present disclosure of social-environmental policies and do not have considerable risks to the financial system.

The literature on banking and financial stability normally uses a set of variables to understand how to safeguard financial stability. Kasman and Kasman (2015) and Fu et al. (2014) suggested that the logarithm of total assets (SIZE) plays a relevant role in financial stability, where bigger banks tend to have a lower value on financial stability. Another variable often used when explaining financial stability is Return on Equity (ROE), which

[2] Table A.2 in the appendix presents the selected banks.

gives insight about how financial stability reacts to a bank's profitability and in studies linking banks with sustainability, Weber (2017) linked sustainability reports with profitability measures. In this sense, ROE will be placed as a control variable inside the baseline model. Moving further, Fazio et al. (2015) suggested that liquidity negatively affects a bank's financial stability.

Also trying to grasp how the macroeconomic condition affects financial stability, Demirgüç-Kunt and Detragiache (1998) suggested that the economic momentum may interfere in the soundness of the banking system. Moreover, Jokipii and Milne (2008) suggested a procyclical behavior in banks. Thus, the output gap is one of the macroeconomic variables used in this study with the purpose of controlling the business cycle. Its calculations are according to what Hamilton (2008) proposed. Other macroeconomic variables are part of the equation. The monetary policy and its effects on the macroprudential environment are the subject of De Mendonça and De Moraes (2019), who have found evidence regarding how Brazil's basic interest rate can interfere in risk measures. Equally to De Mendonça and De Moraes (2019), this study presents the Brazilian selic rate (IR) as a measure of how monetary policy may affect financial stability. The last control variable used in this model is credit variation, as De Moraes and Costa (2022) suggested credit growth can reduce a bank's financial soundness, so for this reason credit variation (credit) was added to the model. Table A.3 in the appendix presents all variables and its descriptive statistics.

It is important to highlight the usage of a dynamic model to allow using the dependent variable lagged as an explanatory variable, since, as pointed out by De Moraes and De Mendonça (2018), financial stability might suffer persistent effect. Hence it is expected that the lagged dependent variable may help explaining financial stability. The model is represented as follows:

$$\boldsymbol{FS_{i,t} = \beta_1 FS_{i,t-1} + \beta_2\, Transparency\ Index_{i,t} + \beta_2\, X_{i,t} + \beta_3\, Z_t + \varepsilon_{i,t}} \qquad (04)$$

Where $FS_{i,t}$ represents all three measures of Financial Stability (Z-score1, Z-score2, and Capital Buffer) for a given bank in each period, $FS_{i,t-1}$ is the same three measures of Financial Stability (Z-score1, Zscore2, and Capital Buffer), although lagged

by one period to include the persistent effect on bank behavior. Transparency Index is the transparency in social-environmental policies crafted by De Moraes and et at. (2022), X is a vector of specific banking control variables, Z is a vector of macroeconomic variables used in the model, and ε is the stochastic error term.

According to Baltagi (2005), using the dependent variable lagged in all models could lead to a correlation problem with the error term in OLS (ordinary least squares) models. To overcome this issue, this study uses the Generalized Moments Method (GMM) with two different approaches as used by De Deus and De Mendonça (2015). The first model is proposed by Arellano and Bond (1991) to solve the aforementioned problem, which estimates the first difference GMM panel data (D-GMM) and is one of the methods used in our estimations. However, this method does not eliminate all possibilities of issues, as shown in Blundell and Bond (1998) who suggested that its usage implies bias for a large or small sample, low accuracy, and weak instruments. To deal with those issues, a second methodology is used to strengthen the outcomes. As proposed by Arellano and Bover (1995) and Blundell and Bond (1998), the system GMM panel data (S-GMM) should be applied to deal with those problems, as used by Montes et al. (2021), Kasman and Kasman (2015), Fu et al. (2014), and De Moraes and Costa (2022). According to Bond et al. (2001), the S-GMM enables a more robust outcome by aggregating regression equations on differences and levels into a system while it uses lagged differences and lagged levels of the variables as instruments in the model.

To check the validity of the outcome, some tests are run to identify problems and craft confidence in our model. As proposed by De Deus and De Mendonça (2015), to understand if the instruments used in the model are pertinent, the Sargan test (J-test) was applied as described by Arellano (2003) as well as tests for serial correlation of first and second order. The study presents AR(1) and AR(2), which give us an understanding if we have a negative first order correlation and non-correlation of second order, respectively. To assess the possibility of an over-fit of the instruments variable caused by using too many instruments that can create a bias (Roodman, 2009), the instruments/number ratio of cross-sections is always under 1, as applied by De Mendonça and Barcelos (2015).[3]

[3] The instruments chosen follows Johnston (1984). In short, we use dated to the period t_(-1) or earlier to help predict contemporaneous variables unavailable at time t.

## 4. Results

With the objective to understand the relationship between financial stability and transparency in social environmental policy, we present empirical evidence on the relationship between financial stability and transparency in social-environmental policies. This section is divided into subsections for each financial stability proxy: Z-score1, Z-score2, and Buffer. All estimations use the D-GMM and S-GMM frameworks. Sargan's J-test was performed for all models; The over-identifying restrictions are judged valid. AR (1) and AR (2) serial correlation tests were also performed. The AR (1) tests reject the null hypothesis for all cases. The AR (2) tests do not indicate the presence of serial correlation.

### 4.1. Z-score1 - CAR

Table 1 presents the relationship between financial stability proxied by Z-score1 and transparency in social-environmental policies. The positive and statistical significance of SETI represents that banks with higher transparency offer less risk to financial stability. This relationship may be explained since banks that understand, act, and especially are transparent about climate-related risks not only have more concern regarding them, but also tend to be safer and more sound, embracing those policies. Being transparent about them brings accountability since it forces them to keep their promises. A common expression for it is "you do what you preach". Further, this effort is constantly observed by society, which enforces this behavior due to social coordination.

In general, the positive and statistical significance of the lagged Z-score1 reveals a persistent effect on financial stability as found by De Moraes and Costa (2022). In other words, financial stability has an inertia effect. Moreover, the consistency in all outcomes suggests a strong relationship among them.

Table 1

Estimation of the relationship between social-environmental transparency and Financial Stability

| Dependent Variable: Zscore1 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | D-GMM | D-GMM | D-GMM | D-GMM | D-GMM | S-GMM | S-GMM | S-GMM | S-GMM | S-GMM |
| Equations | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Lagged Z-score1 | 0.226*** | 0.229*** | 0.228*** | 0.276*** | 0.287*** | 0.236*** | 0.235*** | 0.304*** | 0.299*** | 0.307*** |
| | (0.011) | (0.004) | (0.004) | (0.006) | (0.007) | (0.0090) | (0.009) | (-0.007) | (0.009) | (0.012) |
| SETI | 4.279** | 2.539** | 2.742*** | 4.178*** | 3.056*** | 3.971*** | 4.280*** | 3.771*** | 3.548*** | 5.244*** |
| | (1.91) | (0.371) | (0.752) | (0.986) | (1.047) | (1.104) | (1.086) | (1.188) | (1.107) | (1.286) |
| Size | -4.181** | -3.734*** | -3.706*** | -3.049*** | -2.172*** | -3.251*** | -3.315*** | -2.967** | -2.927*** | -3.056*** |
| | (0.968) | (0.182) | (0.166) | (0.279) | (0.486) | (2.803) | (3.264) | (-2.469) | (2.978) | (0.325) |
| Return on Equity | 3.957*** | 2.991*** | 2.951 | 2.432 *** | 1.010*** | 3.596*** | 3.057** | 1.679** | 1.554* | 1.229 |
| | (1.;207) | (0.603) | (0.780) | (0.942) | (0.311) | (8.610) | (11.813) | (7.180) | (9.051) | (1.009) |
| Liquidity | | 2.598*** | 3.321 | 4.604*** | 3.006 | | 1.244 | 3.361** | 2.536*** | 3.324** |
| | | (0.517) | (0.625) | (0.975) | (1.250) | | (10.826) | (914.84) | (9.472) | (1.655) |
| IR | | | -0.791 | -0.2 | -1.099** | | | 0.382 | -0.103 | 0.361 |
| | | | (0.339) | (0.480) | (0.403) | | | (0.542) | (0.480) | (0.567) |
| Output gap | | | | 0.510*** | 1.166*** | | | | 1.100*** | 0.875*** |
| | | | | (0.194) | (0.386) | | | | (0.231) | (0.247) |
| Credit Variation | | | | | -1.355 | | | | | 1.119 |
| | | | | | (0.792) | | | | | (1.057) |
| N. Obs | 224 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 |
| Inst./Cross | 0.868 | 0.947 | 0.973 | 0.947 | 0.973 | 0.868 | 0.868 | 0.868 | 0.868 | 0.868 |
| J-statistic | 25.267 | 31.934 | 31.586 | 33.893 | 27.401 | 29.555 | 28.158 | 30.315 | 30.019 | 29.667 |
| Prob.(Jstatistic) | 0.664 | 0.470 | 0.436 | 0.243 | 0.907 | 0.436 | 0.456 | 0.300 | 0.267 | 0.237 |
| AR(1) | -2.012 | -1.905 | -1.913 | -1.799 | -2.058 | -0.359 | -0.356 | -0.387 | -0.388 | -0.382 |
| Prob | 0.044 | 0.056 | 0.055 | 0.071 | 0.039 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| AR(2) | 0.483 | 0.453 | 0.442 | 0.458 | 0.656 | 0.082 | 0.082 | 0.100 | 0.107 | 0.103 |
| Prob | 0.661 | 0.650 | 0.658 | 0.643 | 0.511 | 0.241 | 0.238 | 0.129 | 0.106 | 0.116 |

**Notes**: Marginal significance levels with (***) denotes 0.01, (**) denotes 0.05, and (*) denotes) 0.1, and standard errors are in parenthesis. In consonance with Arellano and Bond (1995), two-step S-GMM was applied as well as the consistent covariance matrix of White's heteroskedasticity. And, as suggested by Arellano and Bond (1991), D-GMM was applied.

All control variables to some extent shared good insights over the literature on bank behavior relationship with financial stability. The negative and significant value of the bank's size shows us that bigger banks tend to have a higher risk with financial stability than small banks. This movement might be explained by the bigger possibility of diversification inside its portfolio, another way to mitigate risks measured by the Z-score1, which craft a greater possibility to leverage itself, thus safeguarding its stability despite the lower value on some risk assessment variables. This finding is aligned with Fu et al. (2014), and its explanation can be found in Kim et al. (2020) where moderated diversified banks tend to be more stable. The *return on equity* with a positive and statistically significant sign, since the variable is at the same period as the Z-score, means that the ROE variable has more of a book value than a practical one. In other words, the return was not divided among the equity holders, providing the bank a resource. Despite the possible mechanical relationship between ROE and Z-score, it is understandable that ROE could explain a part of financial stability or a possible stress.

There are other bank characteristics proposed as control variables that display meaningful insights. *Liquidity* with positive and statistical significance suggests a straightforward understanding where banks with higher liquidity tend to reduce their risk since banks with more liquidity are generally more able to honor their obligations in the short term. The same result can be found in De Moraes and De Mendonça (2019). Regarding the macroeconomic variable in the model, the Brazilian basic interest rate (SELIC) displays some significance with a negative sign. Through an economic lens, we can understand this phenomenon as higher interest rate (*IR*) meaning higher risks for banks by enlarging the possibility of a default on debts. Generalizing, the higher the interest rate the higher is the chance of a bank being insolvent. This is the same results found by De Moraes and de Mendonça (2019). The positive and significant results of output gap exhibit that economic growth interfere positively, thus reinforcing the thesis that banks will likely act in a procyclical fashion. Credit variation does not show significance.

### 4.2. Z-score2 – Lev

To analyze how transparency in social-environmental policies affect the financial system, Table 2 presents the output of estimations regarding Z-score2 as a proxy for financial stability. With the results for Z-score1, SETI remained consistently positive and with statistical significance. This reinforces the thesis of market discipline towards banks.

Further, the positive and statistical significance of the lagged Z-score2 displays a persistent effect on financial stability. Hence, banks with a higher soundness will likely remain this way, but banks already suffering from financial stress have a higher chance of remaining with the problem. The same results were funded by De Moraes and Costa (2022).

By scrutinizing the results, it is possible to reinforce some of the findings. Bank size shows the same negative sign with statistical significance, reinforcing the thesis that bigger banks are inclined to have a higher risk level than smaller ones as shown in Z-score1, although this might have as an explanation the fact that those banks have artifices such as diversification to reduce the possibility of a turmoil. ROE, despite losing part of its significance when comparing Table 1 with Table 2, disposes in some models a positive and significant signal, so banks with higher returns on equity have higher soundness. Since both are presented in the same period, the returns might not be divided yet with equity holders, thus creating a financial resource for banks.

Table 2

Estimation on the relationship between social-environmental transparency and Financial Stability

| Dependent Variable: Zscore2 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | D-GMM | D-GMM | D-GMM | D-GMM | D-GMM | S-GMM | S-GMM | S-GMM | S-GMM | S-GMM |
| Equations | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| lagged Z-score2 | 0.188*** | 0.211*** | 0.319*** | 0.302*** | 0.216*** | 0.368*** | 0.324*** | 0.317*** | 0.314*** | 0.359*** |
| | (0.068) | (0.030) | (0.068) | (0.0546) | (0.053) | (0.019) | (0.006) | (0.010) | (0.006) | (0.030) |
| SETI | 12.264*** | 7.093*** | 10.767*** | 10.968** | 11.583*** | 6.823*** | 4.577*** | 5.771*** | 4.947*** | 14.010*** |
| | (4.359) | (2.630) | (3.743) | (4.723) | (5.778) | (2.614) | (1.004) | (1.242) | (1.380) | (2.941) |
| Size | -5.307*** | -4.374*** | -5.067*** | -4.670*** | -5.689*** | -3.342*** | -2.911*** | -3.467*** | -3.711*** | -3.682*** |
| | (1.474) | (0.926) | (1.359) | (1.358) | (1.371) | (0.812) | (0.223) | (0.232) | (0.393) | (0.665) |
| ROE | -0.358 | -2.011 | 0.640 | 7.061 | -4.651 | 0.432*** | 0.808* | 0.638 | 0.367 | 1.971*** |
| | (0.522) | (4.011) | (0.461) | (0.628) | (8.598) | (0.292) | (0.484) | (0.480) | (0.647) | (2.569) |
| Liquidity | | 5.248*** | 4.691 | -0.719 | -3.394 | | 1.994** | 3.938*** | 1.956 | 3.779 |
| | | (1.527) | (5.069) | (6.120) | (5.049) | | (0.870) | (1.290) | (1.313) | (2.569) |
| IR | | | 1.169 | 0.675 | 3.395 | | | -1.072*** | -1.285*** | -0.271 |
| | | | (1.623) | (1.563) | (2.200) | | | (0.304) | (0.363) | (0.882) |
| Output gap | | | | 1.545 | 0.204 | | | | 1.719*** | 1.858** |
| | | | | (1.187) | (1.822) | | | | (0.176) | (0.853) |
| Credit Variation | | | | | -5.461 | | | | | -0.617 |
| | | | | | (25.096) | | | | | (1.371) |
| N. Obs | 244 | 243 | 245 | 244 | 244 | 226 | 245 | 245 | 246 | 245 |
| Inst./Cross | 0.463 | 0.659 | 0.488 | 0.524 | 0.561 | 0.789 | 0.927 | 0.927 | 0.878 | 0.829 |
| J-statistic | 13.267 | 25.385 | 15.964 | 18.803 | 17.326 | 20.8117 | 33.253 | 32.904 | 28.994 | 20.259 |
| Prob.(Jstatistic) | 0.581 | 0.279 | 0.316 | 0.223 | 0.300 | 0.700 | 0.454 | 0.423 | 0.465 | 0.779 |
| AR(1) | -11.144 | -2.077 | -3.155 | -2.638 | -2.459 | -0.379 | -0.377 | -0.372 | -0.385 | -0.379 |
| Prob | 0.000 | 0.038 | 0.002 | 0.008 | 0.014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| AR(2) | -0.041 | 0.161 | 0.306 | 0.208 | -0.040 | 0.747 | -1.514 | 0.075 | 0.082 | 0.074 |
| Prob | 0.967 | 0.871 | 0.759 | 0.835 | 0.968 | 0.226 | 0.189 | 0.219 | 0.168 | 0.226 |

**Notes**: Marginal significance level with (***) denotes 0.01, (**) denotes 0.05, and (*) denotes) 0.1 and standard errors are in parenthesis. In consonance with Arellano and Bond (1995), two-step S-GMM was applied as well as the consistent covariance matrix of White's heteroskedasticty. And, as suggested by Arellano and Bond (1991), D-GMM was applied.

Liquidity, in most of those cases, has a positive sign, displays statistical significance. Thus, banks with higher liquidity tend to be more stable. That is, when Banks are conservative with liquidity, they are less risky than more aggressive banks towards liquidity. Those results corroborate with what was found in Fu et al. (2014) and Kasman

and Kasman (2015). Moving into the next control variable and the first one that is not bank specific, the Brazilian's basic interest rate, when it has significance, it presents negative signal. One of the most likeable explanations for this relationship is that a higher interest rate presents more challenges for banks when talking about financial stability since higher interest rates may be seen as a proxy for higher risk of the financial system. Still in the macroeconomic landscape, the positive and significant sign in output gap displays once more the procyclical behavior in bank behavior. In other words, as banks expand, they are willing to take more risks when the economy is booming, but when it is in a downtrend, banks have a more secure and defensive position. Credit variation remained without statistical significance.

### 4.3 Capital Buffer

As shown in Table 3 regarding Capital Buffer, the third proxy for financial stability presents the relationship with SETI. Since all equations share the positive signal and statistical significance, this suggests that the more transparent banks are, especially due to market discipline, this presents more stability. In other words, Banks that propose and disclose their policies regarding social-environmental issues suffer from a greater pressure from different parts of society to fulfill their promises, crafting a more stable financial system.

Moreover, the positive signal and statistical significance of the lagged Capital Buffer reinforces the thesis that financial stability will last. It means that a more conservative bank tends to remain in the same position and banks with more chances to suffer with instability tend to remain in the same path. Moreover, the consistency in all outcomes suggest a strong relationship inside it as well as reinforces the findings regarding other variables since the persistent effect is controlled.

The first equation presents the outcome regarding the base line model for financial stability proxied by capital buffer. The bank size alongside the return on equity are the first control variables used, and the negative signal together with statistical significance ensure the thesis that bigger banks tend to mitigate risk by other measures than retaining more capital. Moreover, Return on Equity's variable with positive and statistical significance poses as the opposite of the classical risk and return dilemma, although the same

accountable explanation found in both previous models explains this, a priori, contradiction.

Table 3

Estimation on the relationship between social-environmental transparency and Financial Stability

| Dependent Variable: Capital Buffer | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | D-GMM | D-GMM | D-GMM | D-GMM | D-GMM | S-GMM | S-GMM | S-GMM | S-GMM | S-GMM |
| Equations | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Lagged Buffer | 0.326*** | 0.395*** | 0.275*** | 0.330*** | 0.360*** | 0.330*** | 0.463*** | 0.473*** | 0.604*** | 0.444*** |
| | (0.0146) | (0.020) | (0.0291) | (0.027) | (0.025) | (0.012) | (0.025) | (0.022) | (0.047) | (0.024) |
| SETI | 0.094*** | 0.063*** | 0.241*** | 0.143*** | 0.240*** | 0.239*** | 0.220*** | 0.230*** | 0.163*** | 0.243*** |
| | (0.017) | (0.021) | (0.031) | (0.027) | (0.028) | (0.063) | (0.023) | (0.032) | (0.043) | (0.039) |
| Size | -0.082*** | -0.082*** | -0.018 | -0.081*** | -0.117*** | -0.060 | -0.109*** | -0.080*** | -0.062*** | -0.073*** |
| | (0.004) | (0.094) | (0.014) | (0.010) | (0.010) | (0.025) | (0.100) | (0.120) | (0.015) | (0.014) |
| ROE | -0.0003 | 0.031* | -0.001 | 0.085 | -0.006 | -0.017 | 0.030* | 0.065*** | 0.007 | 0.189*** |
| | (0.004) | (0.016) | (0.014) | (0.016) | (0.009) | (0.048) | (0.154) | (0.015) | (0.005) | (0.050) |
| Liquidity | | 0.177*** | 0.138*** | 0.153*** | 0.175*** | | 0.152*** | 0.189*** | 0.237*** | 0.189*** |
| | | (0.016) | (0.009) | (0.014) | (0.007) | | (0.008) | (0.012) | (0.036) | (0.021) |
| IR | | | -0.0248** | -0.042*** | -0.029*** | | | -0.014* | -0.065*** | -0.078*** |
| | | | (0.010) | (-0.009) | (0.009) | | | (0.008) | (0.01478) | (0.013) |
| Output gap | | | | 0.037*** | 0.023*** | | | | 0.005 | 0.007 |
| | | | | (0.007) | (0.004) | | | | (0.009) | (0.010) |
| Credit Variation | | | | | 0.0042 | | | | | -0.069*** |
| | | | | | (0.102) | | | | | (0.020) |
| N. Obs | 244 | 244 | 285 | 244 | 244 | 244 | 244 | 285 | 244 | 243 |
| Inst./Cross | 0.756 | 0.707 | 0.707 | 0.780 | 0.878 | 0.439 | 0.756 | 0.732 | 0.634 | 0.780 |
| J-statistic | 34.124 | 27.106 | 31.288 | 30.185 | 32.975 | 16.560 | 29.541 | 25.530 | 20.110 | 27.042 |
| Prob.(Jstatistic) | 0.162 | 0.300 | 0.116 | 0.217 | 0.237 | 0.280 | 0.287 | 0.377 | 0.388 | 0.302 |
| AR(1) | -2.232 | -3.569 | -2.414 | -3.698 | -2.463 | -0.234 | -0.234 | -0.383 | -0.267 | -0.241 |
| Prob | 0.026 | 0.000 | 0.016 | 0.000 | 0.014 | 0.0005 | 0.000 | 0.000 | 0.000 | 0.000 |
| AR(2) | -1.123 | -0.641 | -1.552 | -0.702 | -1.506 | -0.093 | -0.105 | -0.079 | -0.067 | -0.102 |
| Prob | 0.261 | 0.521 | 0.121 | 0.483 | 0.132 | 0.248 | 0.169 | 0.197 | 0.369 | 0.207 |

Notes: Marginal significance level with (***) denotes 0.01, (**) denotes 0.05, and (*) denotes) 0.1 and standard errors are in parenthesis. In consonance with Arellano and Bond (1995), two-step S-GMM was applied as well as the consistent covariance matrix of White's heteroskedasticity. And, as suggested by Arellano and Bond (1991), D-GMM was applied.

Furthermore, the other control variables, among macroeconomic and singular to banks, presented expected signals and statistical significance, reinforcing the findings in the transparency index. Liquidity presented positive signal and statistical. This has a simple justification indicating that banks with higher liquidity tend to suffer less risks. The first macroeconomic variable added to the model, the Brazilian's basic Interest Rate, shares the same negative signal with significance, crafting more arguments concerning the view that high interest rate is likely to be seen as a higher risk in the Brazilian landscape. A positive and statistically significant result in the output gap might be explained by the non-lagged variable where the banks could not enlarge or reduce the credit portfolio in the same velocity that the economic growth or downtrend happened, thus enlarging their Capital Buffer. Worth noticing, during the time used in this database, Brazil experienced a crisis, fast growth, and slow growth, thus this lag might be banks waiting for the economic trend to be consolidated. The credit variation presents a negative signal with statistical significance, enforcing the findings made De Moraes and Costa (2022).

## 5. Robustness analysis

By providing a robust analysis, it is possible to provide insights with more confidence, which means that we need to replicate the same outcome with different risk measures. In this case, Provisions (PROV) is the proxy for financial stability. As suggested by De Mendonça and De Moraes (2019), provisions is a measure of coverage for credit loss also used for measuring financial stability since banks with higher provisions normally present a more conservative behavior. All other aspects of the study remained the same,

Table 4 shows all outputs from the models and equations. The positive relationship between the provisions and transparency index reinforces the hypothesis crafted on this article and tested within models. This relationship may seem as contradictory but enlarging bank provisions is seen as an insurance for the bank. In other words, by growing the number of provisions, banks are preparing for a worst-case scenario of credit default.

Table 4

Estimation on the relationship between social-environmental transparency and Financial Stability

| Dependent Variable: Prov | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | D-GMM | D-GMM | D-GMM | D-GMM | D-GMM | S-GMM | S-GMM | S-GMM | S-GMM | S-GMM |
| Equations | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Lagged Prov | 0.181*** | 0.126*** | 0.148*** | 0.060*** | 0.116*** | 0.413*** | 0.390*** | 0.186*** | 0.391*** | 0.352*** |
| | (0.035) | (0.038) | (0.034) | (0.015) | (0.034) | (0.048) | (0.070) | (0.032) | (0.014) | (0.023) |
| SETI | 0.002*** | 0.002*** | 0.002*** | 0.001*** | 0.0062*** | 0.005*** | 0.005*** | 0.002*** | 0.004*** | 0.005*** |
| | (0.001) | (0.001) | (0.001) | (0.0003) | (0.001) | (0.001) | (0.002) | (0.001) | (0.0004) | (0.001) |
| Size | -0.0001 | -0.0008 | -0.0002 | -0.001*** | -0.001*** | -0.001*** | -0.001*** | -0.001*** | -0.001*** | -0.013*** |
| | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0002) | (0.0003) | (0.004) | (0.004) | (0.0001) | (0.0002) |
| ROE | -0.001*** | -0.002*** | -0.001*** | -0.0014*** | -0.0021*** | -0.002*** | -0.002*** | -0.002*** | -0.002*** | -0.002*** |
| | (0.0002) | (0.0002) | (0.002) | (0.0002) | (0.0002) | (0.0002) | (0.002) | (0.0003) | (0.0001) | (0.0002) |
| Liquidity | | 0.0008* | 0.0009* | 0.0023*** | -0.0051*** | | 0.0005 | 0.0001 | 0.0001 | 0.0002 |
| | | (0.0004) | (0.004) | (0.0005) | (0.0011) | | (0.001) | (0.0006) | (0.0002) | (0.0006) |
| IR | | | 0.0004 | 0.001*** | 0.001*** | | | | 0.001*** | 0.0005 |
| | | | (0.005) | (0.0003) | (0.001) | | | | (0.0002) | (0.0003) |
| Output gap | | | | -0.003*** | -0.001*** | | | | -0.001*** | -0.002*** |
| | | | | (0.0002) | (0.0002) | | | | (0.0001) | (0.001) |
| Credit Variation | | | | | -0.0041*** | | | | | -0.002*** |
| | | | | | (0.0006) | | | | | (0.0008) |
| N. Obs | 287 | 287 | 287 | 246 | 246 | 246 | 246 | 287 | 244 | 244 |
| Inst./Cross | 0.732 | 0.732 | 0.780 | 0.878 | 0.927 | 0.659 | 0.659 | 0.707 | 0.951 | 0.853 |
| J-statistic | 29.233 | 28.207 | 28.220 | 28.235 | 30.339 | 24.679 | 25.330 | 27.443 | 32.620 | 27.542 |
| Prob.(Jstatistic) | 0.301 | 0.298 | 0.348 | 0.505 | 0.448 | 0.367 | 0.281 | 0.237 | 0.436 | 0.435 |
| AR(1) | -3.052 | -2.689 | -2.376 | -3.135 | -3.451 | -0.437 | -0.431 | -0.403 | -0.431 | -0.423 |
| Prob | 0.002 | 0.007 | 0.018 | 0.002 | 0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| AR(2) | -0.329 | -0.164 | -0.506 | -0.802 | -0.823 | -0.035 | -0.039 | -0.022 | -0.0632 | -0.089 |
| Prob | 0.742 | 0.870 | 0.613 | 0.410 | 0.410 | 0.702 | 0.665 | 0.758 | 0.494 | 0.3596 |

**Notes** Marginal significance levels with (***) denotes 0.01, (**) denotes 0.05, and (*) denotes) 0.1 and standard errors are in parenthesis. In consonance with Arellano and Bond (1995,) two-step S-GMM was applied as well as the consistent covariance matrix of White's heteroskedasticty. And, as suggested by Arellano and Bond (1991), D-GMM was applied.

A high number of provisions means that banks are being conservative in scenario planning. Moreover, the positive signal and statistical relevance of this model shows that banks with higher transparency in sustainability policies tend to have a more conservative approach regarding losses, thus preparing for a higher number of non-paid loans and safeguarding the financial stability.

## 6. Further Analysis

In the process of understanding how beneficial transparency in social-environmental policies can be to financial stability, we simulated a shock of transparency in two different fashions as used in De Mendonça and Silva (2018). Firstly, by a shock of 1 standard deviation on the average value of SETI. Secondly, by a shock of a 10% increase in the same average value of SETI. The Coefficient of SETI in the S-GMM case (eq 10) from tables 1 to 3 were used and compared respectively with their dependent variable (Zscore1, Zscore2, and Buffer). As shown in table 5, in all three proxies in both types of shock there was a positive impact. It is worth saying that due to the high standard deviation in the SETI variable as shown in De Moraes and et al. (2022), a higher percentage were expected in comparison with the 10% shock. In accordance with previous results, this outcome confirms that reinforcing transparency in social-environmental policies can impact positively the financial stability.

Table 5

Effect of a shock in transparency in social-environmental policy on financial stability

| Variable | 10% shock | 1 SD shock |
|---|---|---|
| Zscore1 | 3.1% | 39.9% |
| Zscore2 | 5.5% | 71.2% |
| Buffer | 2.3% | 30.3% |

Note: The effects were computed with the average value of SETI and all Effects computed from the coefficients used were always from eq. 10 where all of them had a statistical significance.

## 7.Conclusion

To investigate the impact of transparency on social-environmental policies in Brazilian financial stability we used a dynamic panel with different proxies for financial stability while using an index that measures transparency in those policies. The results found show a positive relationship with statistical significance. In other words, the higher the transparency in these types of policies, the lower is the chance of a possible stress on financial stability of Brazilian banks. This study sheds light on an important issue on how to prevent distress in the financial system, especially related to climate change. Moreover, all findings give to authorities and regulators good insights on how to enhance regulation. Another interesting insight is that the 3rd pillar of Basel III is correctly being expanded to climate issues as this study builds evidence that disclosing risks related to climate change and policies to mitigate them enhances financial stability.

## 8. Appendix

Table A.1 – Social-Environmental Transparency Index parameters

| *Parameter* | *Representation* | *Value* | *Category* |
|---|---|---|---|
| Social Environmental Responsibility Policy | Sustainable/Social Environmental Responsibility Policy | 0 (does not have)<br>1 (has) | General Framework |
| Sustainability Strategy | Sustainability Strategy | 0 (does not have)<br>1 (has) | |
| Social Environmental Responsibility Committee | Sustainable/Social Environmental Responsibility Committee | 0 (does not have)<br>1 (has) | |
| Report | Publishes an annual report related to sustainability | 0 (not found)<br>0.5 (sustainability report)<br>1 (integrated report) | Report |
| External Assurance | The report is verified by an independent entity | 0 (yes)<br>1 (no) | |
| GRI | Sustainability Reporting Standard from Global Reporting Institute | 0 (does not declare adherence)<br>0.5 (option "core")<br>1 (option "comprehensive") | Reporting Standard |

| | | | |
|---|---|---|---|
| SASB | Sustainability Reporting Standard from Sustainability Accounting Standards Board | 0 (does not declare adherence)<br>1 (declares adherence) | |
| TCFD | Recommendations from the Task Force on Climate-Related Financial Disclosure | 0 (does not declare complete adherence)<br>1 (declares complete adherence) | |
| Section on website | Has an exclusive section for sustainability information | 0 (not found) 1 (found) | Website |

## Table A.2 - Banks

List of Banks

| | | | | | |
|---|---|---|---|---|---|
| ABC-Brasil | Banco da Amazônia | Sumitomo Mitsui | Caixa Econômica Federal | Itau | Safra |
| Banco Alfa | Daycoval | BMG | CCB | John Deere | Santander |
| Bancoob | Banpará | BNP Paribas | Citibank | JP Morgan Chase | Sicred |
| Banestes | Banco do Nordeste | Bofa Merril Lynch | Credit Agricole | Mercantil | Societe Generale |
| Banrisul | Banco Fibra | Bradesco | Credit Suisse | Morgan Stanley | Votorantim |
| *Banco do Brasil* | *Mufg Brasil.* | *BRB* | *Deutsche* | Original | *XP* |
| *Clássico* | *Rabobank* | *BTG Pactual* | *ING* | *PAN* | |

## Table A.3 – Descriptive Statistics

| Variable | Description | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| SETI | Social-Environmental Transparency Index created by De Moraes et al. (2022) | 1.7 | 2.2 | 0.00 | 7.5 |
| Zscore1 | Proxy for Financial Stability calculated as: (ROA + CAR)/ σ ROA | 29.3 | 30.7 | -1.2 | 277.5 |
| Zscore2 | Proxy for Financial Stability calculated as: (ROA + LEV)/ σ ROA | 43.8 | 47.7 | -1.1 | 397.0 |
| CAR | A ratio calculated as: banks' capital/ risk-weighted assets | 0.19 | 0.09 | 0.10 | 0.74 |
| LEV | Adjusted Equity/ total asset | 0.15 | 0.12 | 0.02 | 0.79 |
| Provisions | A ratio calculated as: coverage for credit losses/ the volume of total credit. | 0.04 | 0.03 | 0.0 | 0.1 |
| Buffer | Actual CAR held by banks/ Minimum required by regulator (BCB) | 1.7 | 0.8 | 0.9 | 6.7 |
| Liquidity | Liquid assets/total asset ratio | 0.3 | 0.1 | 0.0 | 0.9 |
| Size | Log of bank's total assets. | 23.9 | 1.5 | 21.1 | 27.9 |
| Roe | Net income (on the last quarter)/shareholder's equity ratio | 0.13 | 0.2 | -0.9 | 1.0 |
| Roa | Net income (on the last quarter)/total asset ratio | 0.01 | 0.02 | -0.2 | 0.1 |
| IR | The Brazilian basic interest rate used as a tool for monetary policy. | 5.17 | 0.8 | 4.5 | 7.0 |
| Output | Brazilian Business Cycle: The difference between the GDP and the potential output calculated as in Hamilton (2018) | 0.6 | 1.9 | -1.9 | 4.1 |
| Credit variation | Growth rate of individuals banks' credit. Calculated by the difference between the difference between the credit in relation to the previous period. | 0.05 | 7.3 | -0.7 | 7.3 |

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