Integration and Financial Stability: A Post-Global Crisis Assessment

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Abstract

In this study, we revisit the debate regarding the effects of financial openness on financial stability. In contrast to previous studies, our approach involves measuring the direct influences of openness on stability through a varied set of proxies used to capture the diverse dimensions of both of these concepts within a unified estimation framework. Employing state-of-the-art machine learning techniques, our estimates enable us to isolate the focal effects while controlling for a comprehensive set of macroeconomic, political, and institutional variables. Covering the period spanning 2010 to 2020 across 45 countries, our results indicate that, in the majority of cases, increased financial openness is beneficial for financial stability. Greater levels of integration tends to reduce the ratio of nonperforming loans to total loans, concurrently improving capital adequacy ratios and the ratio of provisions to nonperforming loans. Additionally, heightened openness leads to an increase in the levels of bank liquidity. Importantly, these enhancements to financial stability occur without any adverse effects on bank profitability. This suggests that policies aimed at fostering greater integration with global financial markets and promoting increased bank competition can exert positive impacts on financial stability without compromising bank profitability.

Keywords: Openness; integration; Financial stability; Double-Debiased Machine Learning.
JEL Codes: F21; F32; G21; G28.

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1. Introduction[6]

The impact of financial integration on financial stability is an intricate subject that has garnered extensive scholarly debate in regard to both its advantageous and deleterious dimensions. The crux of the discourse has predominantly centered around appraising the consequences of financial globalization on middle-income emerging markets that aspire to attain levels of prosperity and stability that characterize advanced industrial economies (Summers, 2000). Notably, the theoretical literature unequivocally suggests a positive relationship between financial integration and economic growth, between that and financial development, and between that and financial stability. However, the extant empirical investigations present a somewhat discordant narrative, revealing conflicting evidence regarding the anticipated outcomes[7].

From a theoretical perspective, financial globalization offers two main advantages. First, it homogenizes the costs of capital across countries, which mostly benefits those countries in which capital is scarce, and hence it results in a low capital-to-labor ratio by reducing the cost of moving capital across national borders. Empirical evidence indicates that the implementation of capital controls, which curtail openness, results in heightened capital costs for firms, particularly for smaller enterprises. For instance, in an examination of firm-level data in Chile covering the period ranging from before to after its capital control regime (1991 to 1998), Forbes (2007) revealed an increase in the cost of capital for smaller traded firms during the capital control period. Larger firms did not seem to encounter intensified liquidity constraints during the same period, which is potentially attributable to their enhanced ability to more readily access domestic savings. Similar results are reported by Wei and Zhang (2007) using a sample of 184 countries in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). They estimated that a one-standard-deviation increase in restrictions on foreign exchange transactions within their sample exerted an equivalent adverse impact on trade that resulted in an 11-percentage-point increase in tariffs.

Second, financial globalization tends to facilitate more streamlined international risk-sharing mechanisms (Backus et al., 1995; Pakko, 1998). The reduction of financing constraints afforded by openness can enhance the resilience of financial systems, fostering smoother consumption and investment patterns that, in turn, mitigate volatility (Pakko, 1998; Sorensen et al., 2007). Finally, financial integration has been associated with diminished macroeconomic volatility, which further fortifies the case for its positive influence on financial stability through enhanced risk-sharing capacities (Evans and Hnatkovska, 2007).

[6] The opinions in this paper are those of the authors and do not commit FLAR or its directory board.

[7] See for instance, the recent studies by Yu et al. (2010), Fecht et al. (2012), Aizenman and Pinto (2013), De Nicolò and Juvenal (2014), Ahrend, and Goujard (2014a,b), Aizenman (2019), Neanidis (2019), Durdu et al. (2020), Eslamloueyan and Fatemifar (2021), Chen (2023), Kouretas et al. (2022). We examine a selection of these studies and make reference to other classical works in the backgrounding of our contribution.

While the theoretical literature unequivocally suggests a positive correlation between increased financial integration and international risk-sharing, empirical investigations present a somewhat discordant narrative, revealing conflicting evidence regarding the anticipated outcomes. As posited by Kose et al. (2009), the degree of international risk sharing is, at most, modest, and it falls substantially short of the levels projected by theoretical frameworks. Notably, optimal risk-sharing outcomes during the recent globalization era have been largely confined to industrialized nations, leaving developing countries largely excluded from this advantage.

Again, from a theoretical perspective, financial globalization is proposed to be generally advantageous for financial development. This phenomenon is beneficial in enhancing institutional effectiveness and financial progress through the adoption of international accounting standards, the incorporation of international financial intermediaries, the enhancement of corporate governance practices, the advancements in technical capabilities, and the reinforcement of market discipline.

Nevertheless, instances such as the global financial crisis, the European debt crisis, and the Asian crisis at the end of the Twentieth century have highlighted some of the disadvantages that are associated with heightened financial globalization. The drawbacks of financial openness on financial stability include heightened volatility in financial markets, susceptibility to external shocks, and difficulties in effectively managing capital flows. The process of financial openness often results in a deeper integration with global financial markets, which exposes domestic financial systems to external shocks and contagion stemming from international financial crises (Pundit, 2015). Furthermore, the surge in capital flows accompanying financial openness can amplify the level of volatility in exchange rates, asset prices, and interest rates, posing challenges for the management of domestic monetary and fiscal policies (Eichengreen and Arteta, 2002).

Increased openness might induce a more pronounced risk-taking stance for domestic financial institutions. In the quest for higher returns within an intensified global competitive environment, these institutions might choose to engage in riskier practices, potentially contributing to the instability and systemic risks facing the financial system (Kaminsky and Reinhart, 1999). A significant source of macroeconomic vulnerability, particularly in emerging market economies, is the volatility of substantial capital flows, which can contribute to the accumulation of sizable imbalances and systemic financial risk. The recent literature underscores that the positive impacts of capital flows are more pronounced in countries where institutional arrangements, financial structures, and macroeconomic and fiscal policies are conducive to safely facilitating such flows (e.g., Igan et al., 2016; Schroth, 2016). On the empirical side, recent studies by Durdo et al. (2020), Eslamloueyan and Fatemifar (2021), Chen (2022) and Kouretas et al. (2022) offer additional assessments of the shortcomings of greater financial openness in the dimension of financial instability.

Recognizing these challenges, numerous countries have undertaken reforms, including the implementation of macroprudential policies, to fortify the resilience of their financial systems against shocks, particularly against those shocks that emanate from the volatility of international capital flows. Macroprudential policies, as a complement to sound macroeconomic strategies and robust financial supervision and regulation, assume a crucial role in assisting countries in harnessing the benefits of capital flows and achieving sound credit growth while mitigating the adverse effects associated with their inherent volatility. This holds particular significance in economies that rely on commodities, where these capital flows are closely linked to fluctuations in international commodity prices.

Macroprudential policies, which have been demonstrated to be effective in various contexts (refer to, for instance, Neanidis, 2019; Kouretas et al., 2022; Giraldo et al., 2023), also incur associated costs. Notably, these policies introduce complexities that can hinder the development of financial markets in the countries where they are implemented.

The debate surrounding the efficacy of capital controls and alternative measures aimed at restricting the financial openness of countries, and that regarding their enduring consequences, remains a subject of ongoing deliberation. The extensive and inconclusive nature of the literature on this matter can be attributed, in large part, to the divergent foci across various studies. These divergences encompass disparate time periods, varied country samples, distinct empirical methodologies, and diverse approaches to measuring both treatment and outcome variables, financial stability and financial openness.

In this context, an important additional challenge is quantifying those effects that transcend the simple correlation between openness and financial stability, as there are arguments that can justify feedback relationships in both directions.

Taking all this into account, we aim to make a significant contribution to our understanding of the effect of openness on financial stability. Our dataset covers annual data for 45 developed and developing countries, covering the period from 2010 to 2020. First, we use several different measures for our treatment and outcome variables. On the one hand, we use various indicators of economic and financial openness, considering that each of these proxies is used to measure different aspects of financial integration. On the other hand, we consider different proxies for financial stability in acknowledgement of the various aspects entailed by this unobserved variable. Second, we use a considerably long period of time and a large sample of countries, which enables us to evaluate the long-term effects of openness on financial stability. Finally, we use a double debiased machine learning model to carry out our estimations. Double machine learning models are valuable for estimating direct effects in observational studies because they can effectively address high-dimensional

sets of confounders. In short, the application of DDML allows us to estimate the treatment effects of openness on financial stability while controlling for a wide range of macroeconomic covariates that could potential be confounders.

Our primary findings indicate that, overall, financial openness tends to be advantageous for financial stability. Using four out of the five proxies analyzed, heightened levels of openness are associated with diminished ratios of nonperforming loans to total loans and/or increased capital adequacy ratios. Additionally, greater openness generally leads to a heightened level of bank liquidity, which is a favorable attribute for maintaining financial stability. Interestingly, the impact of openness on bank profitability is inconspicuous, suggesting that intensified competition in global markets does not notably affect the profitability of local banks. Notably, the outcomes delineated in Table 4 underscore the fact that when openness involves mere receptiveness to increased capital inflows, it may pose a risk to financial stability due to heightened vulnerability to the abrupt stops that are linked with substantial capital surges.

Our results hold substantial policy implications and suggest pathways for further exploration. On the policy front, our results signify that a deeper integration with global financial markets has a positive influence on financial stability, while preserving bank profitability. This implies that policy-makers, especially those in nations with emerging financial markets, should contemplate implementing measures to facilitate integration with global markets, including easing the restrictions on capital inflows. While macroprudential policies may be advantageous in specific market conditions, our results advise against their permanent adoption as a strategy for insulating financial systems from global markets. A protracted reliance on such an approach can impede financial development and hinder long-term financial stability.

From an academic perspective, our findings stress the importance of prudence in selecting a proxy for openness. The specific choice of this variable can yield distinct outcomes that may not be reproducible under alternative proxies. Furthermore, considering the myriad potential confounding factors that can influence causal relationships, researchers should employ techniques, such as double machine learning, to effectively unravel any direct effects. Importantly, the different dimensions of financial stability are influenced in varying ways by diverse financial openness proxies. As a result, researchers must carefully select financial stability proxies based on the specific research question posed.

The remainder of this paper is structured as follows: The second section delineates the methodology employed in this study, providing insights into our analytical approach. Next, the third section furnishes details on the dataset utilized for our analysis. The fourth section encapsulates the primary findings, and the concluding section succinctly summarizes and concludes the study.

2. Methodology

Our methodology consists of two parts. In the first part, we describe the imputation algorithm that we used to complete our dataset, while in the second part, we describe the double-debiased machine learning algorithm that we use to estimate the effects of financial openness across its various dimensions on the financial soundness indicators.

2.1. Random Forest

Completing missing values in a dataset using the Random Forest (RF) algorithm involves integrating the algorithm into a predictive modeling framework and treating the absent values as target variable. To this end, we adopt the methodology introduced by Stekhoven and Bühlmann (2012). The efficacy of the Random Forest algorithm lies in its adept handling of intricate and nonlinear relationships within the data and its ensemble nature, which not only alleviates overfitting but also enhances versatility, rendering it less susceptible to noise. The incorporation of both categorical and continuous variables in our dataset further supports the preference for Random Forest over factor-based alternatives.

Let $x = \left(x_1, x_2, \ldots, x_p\right)$ represent an $n \times p$ matrix of data. Following the approach of Stekhoven and Bühlmann (2012), we directly predict the missing values using Random Forest estimated on the observed variables present in the dataset. That is, for any arbitrary variable x_s, which includes missing points at entries $i_s^{NA} \in \{1, \ldots, n\}$, the dataset can be categorized into four parts: 1) the nonmissing values of x_s; 2) the missing observations; 3) the variables that differ from s, with observations; and 4) the variables other than x_s, with observations.

The RF is initiated by making an initial guess for the missing values in x, such as the mode value. Subsequently, the variables $x_s,\ s = 1, \ldots, p$ are organized based on the number of missing observations. For each variable x_s, the missing values are filled in by estimating a Random Forest using the response variable in the second part above, and the remaining variables each year serve as the predictors. The algorithm then progresses by predicting the missing values through the application of the estimated Random Forest. This iterative process continues until a predetermined stopping criterion is satisfied. We use a random forest consisting of 100 trees in each forest, with sampling of the square root of the number of variables at each split, as suggested by Stekhoven and Bühlmann (2012).

2.2. Double Debiased Machine Learning

We adopt the methodology proposed by Chernozhukov et al. (2018) and adapt the relevant notation to our specific case. When delving into causal relationships, particularly in observational studies where randomization is infeasible, such as ours, controlling for other variables, which are termed confounders, becomes essential.

In our study, there are many potential control variables. Thus, for the multifaceted nature of financial stability, it is imperative to meticulously select the most relevant control variables before proceeding with the analysis, particularly as our primary focus is on examining the impact of financial openness across its several dimensions. The relationship between these variables and their associations with both financial openness and financial stability may be intricate and could potentially involve nonlinearities and interactions.

In such scenarios, machine-learning algorithms such as tree-based methods, along with regularization and shrinkage techniques, are well suited for variable selection. However, using these methods to select from an initially extensive set of control variables introduces a form of bias known as regularization bias. This bias can impact the subsequent estimations of causal effects. Double Debiased Machine Learning (DDML) is a method specifically designed to estimate causal effects in the presence of a high number of confounders.

In our case, we represent our problem as a partially linear regression model (Robinson, 1988) with the following equations:

$$FSI_{i,t} = \alpha FOI_{i,t} + g_0(X_{i,t}) + u_{i,n,t}, \tag{1}$$

$$FOI_{i,t} = m_0(X_{i,t}) + v_{i,n,t}, \tag{2}$$

where $FSI_{i,t}$ is a given financial soundness indicator for country i and year t, and $FOI_{i,t}$ is a given financial openness indicator for country i and year t.

DDML, developed by Chernozhukov et al. (2018), enables us to accurately estimate the functions $g_0(\cdot)$ and $m_0(\cdot)$, which can either be linear or not. DDML also enables the correction of preselection bias through a procedure known as postdouble selection (Belloni et al., 2014).

The model can be rewritten in residual form as follows:

$$v = FOI - m_0(X), \tag{3}$$

$$w = \left(\Phi - l_o(X)\right), \tag{4}$$

$$w = v\alpha + u, \tag{5}$$

where $l_o(X) = E(\Phi|X) = \alpha m_0(X) + g_0(X)$, $E(u|FOI, X) = 0$, $E(v|X) = 0$, and $m_0(X) = E(FOI|X)$. The variables w and v represent the original variables after removing the effect of X, which is known as partialling out the effect of X. In Equation (5), α is identified whenever $var(v) \neq 0$.

The estimation algorithm of the PRL model involves:

1. Estimating l_o and m_0 by $\hat{l}_o$ and $\hat{m}_0$, as solved by predicting Φ and FOI using a generic machine-learning method (e.g., random forest).

2. Estimating α by regressing the residual $\hat{w}$ on $\hat{v}$ using conventional inference tools.

For inference, constructing point and interval estimators with maximum likelihoods involves the method-of-moment estimator for α, based on the empirical moment condition. The Neyman orthogonality condition is satisfied:

$$\partial_\eta E[\psi(w; \alpha, \eta_0)]|_{\eta=\eta_0} = 0. \tag{6}$$

Employing a Neyman-orthogonal score makes the α estimation robust against first-order bias arising from regularization. In the PRL model, we select the partialling-out score. This is the method we followed for DDML estimation, considering that the cross-fitting nature of the problem involves splitting the sample $(w_i)_{I=1}^N$ into K fragments and estimating a random forest for each part. The causal effect is obtained via aggregation.

3. Data

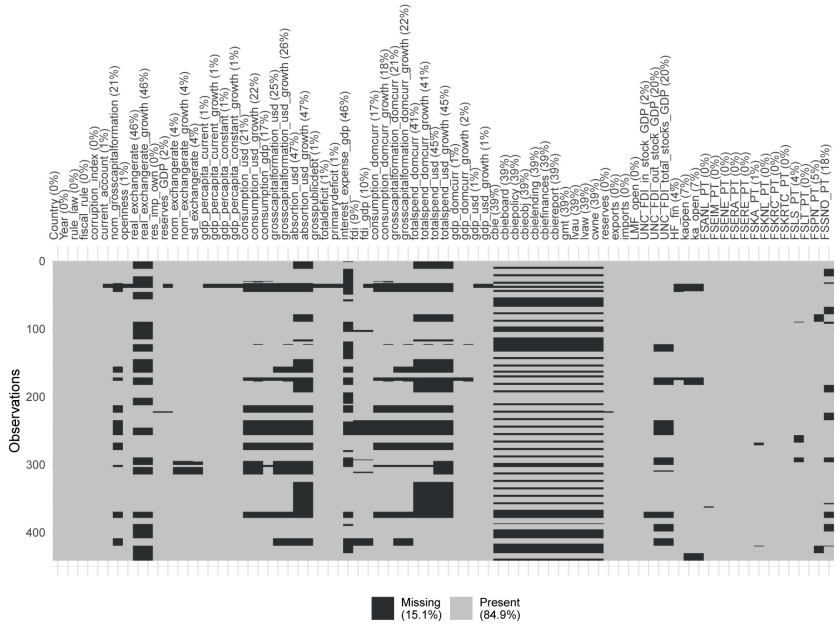
As previously stated, the primary objective of this paper is to examine the effect of increased openness on financial stability while acknowledging the multifaceted dimensions inherent in these two variables. To this end, we compile a comprehensive database sourced from various outlets that encompasses 45 countries spanning both developed and developing regions (see Table A1 in the Appendix). The dataset incorporates annual data covering the period spanning from 2010 to 2020.

The database encompasses the primary variables of interest—namely, the treatment and outcome varia-

bles—alongside an extensive array of potential confounding variables. We employ the DDML algorithm to control for these variables. Table A2 in the Appendix provides a comprehensive overview of each indicator, along with their respective definitions and sources.

Next, we consider the variables of primary interest. We examine five proxies for openness, sourced from the IMF, UNCTAD, and Chinn and Ito (as detailed in Table A2). These proxies include the ratio of Total Foreign Assets plus Total Foreign Liabilities to GDP, Foreign Investors' Equity In and Net Loans to Resident Enterprise, Net FDI as a percentage of GDP, the Financial Openness Index, and the Normalized Financial Openness Index. The first three serve as de facto measures for openness, reflecting actual external financial positions, while the latter two represent *de jure* measures that rely on the legal restrictions of capital flows. In contrast to most studies that focus on a single type of measure, we adopt a comprehensive approach by incorporating both de jure and de facto measures in our analysis. De jure measures are used to assess openness based on legal constraints on capital flows, whereas de facto measures are used to gauge openness through actual external financial positions. Thus we encompass a broad spectrum of openness proxies that capture the various facets inherent to this concept. Our dataset is marked by numerous instances of missing observations, which predominantly apply to certain developing countries where information tends to be more limited and opaque. Figure 1 illustrates the missing patterns across the entire dataset. It is noteworthy that 15.1% of the entries exhibit missing values.

Figure 1. Analysis of missing values across the whole dataset



Note: The figure shows the patterns of missing data in our original dataset. The full set of variables is described in Table A1 in the Appendix.

We addressed missing values by following the method of Stekhoven and Bühlmann (2012), which we previously described. The descriptive statistics for the main variables are provided in Tables 1 (preimputation) and 2 (postimputation). Upon juxtaposing Tables 1 and 2, discernible distinctions in the descriptive statistics prior to and post imputation emerge. It is imperative to note, however, that these variances lack systematicity and are deemed unlikely to exert any substantive influence on the outcomes of this study.

Table 1. Descriptive statistics preimputation. Treatment and outcome variables

Indicator	Abreviation	Source	Mean	Median	Std.Dev	Max.	Min.
Nonperforming Loans to Total Gross Loans	FSANL_PT	FSI-IFS- IMF	7.17	4.41	7.42	47.75	0.96
Interest Margin to Gross Income	FSEIM_PT	FSI-IFS- IMF	55.52	61.36	49.69	91.63	-658.82
Noninterest Expenses to Gross Income	FSENE_PT	FSI-IFS- IMF	63.19	60.44	15.01	115.79	30.59
Return on Assets	FSERA_PT	FSI-IFS- IMF	1.62	1.51	1.34	6.35	-4.6
Return on Equity	FSERE_PT	FSI-IFS- IMF	10.34	10.52	11.15	46.42	-63.96
Tier 1 Capital to Assets	FSKA_PT	FSI-IFS- IMF	9.2	9.07	2.91	18.98	2.68
Nonperforming Loans Net of Provisions to Capital	FSKNL_PT	FSI-IFS- IMF	18.66	11.35	41.83	299.03	-17.29
Regulatory Capital to Risk-Weighted Assets	FSKRC_PT	FSI-IFS- IMF	17.13	17.17	3.74	30.46	5.47
Tier 1 Capital to Risk-Weighted Assets	FSKRTC_PT	FSI-IFS- IMF	14.91	14.31	3.91	29.97	5.3
Liquid Assets to Short-Term Liabilities	FSLS_PT	FSI-IFS- IMF	82.97	50.51	85.69	503.08	14.09
Liquid Assets to Total Assets	FSLT_PT	FSI-IFS- IMF	25.44	25.9	7.98	58.95	10.01
Provisions to Nonperforming Loans	FSPN_PT	FSI-IFS- IMF	85.73	70.19	50.87	314.02	21.47
Net Open Position in Foreign Exchange to Capital	FSSNO_PT	FSI-IFS- IMF	16.56	4.03	48.33	407.97	-59.4
Total Foreign Assests and Total Foreign Liabilities in % GDP	LMF_open	Lane and Milesi-Ferretti (2017)	-43.74	-43.59	51.72	76.39	-227.93
Foreign Investors' Equity In and Net Loans to Resident Enterprise	UNC_FDI_in_stock_GDP	UNCTAD (2023)	119.84	38.72	342.51	1962.87	0.6
Net FDI as percent of GDP	UNC_FDI_total_stocks_GDP	UNCTAD (2023)	34.69	34.67	41.78	313.41	-104.24
Financial Openness Index	kaopen	Chinn-Ito	0.25	-0.16	1.54	2.31	-1.93
Normalized Financial Openness Index	ka_open	Chinn-Ito	0.51	0.42	0.36	1	0

Note: The table shows the main variables used in this study, the variable descriptions, the sources of information and the summary statistics in the last 5 columns prior to the missing value imputations.

Table 2. Descriptive statistics postimputation. Treatment and outcome variables

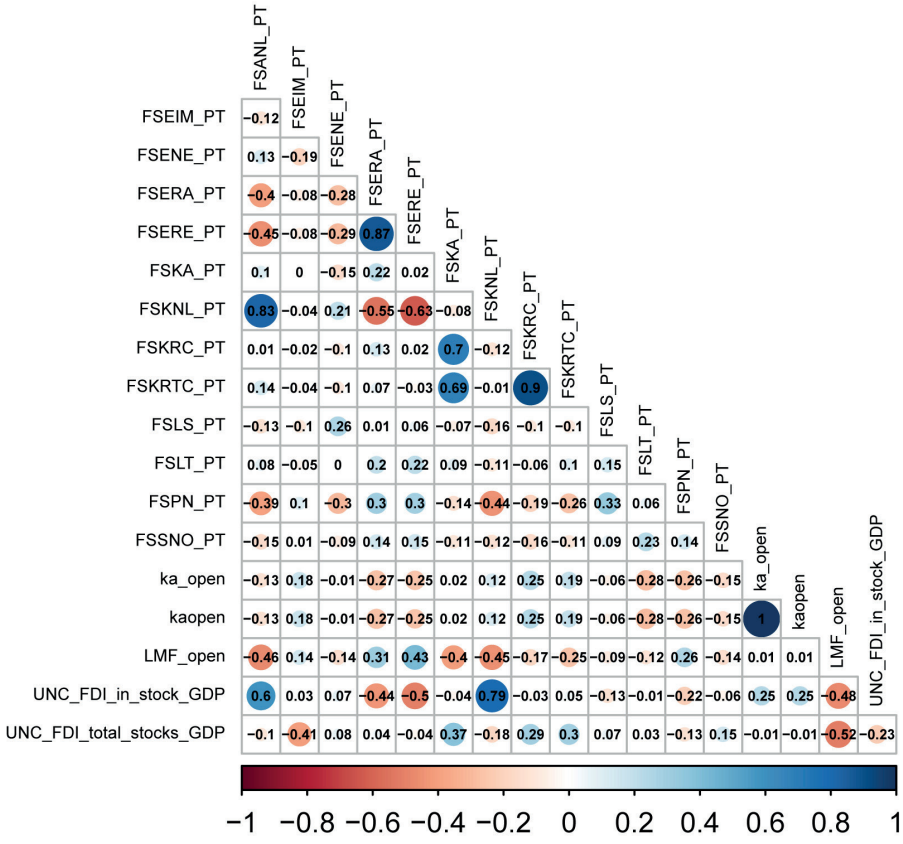
Indicator	Abreviation	Source	Mean	Median	Std.Dev	Max.	Min.
Nonperforming Loans to Total Gross Loans	FSANL_PT	FSI-IFS- IMF	8.15	4.75	8.72	52.24	0.09
Interest Margin to Gross Income	FSEIM_PT	FSI-IFS- IMF	60.07	62.62	41.84	445.36	-658.82
Noninterest Expenses to Gross Income	FSENE_PT	FSI-IFS- IMF	61.07	58.79	22.59	389.32	27.11
Return on Assets	FSERA_PT	FSI-IFS- IMF	1.34	1.32	1.32	6.35	-7.18
Return on Equity	FSERE_PT	FSI-IFS- IMF	12.9	10.52	66.45	1379.97	-95.11
Tier 1 Capital to Assets	FSKA_PT	FSI-IFS- IMF	8.82	8.81	3.32	19.16	-3.14
Nonperforming Loans Net of Provisions to Capital	FSKNL_PT	FSI-IFS- IMF	7.97	8.84	181.77	438.16	-3238.39
Regulatory Capital to Risk-Weighted Assets	FSKRC_PT	FSI-IFS- IMF	17.68	17.33	5.36	42.2	-5.81
Tier 1 Capital to Risk-Weighted Assets	FSKRTC_PT	FSI-IFS- IMF	15.53	14.63	5.37	40.3	-5.02
Liquid Assets to Short-Term Liabilities	FSLS_PT	FSI-IFS- IMF	83.15	59.85	72.13	503.08	14.09
Liquid Assets to Total Assets	FSLT_PT	FSI-IFS- IMF	27.45	26.09	11.22	69.2	9.82
Provisions to Nonperforming Loans	FSPN_PT	FSI-IFS- IMF	79.57	65.97	48.92	314.02	13.67
Net Open Position in Foreign Exchange to Capital	FSSNO_PT	FSI-IFS- IMF	16.74	4.93	49.35	407.97	-291.22
Total Foreign Assests and Total Foreign Liabilities in % GDP	LMF_open	Lane and Milesi-Ferretti (2017)	-13.61	-33.09	123.53	692.44	-301.99
Foreign Investors' Equity In and Net Loans to Resident Enterprise	UNC_FDI_in_stock_GDP	UNCTAD (2023)	100.98	41.25	265.06	1962.87	0.6
Net FDI as percent of GDP	UNC_FDI_total_stocks_GDP	UNCTAD (2023)	38.75	37.46	45.57	418.4	-104.24
Financial Openness Index	kaopen	Chinn-Ito	0.34	0.73	1.51	2.31	-1.93
Normalized Financial Openness Index	ka_open	Chinn-Ito	0.54	0.65	0.36	1	0

Note: This table shows the main variables used in this study, the variable descriptions, the sources of information and the summary statistics in the last 5 columns following the missing value imputations.

The pairwise correlations depicted in Figures 2 (preimputation) and 3 (postimputation) reveal two salient features of the data. First, the correlation patterns among variables before and after the imputation of missing values remain consistent. Second, while the measures of openness exhibit correlations among themselves, these correlations are not absolute in most cases, signifying that they gauge distinct dimensions of this variable. Similar considerations extend to the proxies for financial stability. Nevertheless, there are a few notewor-

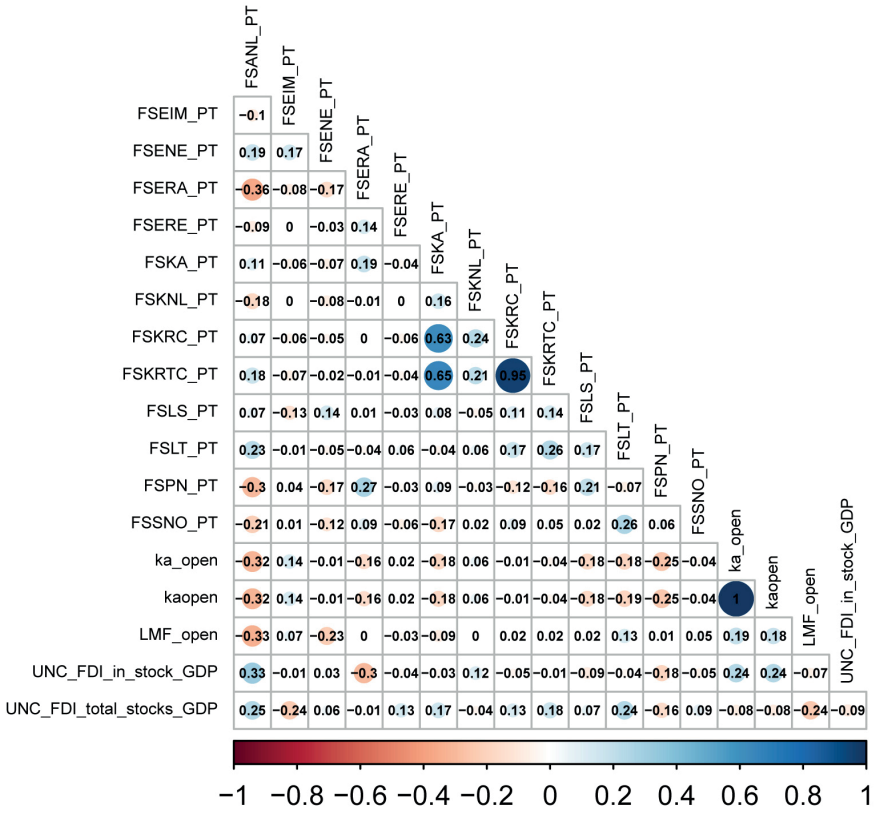
thy exceptions that merit mention. Primarily, a perfect correlation between the Financial Openness Index and the Normalized Financial Openness Index is observed, persisting throughout both pre- and postimputation. Additionally, a very high correlation is evident between Foreign Investors' Equity In and Net Loans to Resident Enterprise, as well as Net FDI as a percentage of GDP. Similarly, substantial correlations are observed among the measures for Basel regulatory banking capital, thus aligning with expectations.

Figure 2. Pairwise correlations between the main variables, preimputation



Note: The figure shows the pairwise correlation between financial openness and soundness indicators from the period of 2010-2020 prior to imputation via Random Forest.

Figure 3. Pairwise correlations between the main variables, postimputation



Note: The figure shows the pairwise correlation between financial openness and soundness indicators from the period of 2010-2020 following imputation via Random Forest.

4. Results

As highlighted in the Introduction, one of the distinctive contributions of this study lies in the incorporation of diverse proxies for both financial stability (outcome) and openness (treatment) variables. In this section, we present the outcomes of double machine learning across various combinations of these treatment and outcome variables. Specifically, we examine five alternative indicators of financial openness and employ thirteen proxies representing distinct aspects of financial stability. These proxies enable a comprehensive exploration of the multidimensional nature of the treatment and outcome variables under consideration. Various metrics for economic openness have been used in recent studies, which reflects a lack of consensus regarding the

optimal method for measuring this economic attribute (e.g., Huchet-Bourdon et al., 2017; Egger et al., 2019). Similarly, there is a similar context for financial stability, where different studies rely on varied proxies. Potentially conflicting outcomes regarding the relationship between openness and financial stability can arise from the disparities in the proxies employed for these variables across various studies. Hence, it becomes imperative to consider diverse proxies that capture different facets of both openness and financial stability to effectively assess the impact of openness on financial stability.

Table 3 illustrates the effects of openness on various proxies of financial stability, with the openness proxy defined as the ratio of Total Foreign Assets plus Total Foreign Liabilities to GDP. This metric offers insights into the degree of a country's financial integration with the global economy. For the sake of comparability, all variables in this study have undergone normalization. Consequently, the statistically significant effects should be interpreted as the response of the outcome variable to a one-standard deviation shock on the treatment variable.

As shown in Table 3, increases in this metric of financial openness cause a reduction in the ratio of nonperforming loans to total loans, signifying an enhancement in financial stability. Specifically, a one-standard deviation increase in the openness proxy causes a 0.19 standard deviation decrease in the nonperforming loan ratio. Additionally, an increase in the treatment variable leads to a decrease in the ratio of noninterest expenses to gross income, reflecting improved efficiency. Furthermore, an increase in this measure is linked to an increase in the ratio of liquid assets to total assets, potentially contributing to the enhanced liquidity of domestic bank assets due to their integration with global financial markets. Moreover, the ratio of provisions to nonperforming loans shows an increasing trend, possibly indicating a response to the heightened adherence to global financial regulations, such as those aligned with Basel III principles, as the integration with global financial markets intensifies.

In summary, a greater level of financial openness as measured by this proxy is beneficial for financial stability. Notably, profitability does not seem to be influenced by financial openness. Consequently, the attainment of higher financial stability and better liquidity appears to be achieved without incurring costs in terms of diminished bank profitability.

Table 3. Treatment variable: (Total Foreign Assets + Total Foreign Liabilities)/GDP

	Effect	S.E.	P.Value	t.Statistic	Lower.CI	Upper.CI
Nonperforming Loans to Total Gross Loans	-0.191	0.077	0.014	-2.462	-0.39	0.009
Interest Margin to Gross Income	0.465	0.246	0.059	1.89	-0.169	1.098
Noninterest Expenses to Gross Income	-0.232	0.089	0.009	-2.613	-0.461	-0.003
Return on Assets	-0.049	0.115	0.669	-0.427	-0.346	0.248
Return on Equity	0.012	0.209	0.952	0.06	-0.526	0.551
Tier 1 Capital to Assets	-0.171	0.089	0.054	-1.928	-0.399	0.057
Nonperforming Loans Net of Provisions to Capital	-0.107	0.145	0.459	-0.74	-0.481	0.266
Regulatory Capital to Risk-Weighted Assets	-0.102	0.103	0.318	-0.998	-0.367	0.162
Tier 1 Capital to Risk-Weighted Assets	-0.118	0.098	0.229	-1.202	-0.371	0.135
Liquid Assets to Short-Term Liabilities	-0.102	0.074	0.168	-1.379	-0.292	0.088
Liquid Assets to Total Assets	0.195	0.095	0.041	2.039	-0.051	0.44
Provisions to Nonperforming Loans	0.156	0.068	0.022	2.289	-0.019	0.331
Net Open Position in Foreign Exchange to Capital	-0.063	0.077	0.415	-0.814	-0.262	0.136

Note: The table shows the effects of the treatment variable on 13 financial stability indicators during the period from 2010 to 2020. An independent DDML model was used to obtain each estimate in the various rows. Random Forest was used as the learner to approximate both functions, $g_0(\cdot)$ and $m_0(\cdot)$ in Equations 1 and 2, with 15 trees and a maximum depth of 5, allowing for a minimum size node of two variables in each vase. The treatment variable is indicated in the title of the table.

Table 4 shows the effect of Foreign Investors' Equity In and Net Loans to Resident Enterprises on the different financial stability proxies. Foreign Investors' Equity In represents the equity or ownership stake that foreign investors hold in resident enterprises. Net Loans to Resident Enterprise focuses on the financial support provided by foreign investors to resident enterprises in the form of loans. By combining these two components, the metric provides a comprehensive view of the financial interactions between foreign investors and domestic businesses. A positive value indicates a net inflow of equity and loans from foreign investors, signifying a financial infusion into the domestic economy. On the other hand, a negative value can suggest that resident enterprises repatriate more funds to foreign investors than they receive.

As depicted in Table 4, increases in this financial openness indicator correspond to increases in the ratio of Nonperforming loans to total loans, indicating a decrease in financial stability. Additionally, there is a decrease in the ratio of provisions to nonperforming loans that further exacerbates the deterioration in financial stability. In summary, the evidence suggests that augmenting financial flows from foreigners to domestic firms has adverse implications for financial stability.

Table 4. Treatment variables: Foreign Investors' Equity In and Net Loans to Resident Enterprise

	Effect	S.E.	P.Value	t.Statistic	Lower.CI	Upper.CI
Nonperforming Loans to Total Gross Loans	0.457	0.228	0.045	2.005	-0.13	1.045
Interest Margin to Gross Income	-0.681	0.383	0.075	-1.78	-1.666	0.304
Noninterest Expenses to Gross Income	0.086	0.108	0.427	0.794	-0.193	0.365
Return on Assets	-0.311	0.178	0.081	-1.744	-0.769	0.148
Return on Equity	0.033	0.161	0.836	0.207	-0.38	0.447
Tier 1 Capital to Assets	0.05	0.077	0.515	0.651	-0.148	0.248
Nonperforming Loans Net of Provisions to Capital	0.28	0.185	0.13	1.512	-0.197	0.757
Regulatory Capital to Risk-Weighted Assets	0.103	0.08	0.195	1.296	-0.102	0.308
Tier 1 Capital to Risk-Weighted Assets	0.114	0.077	0.136	1.489	-0.084	0.312
Liquid Assets to Short-Term Liabilities	0.048	0.069	0.486	0.697	-0.13	0.226
Liquid Assets to Total Assets	-0.012	0.112	0.918	-0.103	-0.3	0.277
Provisions to Nonperforming Loans	-0.325	0.101	0.001	-3.207	-0.586	-0.064
Net Open Position in Foreign Exchange to Capital	-0.007	0.052	0.888	-0.141	-0.141	0.126

Note: The table shows the effects of the treatment variable on 13 financial stability indicators covering the period from 2010 to 2020. An independent DDML model was used to obtain each estimate in the various rows. Random forest was used as the learner to approximate both functions, $g_0(\cdot)$ and $m_0(\cdot)$ in Equations 1 and 2, with 15 trees and a maximum depth of 5, allowing for a minimum size node of two variables in each vase. The treatment variable is indicated in the title of the table.

This intriguing result, which diverges from the primary findings displayed in Table 3, underscores the pivotal role of the chosen proxy for financial openness in determining its effect on financial stability. This implies that merely increasing the economy's reliance on external capital inflows may have adverse implications for financial stability that potentially stem from the banking fragility induced by substantial upsurges in capital inflows and the heightened risk of a sudden stop, as discussed in studies such as Caballero (2016).

Table 5 shows the results when the treatment variable Net FDI as percent of GDP. This variable is a financial metric used to assess the relative magnitude of net foreign direct investment in a country compared to its overall economic output. A higher percentage indicates that the net inflow (or outflow) of foreign direct investment represents a substantial portion of the country's GDP, reflecting a greater degree of integration with the global economy.

Table 5. Treatment variable: Net FDI as a percent of GDP

	Effect	S.E.	P.Value	t.Statistic	Lower.CI	Upper.CI
Nonperforming Loans to Total Gross Loans	-0.022	0.071	0.759	-0.306	-0.206	0.162
Interest Margin to Gross Income	-0.392	0.41	0.339	-0.955	-1.448	0.664
Noninterest Expenses to Gross Income	0.112	0.029	0	3.898	0.038	0.186
Return on Assets	0.003	0.041	0.94	0.075	-0.101	0.107
Return on Equity	0.058	0.219	0.791	0.264	-0.505	0.621
Tier 1 Capital to Assets	0.246	0.091	0.007	2.692	0.011	0.482
Nonperforming Loans Net of Provisions to Capital	0.055	0.121	0.647	0.458	-0.257	0.368
Regulatory Capital to Risk-Weighted Assets	0.267	0.127	0.035	2.109	-0.059	0.593
Tier 1 Capital to Risk-Weighted Assets	0.258	0.111	0.02	2.331	-0.027	0.544
Liquid Assets to Short-Term Liabilities	0.075	0.03	0.013	2.474	-0.003	0.153
Liquid Assets to Total Assets	-0.001	0.075	0.988	-0.016	-0.193	0.191
Provisions to Nonperforming Loans	-0.159	0.033	0	-4.894	-0.243	-0.076
Net Open Position in Foreign Exchange to Capital	0.113	0.062	0.067	1.834	-0.046	0.272

Note: The table shows the effects of the treatment variable on 13 financial stability indicators covering the period from 2010 to 2020. An independent DDML model was used to obtain each estimate in the various rows. Random Forest was used as the learner to approximate both functions, $g_0(\cdot)$ and $m_0(\cdot)$ in Equations 1 and 2, with 15 trees and a maximum depth of 5, allowing for a minimum size node of two variables in each vase. The treatment variable is indicated in the title of the table.

Increases in this treatment variable lead to heightened ratios of noninterest expenses to gross income, indicating lower bank efficiency. Simultaneously, such increases cause increases in the Tier 1 capital to assets ratio, to the regulatory capital to risk-weighted assets ratio, and to the Tier 1 ratio of capital to risk-weighted assets, which all indicate an improvement in financial stability. Furthermore, there is an increase in the ratio of liquid assets to short-term liabilities, thus reflecting enhanced bank liquidity. Additionally, there is an increase in the ratio of provisions to nonperforming loans, which is also beneficial for financial stability, indicating that the banks of countries that better integrated into global financial markets tend to adjust their prudence standards to match those of the Basel Accord. In summary, increments in this particular measure of financial openness are highly favorable for enhancing financial stability.

The outcomes mirror those displayed in Table 3, revealing that greater openness results in heightened capital adequacy ratios and improvements in bank liquidity, without exerting a negative impact on bank profitability.

The openness proxies shown in Tables 3 to 5 correspond to de facto measures. Table 6 presents the results obtained when the treatment variable is the Financial Openness Index of Chinn and Ito (2008), which is arguably the most widely used de jure measure of openness. This index is used to assess the level of integration

of a country's financial system with the global economy. It considers multiple facets of financial openness, including factors such as the ease of cross-border capital flows, the extent of restrictions on foreign exchange markets, and the willingness of a country's financial institutions to involve foreign participation. It is derived from the computation of various subindicators used to capture the distinct dimensions of financial openness.

As shown in Table 6, increases in this index lead to declines in the ratio of nonperforming loans to total loans, which is indicative of an improvement in financial stability. Additionally, there is an increase in the ratio of regulatory capital to risk-weighted assets, thus further contributing to enhanced financial stability. However, paradoxically, there is a reduction in the ratio of provisions to nonperforming loans. While these results are encouraging, as they suggest that heightened financial openness fosters greater financial stability, the counterintuitive decrease in the ratio of provisions to nonperforming loans warrants further examination.

Finally, Table 7 presents the results when the Normalized Financial Openness Index of Chinn and Ito is used as the treatment variable. The findings exhibit qualitative consistency with those presented in the sixth table: An increase in this index leads to a decrease in the ratio of nonperforming loans to total loans, signaling an improvement in financial stability, as well as to an increase in the ratio of regulatory capital to risk-weighted assets, further bolstering financial stability.

Table 6. Treatment variable: The Financial Openness Index

	Effect	S.E.	P.Value	t.Statistic	Lower.CI	Upper.CI
Nonperforming Loans to Total Gross Loans	-0.23	0.069	0.001	-3.345	-0.407	-0.053
Interest Margin to Gross Income	0.018	0.104	0.863	0.173	-0.249	0.285
Noninterest Expenses to Gross Income	-0.21	0.136	0.122	-1.548	-0.559	0.139
Return on Assets	0.046	0.104	0.658	0.443	-0.222	0.315
Return on Equity	0.065	0.054	0.226	1.211	-0.074	0.205
Tier 1 Capital to Assets	0.141	0.078	0.071	1.803	-0.061	0.343
Nonperforming Loans Net of Provisions to Capital	0.053	0.07	0.451	0.754	-0.128	0.234
Regulatory Capital to Risk-Weighted Assets	0.153	0.076	0.044	2.016	-0.042	0.348
Tier 1 Capital to Risk-Weighted Assets	0.051	0.071	0.476	0.713	-0.133	0.235
Liquid Assets to Short-Term Liabilities	-0.024	0.068	0.73	-0.345	-0.2	0.153
Liquid Assets to Total Assets	-0.064	0.06	0.282	-1.076	-0.218	0.089
Provisions to Nonperforming Loans	-0.152	0.076	0.046	-1.996	-0.348	0.044
Net Open Position in Foreign Exchange to Capital	0.048	0.075	0.519	0.644	-0.145	0.241

Note: The table shows the effects of the treatment variable on 13 financial stability indicators during the period from 2010 to 2020. An independent DDML model was used to obtain each estimate in the various rows. Random Forest was used as the learner to approximate both functions, $g_0(\cdot)$ and $m_0(\cdot)$ in Equations 1 and 2, with 15 trees and a maximum depth of 5, allowing for a minimum size node of two variables in each vase. The treatment variable is indicated in the title of the table.

In summary, our findings collectively demonstrate the positive impact of openness on financial stability. Across four of the five proxies employed in this study, increased openness is correlated with reduced ratios of nonperforming loans to total loans and/or elevated capital adequacy ratios. Moreover, higher openness generally results in increased bank liquidity, which is a favorable attribute for financial stability. Intriguingly, openness exhibits no discernible effect on bank profitability, suggesting that heightened competition in global markets does not significantly influence the profitability of local banks. Notably, the results presented in Table 4 highlight the fact that when openness involves a simple receptivity to higher capital inflows, it may pose a risk to financial stability due to the heightened vulnerability to the sudden stops associated with substantial capital surges.

Our findings offer significant policy implications and underscore avenues for further research. On the policy front, our results indicate that greater integration with global financial markets positively impacts financial stability without compromising bank profitability. This suggests that policy-makers, particularly those in countries with nascent financial markets, should consider implementing measures that enhance the level of integration with global markets, including reducing restrictions on capital inflows. While macroprudential policies may prove beneficial in specific market conditions, our results caution against their permanent use as a means of isolating financial systems from global markets. Such a prolonged approach can hinder financial development and hinder long-term financial stability.

Table 7. Treatment variable: The Normalized Financial Openness Index

	Effect	S.E.	P.Value	t.Statistic	Lower.CI	Upper.CI
Nonperforming Loans to Total Gross Loans	-0.218	0.065	0.001	-3.372	-0.384	-0.051
Interest Margin to Gross Income	0.043	0.099	0.669	0.428	-0.213	0.298
Noninterest Expenses to Gross Income	-0.199	0.123	0.104	-1.624	-0.515	0.117
Return on Assets	0.037	0.099	0.708	0.375	-0.218	0.292
Return on Equity	0.072	0.051	0.158	1.412	-0.059	0.203
Tier 1 Capital to Assets	0.129	0.077	0.094	1.676	-0.069	0.328
Nonperforming Loans Net of Provisions to Capital	0.058	0.069	0.404	0.834	-0.12	0.236
Regulatory Capital to Risk-Weighted Assets	0.142	0.072	0.05	1.964	-0.044	0.329
Tier 1 Capital to Risk-Weighted Assets	0.042	0.068	0.533	0.623	-0.133	0.218
Liquid Assets to Short-Term Liabilities	-0.04	0.069	0.564	-0.576	-0.218	0.138
Liquid Assets to Total Assets	-0.063	0.06	0.295	-1.048	-0.217	0.091
Provisions to Nonperforming Loans	-0.174	0.078	0.025	-2.245	-0.374	0.026
Net Open Position in Foreign Exchange to Capital	0.046	0.069	0.502	0.672	-0.132	0.224

Note: The table shows the effects of the treatment variable on 13 financial stability indicators covering the period from 2010 to 2020. An independent DDML model was used to obtain each estimate in the various rows. Random Forest was used as the learner to approximate both functions, $g_0(\cdot)$ and $m_0(\cdot)$ in Equations 1 and 2, with 15 trees and a maximum depth of 5, allowing for a minimum size node of two variables in each vase. The treatment variable is indicated in the title of the table.

From an academic standpoint, our findings emphasize the importance of prudence in selecting a proxy for openness. The specific choice of this variable can yield distinctive results that may not be replicable if alternative proxies are employed. Moreover, given the multitude of potential confounders that can influence causal relationships, researchers should employ suitable techniques, such as double machine learning, to effectively disentangle the causal effects. Importantly, the various dimensions of financial stability are differentially influenced by the use of different financial openness proxies. Consequently, researchers must judiciously choose financial stability proxies based on the specific research question posed.

5. Conclusions

In this paper, we investigate the impact of openness on financial stability by employing a two-part methodology. In the initial phase, we delineate the imputation algorithm utilized for dataset completion due to the presence of several missing values in the dataset. Subsequently, in the second phase, we employ a Double Debiased Machine Learning algorithm for estimating the effects of financial openness across diverse dimensions on financial soundness indicators. When delving into the estimations of direct effects, especially in observational studies such as ours where randomization is infeasible, controlling for many confounders becomes essential. For this purpose, we use Double Debiased Machine Learning, which is a method intricately crafted to estimate effects, particularly when faced with a substantial number of confounding variables.

While theoretical studies forecast a positive correlation between openness and financial stability, the extant research yields conflicting outcomes in this regard. This discrepancy may stem from variations in the sample time periods, countries, and proxies employed for measuring openness and financial stability across different studies. To surmount this challenge, our approach involves the use of an expansive dataset encompassing numerous countries and an extended sample period. Additionally, we adopt diverse proxies for both openness and financial stability that reflect the various facets of these two variables.

Our findings underscore the positive influence of openness on financial stability. Across four out of the five proxies employed in this study, heightened openness is associated with diminished ratios of nonperforming loans to total loans and/or increased capital adequacy ratios. Furthermore, increased openness generally leads to heightened bank liquidity, which is favorable for financial stability. Interestingly, openness demonstrates no evident impact on bank profitability, indicating that intensified competition in global markets does not markedly affect the profitability of local banks. The results obtained from one of our models emphasize that openness strategies should be comprehensive, as when openness involves a mere inclination toward higher capital inflows, it may pose a risk to financial stability due to the heightened susceptibility to sudden stops linked to substantial capital surges.

References

Ahrend, R., & Goujard, A. (2014). Are all forms of financial integration equally risky? Asset price contagion during the global financial crisis. Journal of Financial Stability, 14, 35-53.

Ahrend, R., & Goujard, A. (2014). Drivers of systemic banking crises: The role of financial account structure and financial integration. International Finance, 17(2), 135-160.

Aizenman, J. (2019). A modern reincarnation of Mundell-Fleming's trilemma. Economic Modelling, 81, 444-454.

Aizenman, J., & Pinto, B. (2013). Managing Financial Integration and Capital Mobility—Policy lessons from the past two decades. Review of International Economics, 21(4), 636-653.

Backus, D., P. Kehoe, and F. Kydland (1995). International Business Cycles: Theory and Evidence," in Frontier of Business Cycle Research, ed. by Thomas Cooley (Princeton: Princeton University Press), pp. 331–356.

Belloni, A., V. Chernozhukov, & C. Hansen (2014). Inference on Treatment Effects after Selection among High-Dimensional Controls. The Review of Economic Studies 81, 608-650.

Caballero, J. (2016). Do Surges in International Capital Inflows Influence the Likelihood of Banking Crises? The Economic Journal 126, 281-316.

Chen, Y. (2022). Bank interconnectedness and financial stability: The role of bank capital. Journal of Financial Stability, 61, 101019.

Chernozhukov, V., D. Chetverikov, M. Demirer, E. Duflo, C. Hansen, W. Newey, & J. Robins (2018). Double/debiased machine learning for treatment and structural parameters. The Econometrics Journal 21, C1–C68.

Chinn, M.D. & H. Ito (2008). A New Measure of Financial Openness. Journal of Comparative Policy Analysis: Research and Practice 10, 309-322.

De Nicolò, G., & Juvenal, L. (2014). Financial integration, globalization, and real activity. Journal of financial stability, 10, 65-75.

Durdu, C. B., Martin, A., & Zer, I. (2020). The role of US monetary policy in banking crises across the world. IMF Economic Review, 68, 66-107.

Egger P., S. Nigai, & N. Strecker (2019). The taxing deed of globalization. American Economic Review 109, 353-390.

Eichengreen, B. & C. Arteta (2002). Banking crises in emerging markets: Presumptions and evidence, in Financial policies in emerging markets, ed. By Mario Blejer and Marco Skler (The MIT Press), pp. 47-94.

Eslamloueyan, K., & Fatemifar, N. (2021). Does deeper financial integration lead to macroeconomic and financial instability in Asia?. Economic analysis and policy, 70, 437-451.

Evans, M.D. & V.V. Hnatkovska (2007). Financial Integration, Macroeconomic Volatility, and Welfare. Journal of the European Economic Association 5, 500-508.

Fecht, F., Grüner, H. P., & Hartmann, P. (2012). Financial integration, specialization, and systemic risk. Journal of International Economics, 88(1), 150-161.

Forbes, K.J. (2007). One Cost of the Chilean Capital Controls: Increased Financial Constraints for Smaller Traded Firms," Journal of International Economics 71, 294-323.

Giraldo, C., I. Giraldo, J.E. Gomez-Gonzalez & J.M. Uribe (2023). Banks' leverage in foreign exchange derivatives in times of crisis: A tale of two countries. Emerging Markets Review 55, 101028.

Huchet-Bourdon, M., C. Le Mouël, & M. Vijil (2017). The relationship between trade openness and economic growth: Some new insights on the openness measurement issue. World Economy 41, 59-76.

Igan, D., A.M. Kutan, & A. Mirzaei (2016). Real Effects of Capital Inflows in Emerging Markets. IMF Working Paper WP/16/235, International Monetary Fund.

Kaminsky, G.L. & C.M. Reinhart (1999). The twin crises: The causes of banking and balance-of-payments problems. American Economic Review, 473-500.

Kose M., E. Prasad, & M. Terrones (2009). Does financial globalization promote risk sharing? Journal of Development Economics 89, 258-270.

Kouretas, G. P., Papadopoulos, A. P., & Tavlas, G. S. (2022). Financial risks, monetary policy in the QE era, and regulation. Journal of Financial Stability, 63, 101051.

Neanidis, K. C. (2019). Volatile capital flows and economic growth: The role of banking supervision. Journal of Financial stability, 40, 77-93.

Pakko, M.R. (1998). Characterizing Cross-Country Consumption Correlations. Review of Economics and Statistics 80, 169–174.

Pundit, M., Ramayandi, A., & Baum, C. F. (2015). Openness and financial stability (No. 8652). Ecomod Working Paper.

Robinson, P.M. (1988). Root-N-Consistent Semiparametric Regression. Econometrica 56, 931-954.

Schroth, J. (2016). Capital Flows to Developing Countries: Is There an Allocation Puzzle? Staff Working Paper 2016–53 Bank of Canada.

Sorensen, B., Y.-T. Wu, O. Yosha, & Y. Zhu (2007). Home bias and international risk sharing: Twin puzzles separated at birth. Journal of International Money and Finance 26, 587-605.

Stekhoven, D.J. & P. Bühlmann (2012). MissForest—non-parametric missing value imputation for mixed-type data. Bioinformatics 28, 112-118.

Summers, L.H. (2000). International Financial Crises: Causes, Prevention, and Cures. American Economic Review 90, 1-6.

Wei, S.-J. & Z. Zhang (2007). Collateral Damage: Capital Controls and International Trade. Journal of International Money and Finance 26, 841-63.

Yu, I. W., Fung, K. P., & Tam, C. S. (2010). Assessing financial market integration in Asia–equity markets. Journal of Banking & Finance, 34(12), 2874-2885.

Appendix

Table A1. Countries included in the analysis

	Country		Country		Country		Country
1	Albania	13	Belgium	24	Cameroon	35	Croatia
2	Algeria	14	Belize	25	Canada	36	Cyprus
3	Angola	15	Bhutan	26	Central African Republic	37	Czech Republic
4	Anguilla	16	Bolivia	27	Chad	38	Denmark
5	Antigua and Barbuda	17	Bosnia and Herzegovina	28	Chile	39	Djibouti
6	Argentina	18	Botswana	29	China	40	Dominican Republic
7	Armenia	19	Brazil	30	Colombia	41	Ecuador
8	Australia	20	Brunei Darussalam	31	Comoros	42	El Salvador
9	Austria	21	Bulgaria	32	Congo, Dem. Rep.	43	Equatorial Guinea
10	Bangladesh	22	Burundi	33	Congo, Rep.	44	Hong Kong SAR, China
11	Barbados	23	Cambodia	34	Costa Rica	45	Macao SAR, China
12	Belarus						

Table A2. Variables, definitions, and sources

Definition	Indicator	Source
Rule of Law Index	Rule_law	World Bank
1 if the country has at least a rule of expenditure, debt o balance	fiscal_rule	IMF
Control of Corruption	corruption_index	World Bank
Current Account Balance % GPD	current_account	WEO
Nominal Gross Capital Formation % GDP	nom_grosscapitalformation	Own calculation IFS-IMF
(Exports+Imports)/GDP	openness	Own calculation DoT-IMF/WEO
Real Effective Exchange Rate	real_exchangerate	IFS-IMF
real_exchangerate Annual growth	real_exchangerate_growth	Own calculation IFS-IMF
Adequacy reserves metric: Reserves/Imports	res_imp_own	Own calculation
Reserves/GDP	reserves_GDP	Own calculation IFS-IMF/WEO
Nominal exchange rate USD/Domestic Currency	nom_exchangerate	Bloomberg
Nominal exchange rate USD/Domestic Currency Growth	nom_exchangerate_growth	Own calculation Bloomberg
Exchange Rate Standard Deviation	sd_exchangerate	Own calculation Bloomberg
GDP per Capita (Current USD)	gdp_percapita_current	WEO
GDP per Capita (Current USD) Growth	gdp_percapita_current_growth	Own calculation WEO
GDP per Capita (PPP USD 2017)	gdp_percapita_constant	WEO
GDP per Capita (PPP USD 2017) Growth	gdp_percapita_constant_growth	Own calculation WEO
Consumption (Current USD, Millions)	consumption_usd	Own Calculation IFS - IMF/ Bloomberg

Definition	Indicator	Source
Consumption (Current USD, Millions) Growth	consumption_usd_growth	Own Calculation IFS - IMF/ Bloomberg
Consumption (% GDP)	comsumption_gdp	Own Calculation IFS - IMF
Gross Capital Formation (Current USD, Millions)	grosscapitalformation_usd	Own Calculation IFS - IMF/ Bloomberg
Gross Capital Formation USD Growth	grosscapitalformation_usd_ growth	Own Calculation IFS - IMF/ Bloomberg
Domestic Absortion (Current USD, Millions)	absortion_usd	Own Calculation IFS - IMF/ Bloomberg
Domestic Absortion USD Growth	absortion_usd_growth	Own Calculation IFS - IMF/ Bloomberg
Total Goverment Debt (% GDP)	grosspublicdebt	WEO
Total Net Borrowing/Lending (% GDP)	totaldeficit	WEO
Primary Deficit (% GDP)	primarydeficit	WEO
Interest Expense % of GDP	interest_expense_gdp	Goverment Finance Statistics (GFS) - IMF
Foreign Direct Investment (Millions)	fdi	Balance of Payments - IMF
Foreign Direct Investment (% GDP)	fdi_gdp	Own calculations BoP -IMF/ WEO
Final Consumption Expenditure Nominal	consumption_domcurr	IFS - IMF
Final Consumption Expenditure Growth	consumption_domcurr_growth	Own calculation IFS-IMF
Gross Capital Formation Nominal	grosscapitalformation_domcurr	IFS - IMF
Gross Capital Formation Nominal Growth	grosscapitalformation_domcurr_ growth	Own calculation IFS-IMF
Expenditure Nominal	totalspend_domcurr	IFS-IMF
Expenditure Nominal Growth	totalspend_domcurr_growth	Own calculation IFS-IMF
Total Expenditure USD	totalspend_usd	Own Calculation IFS - IMF/ Bloomberg
Total Expenditure USD Growth	totalspend_usd_growth	Own Calculation IFS - IMF/ Bloomberg
Gross Domestic Product (Current Domestic Currency, Millions)	gdp_domcurr	IFS-IMF
Gross Domestic Product Growth	gdp_domcurr_growth	Own calculation IFS-IMF
Gross Domestic Product (Current USD, Millions)	gdp_usd	WEO
Gross Domestic Product Growth	gdp_usd_growth	Own calculation IFS-IMF
CBIE (Central Bank Independence - Extended)	cbie	Romelli (2022)
Degree of independence of the "Governor and central bank board"	cbieboard	Romelli (2022)
Degree of independence of the "Monetary policy and conflicts resolution"	cbiepolicy	Romelli (2022)
Degree of independence of the "Objectives"	cbieobj	Romelli (2022)
Degree of independence of the "Limitations on lending to the government"	cbielending	Romelli (2022)
Degree of independence of the "Financial independence"	cbiefinances	Romelli (2022)
Degree of independence of the "Reporting and disclosure"	cbiereport	Romelli (2022)

Definition	Indicator	Source
Grilli, Masciandaro and Tabellini (1991) Index of Central Bank Independence	gmt	Romelli (2022)
Cukierman et al. (1992) Unweighted Index of Central Bank Independence	lvau	Romelli (2022)
Cukierman et al. (1992) Weighted Index of Central Bank Independence	lvaw	Romelli (2022)
Jácome and Vázquez (2008) Index of Central Bank Independence	cwne	Romelli (2022)
International Reserves excluding Gold, US Dollar	reserves	IFS-IMF
Goods, Value of Exports Millions US Dollars	exports	DoT-IMF
Value of Imports, Millions US Dollars	imports	DoT-IMF
Total Foreign Assests and Total Foreign Liabilities in % GDP	LMF_open	Lane and Milesi-Ferretti (2017)
Foreign Investors' Equity In and Net Loans to Resident Enterprise	UNC_FDI_in_stock_GDP	UNCTAD (2023)
Net FDI as percent of GDP	UNC_FDI_total_stocks_GDP	UNCTAD (2023)
Financial Openness Index	kaopen	Chinn-Ito
Normalized Financial Openness Index	ka_open	Chinn-Ito
Nonperforming Loans to Total Gross Loans	FSANL_PT	FSI-IFS- IMF
Interest Margin to Gross Income	FSEIM_PT	FSI-IFS- IMF
Noninterest Expenses to Gross Income	FSENE_PT	FSI-IFS- IMF
Return on Assets	FSERA_PT	FSI-IFS- IMF
Return on Equity	FSERE_PT	FSI-IFS- IMF
Tier 1 Capital to Assets	FSKA_PT	FSI-IFS- IMF
Nonperforming Loans Net of Provisions to Capital	FSKNL_PT	FSI-IFS- IMF
Regulatory Capital to Risk-Weighted Assets	FSKRC_PT	FSI-IFS- IMF
Tier 1 Capital to Risk-Weighted Assets	FSKRTC_PT	FSI-IFS- IMF
Liquid Assets to Short-Term Liabilities	FSLS_PT	FSI-IFS- IMF
Liquid Assets to Total Assets	FSLT_PT	FSI-IFS- IMF
Provisions to Nonperforming Loans	FSPN_PT	FSI-IFS- IMF
Net Open Position in Foreign Exchange to Capital	FSSNO_PT	FSI-IFS- IMF

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