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Gender-Inclusive Development through Fintech: Studying Gender-Based Digital Financial Inclusion in a Cross-Country Setting

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Abstract: Financial inclusion (FI) for vulnerable populations, such as women, is critical for achieving gender equality, women's empowerment, and thereby, inclusive growth. Sustainable development goal 5 considers gender equality as a fundamental right and views the empowerment of women as a necessary step. Access to finance is a significant means to empower a person. In this regard, the use of digital financial services is of particular significance for women as it allows them easier access to financial products for business and household needs. For implementing policies to reduce financial exclusion of women, it is necessary to first measure the extent of FI in society. While there are several attempts to measure FI for the general population, there is limited literature on the gender-based measurement of FI. This paper fills this important research gap by developing a gender-based FI index (*GFII*) focusing particularly on digital services and evaluating the performance of countries across the globe (by considering 109 countries based on data availability) in terms of a gender-based FI measure developed by us. This index is developed using two separate indices, a digital financial service usage index (*DFI*) and a conventional financial service usage index (*CFI*). We calculate it for different countries for 2011, 2014, 2017, and 2021 using the Global Findex databaseIt helps us to investigate the performance of different countries over the years in ensuring the financial inclusion of women and how digital services are penetrating over the years. One contribution of the paper is to relate the Gender Development Index (GDI) and Gender Inequality Index (GII) of countries, two well-known measures of inclusive and sustainable development, with *GFII* and *DFI* for female (*DFIF*). This exercise shows that while there is a positive correlation between these two sets of indicators, there are a number of countries that are high (or low) in gender development (or inequality) that need to improve their digital FI. Interestingly, using the Global Findex database and the Feasible Generalized Least Squares (FGLS) and instrumental variable panel data model, we show that health, education, labour force participation rate, and political empowerment of women significantly impact the digital financial inclusion of women. The paper brings out relevant policy suggestions for improving women's digital financial access and thereby enhancing gender empowerment for faster and more inclusive growth.

Keywords: digital financial inclusion; gender-based financial inclusion; inclusive growth; gender development index

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1. Introduction

Current global efforts have not made adequate progress on women's financial inclusion (FI), especially digital FI. Women are less likely than men to hold accounts, avail credit, or access insurance facilities owing to barriers to accessing services from formal financial intermediaries (Demirguc-Kunt et al., 2015, 2018) [1,2] and lack of identification documents, mobile phones, digital skills, financial capability, and appropriate financial products (GPFI, 2020) [3]. Therefore, women are more vulnerable than men and face numerous hurdles in access to essential resources such as education, healthcare, and tangible assets (Kabeer, 2009) [4]. As a result, economic development is not as robust and inclusive (Corrado and Corrado, 2017; Dabla-Norris et al., 2015) [5,6] as desired for the sustainable development of a society. Such exclusion in turn reduces their empowerment, freedom, and decision-making power in the household and society (Corrado and Corrado, 2017) [5]. Under the sustainable development goals (SDG), gender empowerment is considered a necessary means to achieve gender equality (SDG 5). Therefore, universal financial inclusion is important for realizing inclusive economic growth and welfare (Johnston and Murdoch, 2008) [7].

Financial inclusion is a multi-stage process and its levels can be defined as having a bank account, regular use of the account, ease in making payments, and affordability of financial service access (Demirguc-Kunt et al., 2015) [2]. In the modern era, financial services are increasingly reliant on digital infrastructure, and digitization of these services through computer programs and other technology, known as fintech, has made them more accessible to a much wider range of communities and groups than ever before. In the context of empowering women financially, leveraging digital infrastructure is of paramount importance. Women often have limited mobility owing to societal and familial constraints, and fintech services can provide them greater control over their financial resources. Improving access to credit through digital services can also allow women to become entrepreneurs and economically empowered to start and run businesses, which in turn can aid in their development and overall empowerment.

Sustainable development depends on gender equality and sustainable development goal 5 specifically emphasizes that. The issue of closing the economic gender gap goes beyond simple social justice. It propels advancement as well. A recent Gallup-International Labour Organisation (ILO) study found that if the economic gender gap were to narrow by 25%, the world GDP might rise by $5.3 trillion by 2025. To reduce the economic gender gap and promote sustainable development, specific actions must be taken to improve women's financial inclusion and empowerment (Tellez, 2018) [8]. Quantifying the gender gap between men and women in several spheres has been attempted through the use of certain indices, viz., the Gender Development Index (GDI) (United Nations Development Programme, 2018) [9], Gender Inequality Index (GII), and the Gender Empowerment Measure (GEM) (Government of India, 2009) [10]. The Gender Development Index, computed by the United Nations Development Program, captures gaps in human development between men and women in health, knowledge and living standards. It is the ratio of the HDI of women to the HDI of men, computed separately for a country. The UNDP also computed the Gender Inequality Index and measures gender inequalities in reproductive health, empowerment, and economic status. The higher the GII, the greater the inequality.

These indices are well-known and accepted measurements of gender inequality. However, the link between these indices and gender-based financial inclusion indices is not adequately captured in the extant literature. Even though one can expect a relationship between these two sets of measures on average, a cross-country study will reveal the differences in the achievement of digital financial inclusion for otherwise similarly developed nations in terms of gender. As, in the modern era, financial services are increasingly reliant on digital infrastructure, such an exercise is expected to provide policy suggestions for different countries.

From the existing literature one finds that starting from Sarma (2008) [11], a few recent studies such as Fanta and Makina (2019) [12], Van et al., (2021) [13], Nagpal et al., (2020) [14], and Tram et al., (2021) [15] have measured financial inclusion for various countries in the world. However, a limited number of studies (Asongu and Odhiambo, 2018; Morsy, 2020; Delechat et al., 2018) [16–18] have attempted to measure gender-based financial inclusion at the cross-country level.

The core research agenda of the paper is to construct an index of gender-based FI (G*FII*) (comprised of 2 components: conventional financial service usage index (*CFI*) and digital financial service usage index (*DFI*)), examine their link to GDI and the GII (though based on simple correlations, not a causality exercise), and then identify the drivers of financial inclusion (i.e., *GFII*) in particular focusing on the digital aspect. We calculate indices for different countries for 2011, 2014, 2017, and 2021 using the Global Findex database (see Demirgüç-Kunt et al., 2018) [1]. It helps us to investigate the performance of different countries over the years in ensuring the financial inclusion of women and how digital services are penetrating over the years. To construct the gender-based financial inclusion indices the paper considers a number of indicators that reflect usage of financial services. We construct the indices for men and women separately and using the standard method adopted for the gender development index of UNDP, a ratio of the two is arrived at for different countries. Finally, the paper investigates the drivers of gender-based financial inclusion focusing in particular on the digital index.

For a theoretical underpinning, this paper considers the technology acceptance model (TAM) (Davis, 1989) [19], which highlights two important factors that induce one to use technology such as digital technology. These two factors are the perceived ease of use and perceived usefulness of adopting technology. Ease of use of a digital financial service depends on infrastructure such as bank branches, ATMs, etc. On the other hand, the perceived usefulness depends on the level of education, regular earnings of women through labour market participation, and so on. Various extensions of the TAM model have been formulated in the literature which suggest that the above two factors are influenced by other external factors too (Venkatesh and Morris 2000 [20]; Saravanabhavan and Rajeev 2023) [21]. Some of these external factors one can consider are women's life expectancy at birth, mean years of schooling, per capita income, the share of seats in parliament, and labour force participation rate.

The theoretical relation between FI and other related macro variables such as GDP and inequality has been studied by Banerjee and Newman (1993) [22] and Ghatak and Jiang (2002) [23]. However, there are no gender-specific theoretical studies on financial inclusion.

We use advanced econometric techniques such as the instrumental variable regression model for this task. Finally, relevant policy suggestions are put forth for the improvement of fintech-based financial inclusion for women in different countries around the world.

To construct the *GFII* we use the Principal Component Analysis (PCA) in which weights are endogenous estimates through specific model assumptions (Elsherif, 2019; Sha'ban et al., 2020; Tram et al., 2021) [15,24,25]. This is better than the approach, where the weights assigned to each dimension are selected in an ad hoc manner (e.g., Sethi and Sethy, 2019; Huang and Zhang, 2020) [26,27]. Therefore, the use of the PCA method provides more robust results.

Before constructing the indices, we first look at the levels of financial service usage by women using the Global Findex database (Demirgüç-Kunt et al., 2018) [1]. Our analysis showed that female participation in the financial system varies with the income level of a country. For instance, 92% of women made or received digital payments in high-income countries, while it was only about 27% in low-income countries (Figure 1) in 2021. However, one phenomenon amongst the lower middle- and low-income countries is worth noting. In both these categories, the percentage of women having a bank account in a formal bank is lower than the percentage of women using digital platforms for financial transactions. This shows that in low-income countries, the digital channels of financial transactions have relatively greater importance than conventional modes. This may be due to a lack of adequate brick and mortar infrastructure or a higher level of societal restrictions faced by women. However, within the low-income nations too, there are significant variations. For example, among these countries, the percentage of women that had saved at a financial institution was about 11% in Mali, whereas it was as low as 0.13% in Afghanistan in the same period. Therefore, given the varied experiences of countries, the measurement of the gender-based financial inclusion index across nations is a worthwhile exercise.

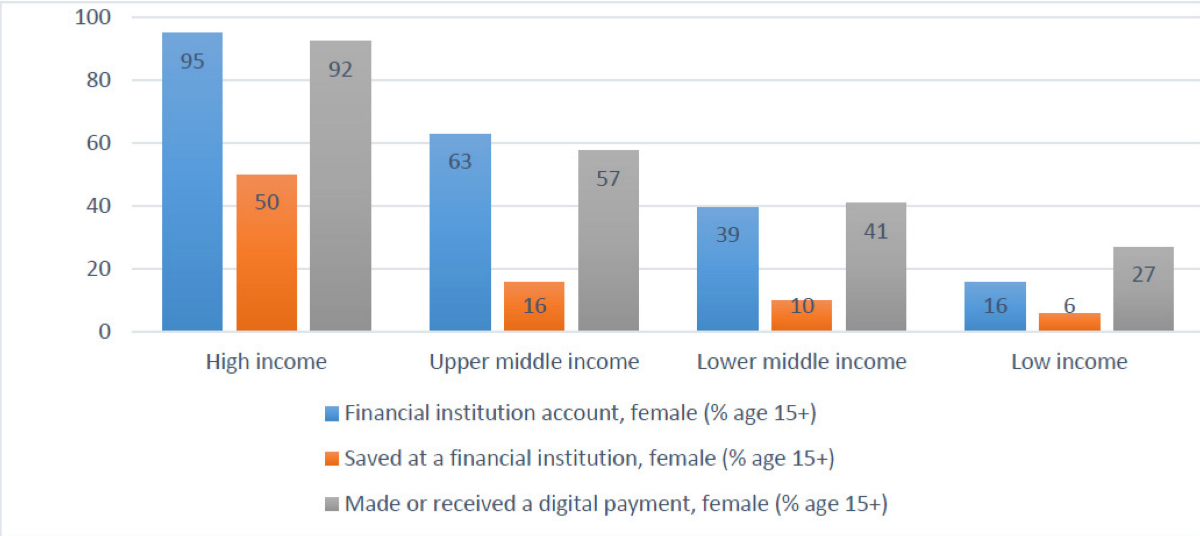

Figure 1. Women's participation in the financial system and digital platform in 2021. Source: Authors' calculation using the Global Findex database (https://www.worldbank.org/en/publication/globalfindex/Data accessed on 2 January 2023).

It is also vital to know whether countries are improving in position in terms of the adoption of technologies for financial access, or not, along with their overall development process.

Our work can be applied to ascertain country-level *GFII* as well as digital financial inclusion of the female population (*DFIF*), to understand a country's positions in different years. Different countries can focus on the important determinants considered in this study for improving their rank concerning *GFII* and in particular *DFIF*. Finally, our study could be used to derive policies for empowering women through financial inclusion through digital platforms for inclusive development.

The structure of the paper is as follows: the next section provides an overview of the literature on financial inclusion and the construction of indices to measure it. We examine studies that have looked at disparities in financial access between men and women. It is found that most studies do not use or construct any comprehensive measure (index). We bridge this research gap in Section 3 by creating appropriate indices using the World Bank data. Section 4 uses the index of gender-based financial inclusion to build an econometric model to assess the impact of country-level factors on women's financial inclusion, focusing on questions such as whether lower national gender development leads to lower financial inclusion and if so, which components are influential. Finally, conclusions and policy implications are made in Section 5.

2. Review of Literature

2.1. Role of Financial Inclusion

The literature on financial inclusion is vast and an exhaustive review is beyond the scope of this paper (see Otiwu et al., 2018; Ahamed and Mallick, 2019; Saha and Dutta, 2021; Tchamyou, 2020; Singh and Kodan, 2011; Van de Werff et al., 2013; Ayyagari and Beck, 2015; Iyer, 2015; Okoye et al., 2017) [28–36]. We discuss a few papers dealing with specific issues and regions.

Financial inclusion is widely found to be a significant determinant of a country's economic development and sustainability. In this regard, a study based on the Global Findex, including both developed and developing countries found correlations between indicators of financial inclusion and gross national income (Van de Werff et al., 2013) [33]. Further, in a cross-country study in the Asia Pacific Region, financial inclusion was found to have a very high correlation with the per capita GDP and a negative correlation with the level of poverty (Ambarkhane et al., 2020) [37]. Studying the African region, Makina and Walle (2019) [38], found access to financial services to exert a significant positive effect on economic growth in the region. Among the country-specific studies, a paper by Singh and Kodan (2011) [32] identifies financial inclusion to be associated with the socio-economic development of India.

Exclusion from financial services continues to be an issue in some regions and contexts. Although the Asian region has much better financial inclusion than other developing areas, there remain significant regional disparities to be addressed (Ayyagari and Beck, 2015) [34]. In the context of India, moreover, Iyer (2015) [35] notes that low incomes may hinder the ability to save funds and invest them.

While analyzing the state of financial inclusion for women, several studies find that they are widely excluded from the financial system, owing to a variety of factors, such as limited education, income, and employment status (Demirguc-Kunt et al., 2014) [39], and a general lack of empowerment (Efobi et al., 2018; Stewart and Sanman, 2014; Fernandez et al., 2014) [40–42]. However, the rapid digitization of financial services in the modern era has been seen by many scholars as an important tool to reduce disparities between men and women in financial inclusion (Amidzic et al., 2014; Gammage et al., 2017; World Bank, 2020; Chen et al., 2021) [43–46].

2.2. Methodology for Constructing FI Index

Several approaches have been adopted towards studying this gap between the genders in financial inclusion. For example, Fanta (2016) [47] uses descriptive statistics and a binary logistic regression model to capture the effect of gender on access to savings, credit, education, and income levels. On the other hand, Botric and Broz (2017) [48] used Fairlie decomposition to identify and decompose the gender gap in financial inclusion in Central and South-Eastern Europe using World Bank data. However, these scholars only look at the individual components of financial inclusion—such as having a savings bank account or access to credit—and do not provide any aggregated measure of the disparities between men and women in this area. In other words, there is no comprehensive measure developed to capture gender-based financial inclusion considering all countries across the globe. This paper fills this research gap.

An aggregated measure, such as a gender-based index of financial inclusion, would assist in a better understanding of the performance of different countries and aid policy formulation for the lagging nations.

In order to undertake this, we study the efforts made toward building indices of financial inclusion. Appendix A Table A1 summarises the different ways in which indices of financial inclusion have been constructed.

We can see two common approaches to constructing an index in Table A1. The first finds the average distances (such as Euclidean distances) of the components included for measuring FI from an ideal value using the distance formula. The second uses Principal Component Analysis (PCA) to identify the important contributors to an underlying indicator of financial inclusion. The former fall into the category of methods, where different constituents of financial inclusion are used as components and a weighted average or a Euclidean distance from a reference ideal is calculated (Gupte et al., 2012; Kaur and Abrol, 2018; Prastowo and Putriani, 2019; Sarma, 2016; Sethi and Sethi, 2019; and Huang and Zhang, 2020) [26,27,49–52]. The final index is sensitive to the selection of weights. While many studies have made use of ad hoc methods to select weights, recent efforts have been directed towards using approaches such as PCA (Mialou et al., 2017; Camara and Tuesta, 2017; Park and Mercado, 2018; Yorulmaz, 2018; Ahamed and Mallick, 2019; Anarfo et al., 2019; Elsherif, 2019; Sha'ban et al., 2020; Tram et al., 2021) [15,24,25,29,53–57]. In the PCA method, weights for combining the indicators of FI are arrived at based on the eigen values computed from the data at hand. Thus, weights for combining different indicators are data-driven rather than subjective selection by the researcher. Keeping in mind such advantages of PCA, we use this method for constructing our index. In the next section, we detail the methodology used to construct G*FII*. However, when we use principal component analysis in any data set, the initial data are converted into principal components, which are linear combinations of the initial data points. After performing the PCA and arriving at an aggregate index, it may be challenging to identify which variables are most significant.

3. Measurement of G*FII* and *DFIF*

3.1. Data Sources and Research Models

3.1.1. Data

We use the Global Findex Database to measure the overall financial inclusion index for women for the years 2011, 2014, 2017, and 2021. Based on gender-wise availability of data, we consider eight indicators for the measurement of G*FII* (see Figure 2). Though to arrive at a comprehensive set of indices for gender-based financial inclusion we intended to consider all countries across the globe we observe that the data are available for only 109 countries. This compelled us to confine ourselves to 109 countries for our study. The construction of a gender-based FI index focusing on digital technology for all countries of the world helps us to compare and contrast countries with different levels of gender development with their digital financial inclusiveness.

3.1.2. Approach towards Constructing G*FII* and *DFIF*

In the literature, one observes that the FI index is often constructed using the indicators of financial infrastructure, such as the number of bank branches. However, when we consider the financial inclusion of vulnerable sections such as women, having infrastructure does not necessarily imply that women access financial services through the present infrastructure. Keeping this important aspect in mind, we have considered only those indicators for constructing indices that reveal the actual usage of financial services.

Therefore, we have constructed two indices: digital access and conventional method-based access through, say, brick-and-mortar branches of banks. These two indices viz., *DFI* and *CFI*, are indeed usage-based indices. We combine these indices to arrive at the overall FI index (*FII*). These indices are constructed for males and females separately as in the case of UNDP's gender development index, and then based on them, we arrived at the G*FII*. Figure 2 presents the methodological flowchart.

As mentioned, we consider the PCA method for the measurement of FI. Based on the PCA, we calculate the appropriate weights and postulate that the latent variable is linearly determined as follows:

$$FII_i = w_1 DFI_i + w_2 CFI_i + e_i \tag{1}$$

where FII_i is the Overall Financial Inclusion Index for country i; w_1 and w_2 are the relative weights of the two sub-indices; e_i is the variation due to error.

DFI and *CFI* are computed as follows:

$$DFI_i = \alpha_1 X_{1i} + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{4i} + \alpha_5 X_{5i} + u_i \tag{2}$$

$$CFI_i = \beta_1 X_{6i} + \beta_2 X_{7i} + \beta_3 X_{8i} + \vartheta_i \tag{3}$$

Indicators used to compute these two sub-indices are presented in Table 1. These indicators are chosen based on a review of the literature and the availability of gender-specific data from FINDEX. For example, in the literature, Morsy (2020) [17] considered variables such as respondents with an account at a financial institution, using their accounts at a formal financial institution for business purposes, credit card ownership, and debit card ownership to measure financial inclusion.

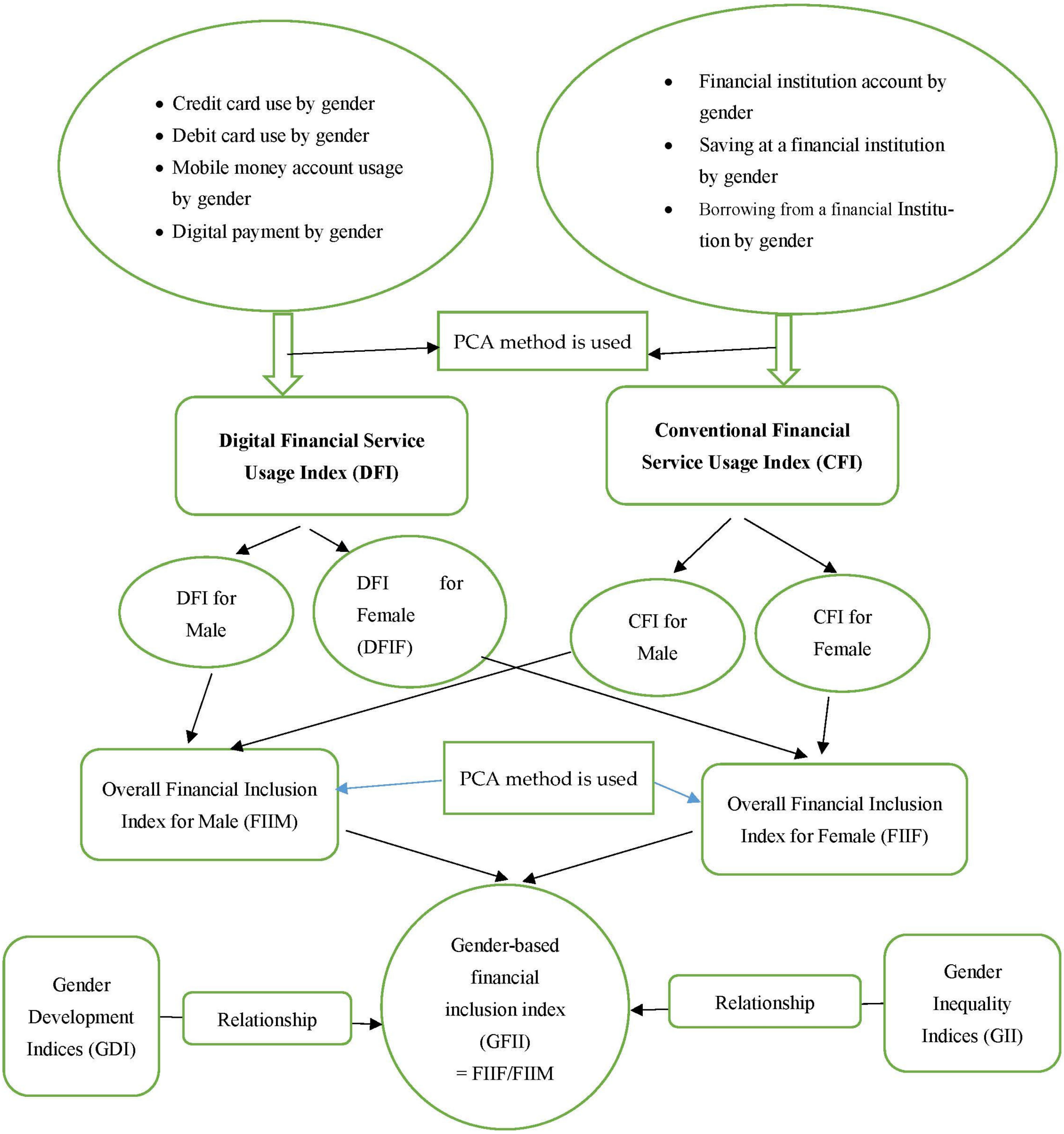

Figure 2. Methodological flow chart. Source: Authors' compilation.

It is important to note that we calculate the *FII* for males and females separately by considering the indicators for males and females as shown in Table 1, and arriving at *DFI* and *CFI* indices gender-wise.

Table 1. Explanation of variables considered for the measurement of different financial indices for different years.

Variables	Indicators	
	Male	**Female**
Digital financial service usage index (*DFI*)		
X1	Owns a credit card, male (% age 15+)	Owns a credit card, female (% age 15+)
X2	Owns a debit card, male (% age 15+)	Owns a debit card, female (% age 15+)
X3	Borrowed any money from a formal financial institution or using a mobile money account, male (% age 15+)	Borrowed any money from a formal financial institution or using a mobile money account, female (% age 15+)
X4	Mobile money account, male (% age 15+)	Mobile money account, female (% age 15+)
X5	Made or received a digital payment, male (% age 15+)	Made or received a digital payment, female (% age 15+)
Conventional financial service usage index (*CFI*)		
X6	Financial institution account, male (% age 15+)	Financial institution account, female (% age 15+)
X7	Saved at a financial institution, male (% age 15+)	Saved at a financial institution, female (% age 15+)
X8	Borrowed from a formal financial institution, male (% age 15+)	Borrowed from a formal financial institution, female (% age 15+)

Source: The Global Findex database 2021. Note: Variables X3, X4, and X5 are not available for 2011. Variable X3 is not available for 2014 and 2017.

3.2. PCA Methodology

Principal component analysis (PCA) as a pattern recognition technique helps us to identify and determine which parameter among variables is more crucial than others. Instead of being subjective in our weight selection, PCA enables us to justifiably weigh the variables based on their variability.

The *FII* is computed by estimating a two-stage PCA:

- **The first stage of PCA:** Estimation of the two sub-indices: *DFI* and *CFI* and the parameters (α and β) in the system of Equations (2) and (3). We estimate them using the principal components as linear functions of the independent variables. These two sub-indices are computed for males and females separately.
- **The second stage of PCA:** By considering the same procedure as in the first stage, we estimate the weights of the two sub-indices and combine them we arrive at the *FII* index for males and females separately.

To present the computation procedure of *GFII* we now introduce the notations $FIIM_i$ and $FIIF_i$ that represent overall *FII* for male and female, respectively, for country i.

$$GFII_i = \left(\frac{FIIF_i}{FIIM_i}\right) \times \left(\frac{FIIM_i + FIIF_i}{2}\right) \tag{4}$$

Based on data availability, we have calculated $GFII_i$ for the years 2011, 2014, 2017 and 2021, separately.

3.3. Estimated FII Index for Women

Table 2 presents the descriptive statistics of the indicators used to measure the *FII* for the year 2021. Descriptive statistics for the other three years, i.e., 2011, 2014, and 2017 are not presented here due to space constraints.

Table 2. Descriptive statistics of the variables used to measure the *GFII* in 2021 (in %).

Variable	Male				Female			
	Mean	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
X1	24.0	22.4	0.0	82.1	20.9	22.4	0.0	83.4
X2	55.3	31.6	2.5	99.1	49.8	33.7	0.3	98.9
X3	29.5	18.4	3.4	80.8	25.3	18.9	0.8	81.2
X4	13.8	19.1	0.0	71.4	11.0	16.6	0.0	66.0
X5	69.3	25.4	11.9	100.0	63.1	28.9	4.0	100.0
X6	69.8	28.2	14.8	100.0	64.5	31.6	4.7	100.0
X7	29.4	22.0	1.0	80.6	25.4	22.7	0.1	78.9
X8	28.2	19.2	3.4	80.8	24.4	19.3	0.8	81.2

Note: The calculation is based on a sample of 109 countries. See Table 1 for the variable definition. Source: Calculated by authors.

To ensure that the scale on which the indicators are measured is consistent, we normalize the indicators for each index before applying the PCA factoring by using the following formula;

$$Dimension\ index_i = \frac{X_i - X_{min}}{X_{max} - X_{min}} \quad (5)$$

Data after normalization takes values from 0 to 1, where 0 indicates the lowest level of financial inclusion, and 1 indicates the highest level.

3.3.1. First-Stage PCA Results

Before performing PCA analysis, we evaluated and ensured the validity of the data. Validity refers to the closeness of the measured values. We measure the validity using the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity. We used STATA version 14 (Stata Corp, College Station, TX, USA) to perform the KMO test and Bartlett's test of sphericity and, in both cases, found that PCA is appropriate for the analysis. The relevant statistics can be found in Appendix A Table A2.

To find the weights to estimate Equations (2) and (3), we have estimated eigenvalues displayed in Table 3 using the PCA technique. Based on Kaiser (1960) [58], we consider eigenvalues greater than 1 for the principal components analysis. Table 3 shows the eigenvalues of the principal components for both sub-indices for males and females separately for 2021. Except for the first principal component (comp1 of both sub-indices), none has an eigenvalue greater than 1. Therefore, the first components are considered for analysis. The weights obtained from the PCA analysis are assigned to the first principal component of each sub-index. The estimations are consistent for the years 2011, 2014 and 2017 (see Appendix A Tables A3–A5).

Table 4 displays the weights obtained from the information in the principal components and the corresponding eigenvalues. For the *DFI* sub-index, X1 (owns a credit card) and X2 (owns a debit card) have higher weights than other indicators for males and females. On the other hand, for the *CFI* sub-index, X7 (saved at a financial institution) has higher weights than X6 (financial institution account) and X8 (borrowed from a formal financial institution) though the difference is minimal. Similarly, we present results for 2011, 2014, and 2017 in Appendix A Tables A6–A8). Table 4 also shows that only X4 (mobile money account) is largely unexplained, as for about 55 countries out of 109 countries, this data is not available.

Table 3. Principal Components Estimates for different financial indices for 2021.

	Male				Female			
Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
				DFI				
Comp1	**3.63962**	2.75713	0.7279	0.7279	**3.56811**	2.64554	0.7136	0.7136
Comp2	0.882481	0.493601	0.1765	0.9044	0.922572	0.496383	0.1845	0.8981
Comp3	0.388881	0.340041	0.0778	0.9822	0.426189	0.383193	0.0852	0.9834
Comp4	0.048839	0.008657	0.0098	0.992	0.042996	0.002862	0.0086	0.992
Comp5	0.040183	.	0.008	1	0.040134	.	0.008	1
				CFI				
Comp1	**2.60255**	2.38013	0.8675	0.8675	**2.58152**	2.32661	0.8605	0.8605
Comp2	0.222424	0.047402	0.0741	0.9417	0.254906	0.091333	0.085	0.9455
Comp3	0.175022	.	0.0583	1	0.163574	.	0.0545	1
				FII				
Comp1	**1.9796**	1.95919	0.9898	0.9898	**1.97757**	1.95513	0.9888	0.9888
Comp2	0.020403	.	0.0102	1	0.022435	.	0.0112	1

Source: Calculated by the authors.

Table 4. Scoring coefficients for orthogonal varimax rotation (Weights) for 2021.

	Male		Female	
Variable	**Comp1**	**Unexplained**	**Comp1**	**Unexplained**
		DFI		
X1	0.4981	0.09692	0.5028	0.09779
X2	0.4843	0.1462	0.4874	0.1525
X3	0.4798	0.1622	0.4807	0.1755
X4	−0.2588	0.7561	−0.225	0.8194
X5	0.4692	0.1989	0.4774	0.1867
		CFI		
X6	0.5724	0.1474	0.5694	0.1629
X7	0.5822	0.1177	0.5878	0.108
X8	0.5774	0.1323	0.5747	0.1475
		FII		
DFI	0.7071	0.0102	0.7071	0.01122
CFI	0.7071	0.0102	0.7071	0.01122

Source: Calculated by the authors.

3.3.2. Second Stage PCA Results

In the second stage, by carrying out the same procedure as in the first stage, we apply the PCA method to the two sub-indices (*DFI* and *CFI*) to calculate their weights in the overall *FII*. Table 3 shows the results of principal components estimates for *FII*. The results show that only the first component has an eigenvalue greater than 1 for males and females. Therefore, only the first component is considered for analysis. The KMO results in Appendix A Table A2 show that PCA analysis is relatively suitable. Similar to the method in the first stage, we also calculated weights for both dimensions, which are presented in Table 4. Considering values of weights, we find that two sub-indices are equally important for explaining the level of financial inclusion. Similarly, we estimate the overall *FII* for males and females separately for 2011, 2014, 2017, and 2021 for different countries in the world. Finally, following the estimation procedure explained in Equation 4, we calculate the *GFII*.

3.4. Ranking of Countries Based on Different Indices

Considering *DFIF*, we observe that Canada, Hong Kong SAR, the United States, Israel, New Zealand, Republic of Korea, Austria, Japan, the United Kingdom, and Finland assume the top 10 positions. On the other hand, Afghanistan, Pakistan, Iraq, Sierra Leone, Guinea, Lebanon, Tanzania, Benin, Burkina Faso, and Zimbabwe are in the bottom ten positions. We also found that countries like Thailand, Sri Lanka, India, South Africa, and Malaysia rank better in *CFI* but lower in *DFI* for women.

Appendix A Table A9 presents the rank of the countries according to the estimated values of *GFII* for women. Rank 1 indicates that the country is the best in terms of financial inclusion for women, and subsequently, larger ranks indicate a lower level of financial inclusion for women. The Table A9 shows that in 2021, the top 10 countries with the highest financial inclusion for women (as per *GFII* index) in the sample are Canada, Hong Kong, the United States, Australia, New Zealand, Israel, the United Kingdom, Germany, Ireland, and Japan. It is important to note that these are all high-income countries. The ten countries with the lowest financial inclusions for females in the sample are Ecuador, Afghanistan, Pakistan, Iraq, Lebanon, Guinea, Tanzania, Leone, Sierra, Gabon, and Benin. Interestingly, some of the countries that belong to the high or upper-middle-income group but still have relatively lower *GFII* include Ecuador, Iraq, the United Arab Emirates, Greece, and Saudi Arabia.

Subsequent computation of Spearman's rank correlation to understand the association over the years reveals that the coefficient between the ranking of countries in 2011 and 2014 is 0.9427, which is statistically significant at a 1% level. The rank correlation between 2014 and 2017 is 0.9446, which is also statistically significant at the 1% level. The rank correlation between 2017 and 2021 is 0.9436 at a 1% level of significance. This indicates that the rankings of countries do not vary much over the years.

To understand the changes in ranking in different years with regard to the use of financial technology, we calculate the differences in the ranking of countries from 2011 to 2021. Positive differences indicate that the country has improved in terms of higher financial inclusion for females from 2017 to 2021, while negative differences indicate worsened conditions. Among the 39 high-income countries, Italy, Uruguay, Chile, Hong Kong, Japan, Israel, Spain Germany, the United States, and Poland have the highest positive differences between rankings. On the other hand, Saudi Arabia, Sweden, Slovenia, Netherlands, Croatia, the United Arab Emirates, Lithuania, Denmark, Belgium, and Malta show the highest negative differences. Among 8 low-income countries, Mali, Uganda, and Togo show the highest positive differences, whereas Malawi, Sierra Leone, Burkina Faso, and Afghanistan confirm the highest negative differences. Among 31 lower-middle-income countries, Tajikistan, India, Senegal, and Ukraine show the highest improvement, whereas Zimbabwe, Tanzania, Zambia, and the Philippines experience the lowest improvement. Among 31 upper-middle-income countries, Bosnia and Herzegovina, Kazakhstan, Venezuela, Moldova, Russian Federation, China, and Bulgaria show the best enhancement. Costa Rica, Ecuador, Kosovo, Mauritius, and the Dominican Republic experienced the lowest enhancement in female financial inclusion.

Finally, among 109 countries, Bosnia and Herzegovina, Italy, Kazakhstan, Venezuela, Mali, Tajikistan, Uruguay, and India show the highest improvement. In contrast, Costa Rica, Ecuador, Zimbabwe, Tanzania, Saudi Arabia, and Malawi show the lowest improvement in financial inclusion for females. On the other hand, Australia, Canada, Portugal, Brazil, and Malaysia do not show any ranking change from 2014 to 2021.

The construction of *DFIF* and *GFII* and the ranking of countries provides useful insights into gender deprivation in terms of financial access. It is interesting to examine whether a lack of gender development in terms of education, income, or ability to participate in socio-political programmes contributes towards such exclusion. It led us to scrutinize how our *GFII* is related to the already established gender development index (GDI) and gender inequality index (GII) of the respective countries.

3.5. Region-Wise Analysis of DFIF and GFII

After country-wise ranking, we assess the region-wise changing pattern of *DFIF* and *GFII* from 2017 to 2021. A simple average is computed by using the respective indices of countries of a region to arrive at the corresponding region-specific index (Table 5).

Table 5. Region-wise average of calculated values of *DFIF* and *GFII*.

Region	***DFIF***		***GFII***	
	2017	**2021**	**2017**	**2021**
Africa	−1.375	−1.366	−1.394	−1.355
Asia	−0.075	−0.034	0.251	0.066
Central America	−0.898	−1.130	−0.883	−1.287
Europe	0.894	0.891	0.902	0.889
Middle East	−0.237	−0.340	−0.339	−0.373
North America	2.778	2.738	2.842	2.854
Oceania	2.520	2.388	2.633	2.620
South America	−0.347	−0.222	−0.391	−0.447

Source: Computed by authors.

Table 5 shows that the most developed regions including Europe, North America, and Oceania performed well in *DFIF* and *GFII*. On the other hand, Africa, Central America, and South America performed the worst in both indices. Interestingly Asia performs better than these regions including the Middle East. Some regions improved their scores between 2017 and 2021 (namely, Africa, Asia, and South America) in *DFIF* over *GFII*. On the other hand, Central America and the Middle East regressed (in ranking) between the same periods and hence need special attention from policymakers.

Looking in particular at the Asian region, it is clear that East Asia (including Japan, China, and South Korea) is the best performing, while West Asia (including Afghanistan, Iran, and Iraq, among others) is the worst as of the 2021 data in Table 6. In terms of the overall index (*GFII*) improvements, were observed in East Asia and South Asia while the other regions fared worse in 2021 than in 2017. Digital indices, however, show improvements in many of the sub-regions of Asia.

Table 6. Digital and Overall Index Comparisons Between Asian Regions.

Subregion in Asia	***DFIF***		***GFII***	
	2021	**2017**	**2021**	**2017**
East Asia	2.164	1.924	2.243	2.088
North Asia	0.457	0.230	0.934	2.315
South Asia	−1.043	−1.112	−1.007	−1.113
South East Asia	−0.084	−0.022	−0.046	0.102
West Asia	−1.220	−1.082	−1.176	−1.024

Source: Computed by authors.

3.6. Relationship between DFIF and GFII

After observing different trends between *DFIF* and *GFII* over the years it is of interest to examine whether there is any correlation between *DFIF* and *GFII*. As *DFIF* is used to construct *GFII* it may not be appropriate to compute a usual correlation coefficient between these two measures. As we have used the PCA method for index creation and the principal components as such are less interpretable, we use the actual data on digital FI to ascertain its increasing role in the financial inclusion of women.

We consider that it may be more apt to calculate the rank correlation between countries for different years based on these two indices. Our computation reveals that the rank correlation between the two indices is as high as 0.95 (or 0.98 or 0.99 or 0.99) for 2011 (or 2014 or 2017 or 2021). These rank correlation coefficients over the years have also been statistically significant at a 1% level. This indicates that if the rank of a country based on *DFIF* is higher the same country also ranks high in terms of *GFII*. This concludes that a gender-based digital financial index is important in improving the overall financial inclusion for women.

Moreover, Figure 3 demonstrates that the various components of *DFIF* are on the rise. Women's ownership of credit cards, for instance, increased from 17.5% in 2011 to 20.9% in 2021. During the same period, the number of women who "made or received a digital payment" climbed by roughly 17%. A 25% increase in the percentage of women who "borrowed any money from a formal financial institution or through a mobile money account" is also estimated for 2021. Female account ownership of mobile money increased from 2.6% in 2014 to 11% in 2021. The rising trend shows that female financial inclusion digitally is rising gradually, and this has a big impact on financial inclusion for women as a whole.

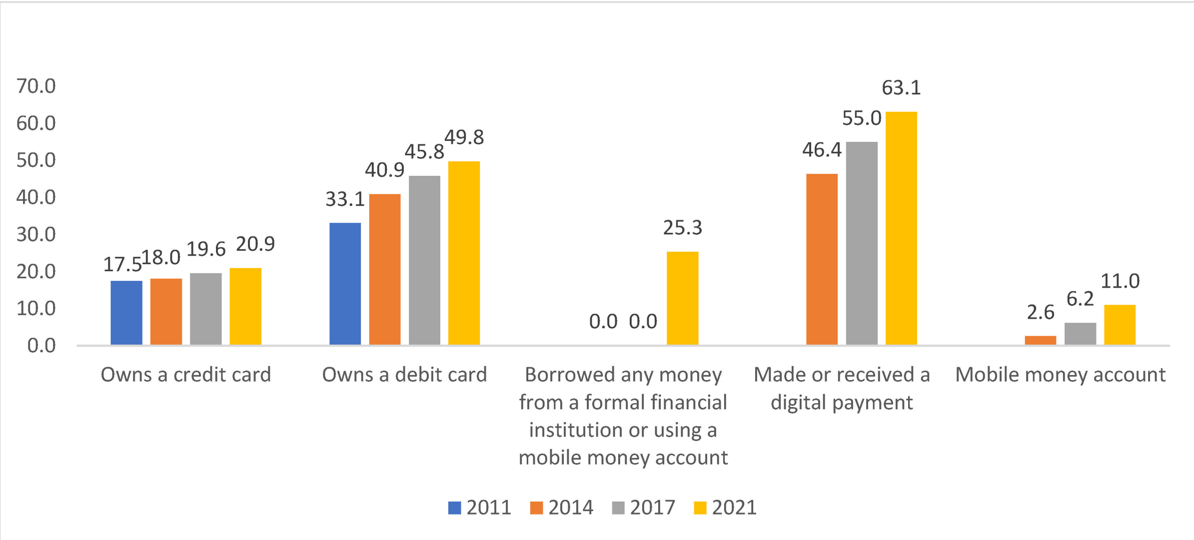

Figure 3. The increasing trend in components of *DFIF*. Source: Authors.

3.7. DFIF and GFII Indices Related to GDI or GII?

Figure 4 depicts the association between the Gender Inequality Index (GII, higher figures imply greater inequality) and the estimated *GFII* Index. A negative relationship between the two indices reveals that higher gender inequality is associated with greater financial exclusion for women. The correlation coefficient between these indicators is −0.85, and it is statistically significant (at a 1% level). However, from the developing countries' perspective, China and the Russian Federation show a much better position than Brazil and India. Therefore, the correlation seems to vary among and within the different groups of countries separated by income. On the other hand, higher gender inequality correlated with the greater exclusion of the digital financial inclusion index too.

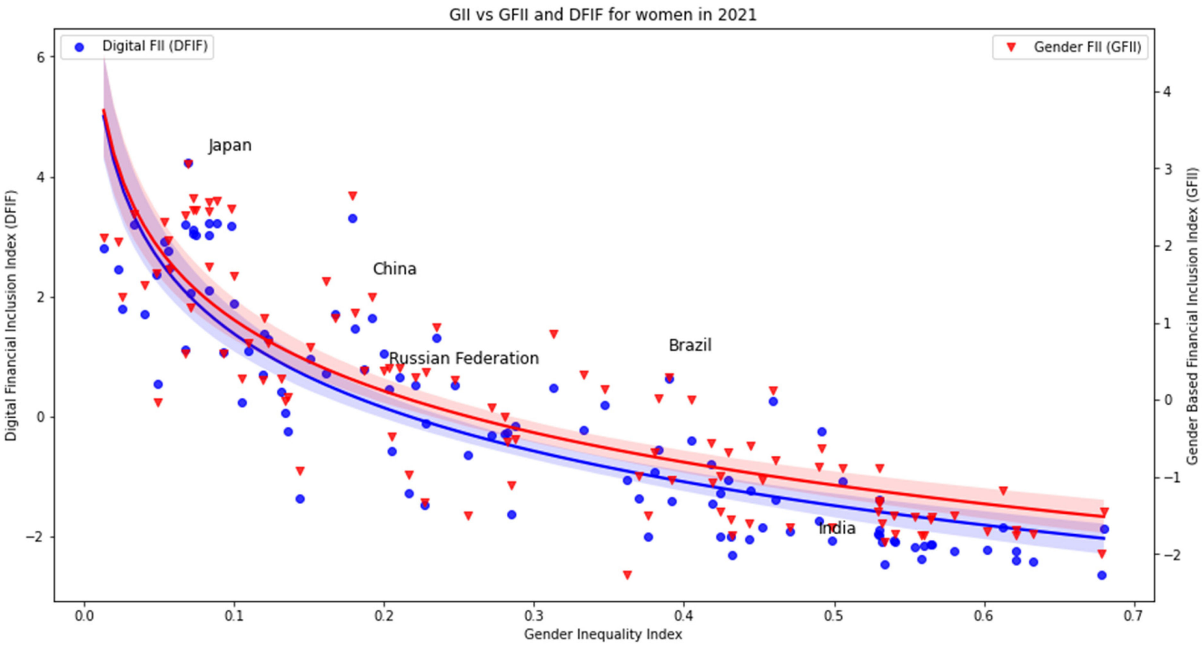

Figure 4. Relationship between GII and estimated *GFII* and *DFIF* for women in 2021. Source: Authors' calculation. Note: Chart uses y ~ log(x) regression for mean estimates (blue and red lines).

Furthermore, as expected, a positive relationship is revealed between the GDI and estimated *GFII* in Figure 5. It implies that higher achievement in the basic dimensions of human development for women promotes higher financial inclusions for them. The graph shows that both *GFII* and *DFIF* almost coincide. If we compare similar graphs for the year 2017 (graphs not shown due to space constraints) another interesting feature can be noted. Namely, the differences between the two curves based on *GFII* and *DFIF* have reduced in 2021 compared to 2017 (against both GDI and GII). This quantitatively establishes that over time usage of digital financial services is dominating for countries across the globe. The correlation coefficient between these two indicators is 0.53, which is statistically significant at a 1% level. The results show that the GII components (comprising reproductive health, political, and labour market participation and a higher level of education) have more compatible relations than the GDI components (comprising longevity of life, basic education, and income per capita) with the financial inclusion of women. We observe in Figure 5 that similar levels of GDI values in countries are associated with significantly different levels of financial inclusion for women. It indicates that women's empowerment in terms of political and labour market participation and higher education levels make a significant difference in achieving women's financial inclusion. On the other hand, a higher GDI indicates a higher inclusion in *DFIF*.

As a next step, we move to a more disaggregated analysis to see whether all components of gender development play a significant role in enhancing FI. Secondly, we ask whether infrastructure is an important variable to determine *GFII*. To investigate this, we employ a panel data regression model to understand the impact of different country-level development factors on women's financial inclusion.

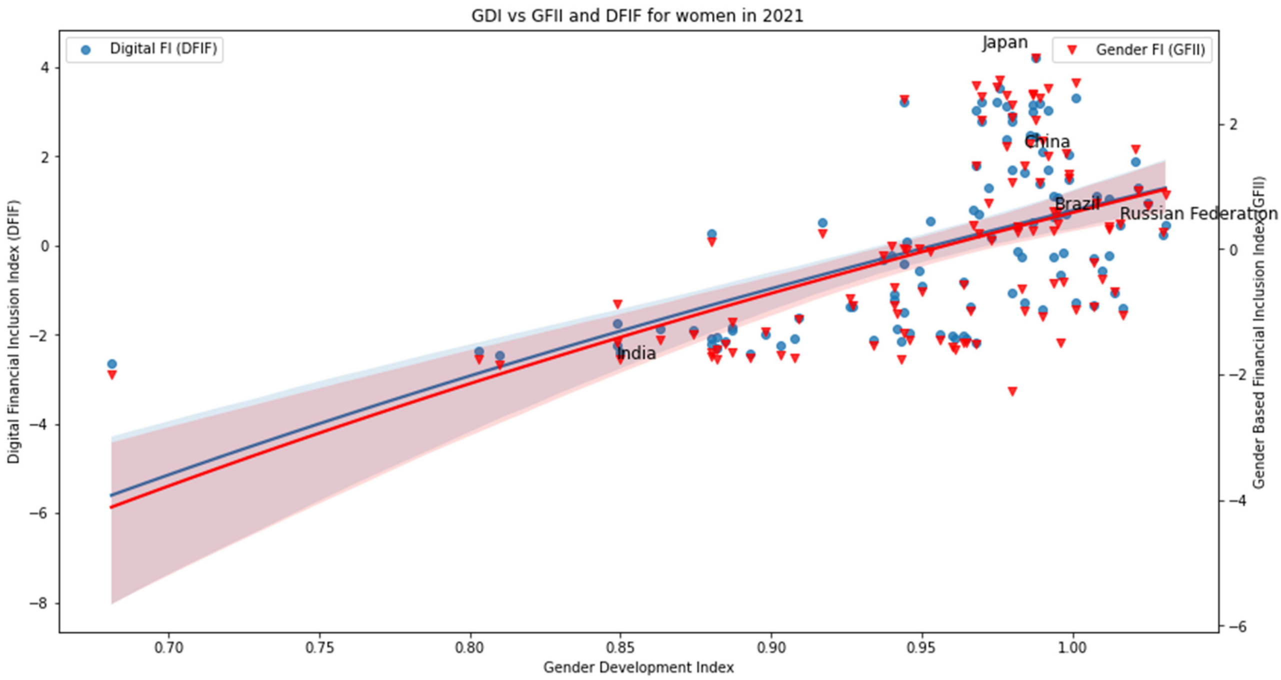

Figure 5. Relationship between GDI and estimated *GFII* and *DFIF* in 2021. Source: Authors' calculation. Note: Chart uses y ~ log(x) regression for mean estimates (blue and red lines).

4. Determinants of G*FII*

4.1. Econometrics Model Specification

Our econometric model to investigate the determinants of G*FII* (as well as *DFIF*) takes the following representation:

$$GFII_{it} = \beta_o + \beta_i Z_{it} + \delta_t + \eta_i + \epsilon_{it} \quad (6)$$

where Z_{it} represents the set of independent variables for country i at time t, η_i is the unobserved time-invariant specific effects; δ_t captures a common deterministic trend; ϵ_{it} is a random disturbance (assumed to be normal), and identically distributed with $E(\epsilon_{it}) = 0$; Var $(\epsilon_{it}) = \sigma^2 \succ 0$.

4.2. Empirical Results

Summary statistics for each variable used in the panel data estimations are presented in Appendix A Table A10. The dispersion around the mean is higher for the *GFII*, *DFIF*, and per capita gross national income for women. It implies a less symmetrical distribution for these variables. However, as the coefficient of variation is lowest for female life expectancy at birth, it shows a more symmetric distribution than other variables.

Appendix A Table A11 presents simple correlation coefficients for the regression variable. Results show that the correlation coefficient between Female mean years of schooling and female life expectancy at birth is high (i.e., 0.77). Similarly, the correlation coefficient between the total fertility rate and life expectancy at birth for females is very high (i.e., −0.89). Young (2017) [59] indicated that if the absolute value of the Pearson correlation coefficient is less than 0.8, collinearity is less likely to exist. Therefore, we estimate the Variance Inflation Factors (VIF) for independent variables and present them in Appendix A Table A10. As the VIF values of a pooled OLS regression are below 10, we confirm that our regression results are free from multicollinearity. However, the correlation coefficients between the *DFIF* and independent variables such as female mean year of schooling (i.e., 0.73) and gross national income per capita for females (i.e., 0.87) are high. Therefore, there is a possibility that our regression models suffer from endogeneity due to variables that are not considered and which may be included within the residuals, and which are correlated with the dependent variable and one independent variable. To solve this problem, we estimate panel Two-Stage Least Squares (2SLS) regression analysis.

Table 7 reports the estimated results. As mentioned, the panel sample comprises 109 countries selected based on data availability. The period covered for analysis is 2011–2021. The significance values of the F-test and Breusch-Pagan Lagrange multiplier (LM) test for model specification indicate that we must choose a Fixed Effect (FE) or a Random Effect (RE) model for the analysis over Pooled regression model. The Hausman tests are conducted to choose between the FE and RE models. Given the statistically significant Chi-squared value for the regression model, the FE model is chosen for our analysis. The Wald test for heteroskedasticity (Chi-squared) indicates the presence of heteroskedasticity. The Feasible Generalized Least Squares (FGLS) method is employed for estimation to correct it. It automatically considers the country-fixed effect but does not incorporate the time effect. The FGLS estimator is more efficient than ordinary least squares in the presence of heteroskedasticity, and serial and cross-sectional correlations (Bai et al., 2021) [60].

Table 7. Determinants of *GFII* and *DFIF*.

Variables	**Dependent Variable**			
	GFII	*DFIF*	*DFIF*	
	FGLS		*IV-2SLS*	
	Model 1	**Model 2**	**Model 3**	**Model 4**
Female life expectancy at birth (leb_f) (years)	−0.0189	0.00460	0.0706 ***	−0.00195
	(0.0165)	(0.00526)	(0.0156)	(0.0131)
Female mean years of schooling (mys_f) (years)	0.149 ***	0.0623 ***	0.113 ***	
	(0.0202)	(0.00800)	(0.0228)	
Gross national income per capita for females (gnp_f) (2011 PPP $)	6.85×10^{-5} ***	5.93×10^{-5} ***		7.96×10^{-5} ***
	(4.99×10^{-6})	(2.24×10^{-6})		(6.68×10^{-6})
Share of seats in parliament for females (perliament_f) (% held by women)	0.0248 ***	0.00180	0.0138 ***	−0.00124
	(0.00538)	(0.00111)	(0.00444)	(0.00343)
Labour force participation rate for females (lpr_f) (% ages 15 and older)	0.0165 ***	0.00568 ***	0.0179 ***	0.00278
	(0.00415)	(0.000998)	(0.00296)	(0.00275)
Total fertility rate (tfr) (birth per women)	0.0666	0.0195	0.202 ***	−0.0240
	(0.0927)	(0.0219)	(0.0692)	(0.0610)
Percentage of urbanization (urban)	−0.0148 ***	−0.00175	0.00677 **	−0.00225
	(0.00366)	(0.00117)	(0.00274)	(0.00211)
Number of commercial bank branches per 100,000 adults (bank_bran)	−0.00711 **	0.00723 ***	0.00591 *	0.00745 **
	(0.00291)	(0.00157)	(0.00335)	(0.00376)
Number of ATMs per 100,000 adults (atm)	0.0110 ***	0.00677 ***	0.00769 ***	0.00560 ***
	(0.000979)	(0.000503)	(0.00109)	(0.00109)
Constant	−2.174	−2.611 ***	−9.068 ***	−1.438
	(1.401)	(0.423)	(1.295)	(1.159)
Wald chi^2/R^2	1910.74 ***	12,044.00 ***	0.732	0.809
Observations/Number of countries	296/104	296/104	296	296
Endogeneity test (Chi^2)			3.237 *	46.921 ***
Under identification test (Kleibergen-Paaprk LM statistic):			103.834 ***	67.940 ***

Table 7. *Cont.*

Variables	**Dependent Variable**			
	GFII	*DFIF*	*DFIF*	
	FGLS		*IV-2SLS*	
	Model 1	**Model 2**	**Model 3**	**Model 4**
Weak identification test	Cragg-Donald Wald F statistic		1446.442	790.529
	Kleibergen-Paaprk Wald F statistic		2260.655	300.146
Stock-Yogo weak ID test critical values		10% maximal IV size	16.38	
		15% maximal IV size	8.96	
		20% maximal IV size	6.66	
		25% maximal IV size	5.53	

Standard errors for FGLS and Robust standard errors for IV-2SLS in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

We run the '*testparm*' STATA command after estimating a fixed-effect model with time dummies to test for a time-fixed effect. The statistically insignificant F values of the time-fixed effect reject the null that the coefficients for all years are jointly equal to zero, and hence, no time-fixed-effects are needed in this case. The values of Wald Chi-squared in the regression model indicate that overall, the regression model has a statistically significant relationship between dependent and independent variables.

However, as we discussed earlier, our regression model may have suffered an endogeneity problem due to a higher correlation between explanatory variables and the error term. Therefore, we utilize an instrumental variable (IV) approach in the 2-SLS regression model. As the IV heteroskedasticity test, the Pagan-Hall general test statistic, is statistically significant at the 1% level we use *the robust* option with the *ivreg2* STATA command to obtain robust standard errors. As per the estimated correlation coefficient values, female mean years of schooling and female per capita income can be endogenous variables when we consider *DFIF* as the dependent variable. However, it is not the case for G*FII* where correlation coefficients for these variables are small and endogeneity is not a problem hence, we are not using an IV regression for G*FII*. Thus, for the *DFIF*-based regression, we utilize the IV-2SLS model. The IV-2SLS regression model considers total per capita gross domestic product as an instrument for female per capita income. With the limited data availability, we could consider only one instrument for female per capita income. On the other hand, female mean years of schooling is instrumented by female secondary education level.

The estimated results are presented in Table 7. The statistically significant Chi^2 value of the endogeneity test indicates that per capita female national income and female mean years of schooling are endogenous variables. The statistically significant LM statistic of the Kleibergen-Paap test indicates that our model is not under-identified. Kleibergen-Paap and Cragg-Donald's statistics are greater than the Stock and Yogo 10 percent critical values. Therefore, we also reject the weakness of instruments. As we are using only one instrument, an overidentification test is not performed. However, as we have two endogenous variables: we consider two separate regression models by considering one of them in each model. We discuss our regression results below.

4.3. Discussions

Our regression results show that gross national income per capita for females has a positive impact on both G*FII* and *DFIF* in regression models 1 and 2, respectively, revealing that economic condition matters. Thus, richer countries have higher levels of financial inclusion among women vis-à-vis men while poorer countries have a lower level of financial inclusion of women. Secondly, the mean years of schooling for women, and per capita gross national income have statistically significant impacts on women's overall financial inclusion i.e., G*FII* and digital FI index (*DFIF*). The importance of education for financial inclusion has been reiterated by other studies as well (see Demigurc-Kunt et al., 2014) [39] which observed that women are often found to be excluded from the financial system owing to a lack of education. However, interestingly, it is revealed that while improving these basic development variables is necessary for ensuring FI, other aspects of gender development also significantly contribute towards the FI of women. These include shares of seats in parliament for females and the female labour force participation rate. Needless to say, participation in labour force and state institutions empowers a woman and this lack of empowerment has been noted as a driving factor for several negative effects on women in the literature, including financial inclusion (Stewart and Sanman, 2014) [41]. Another study concerning Bangladesh (Pitt, Khandaker, and Cartwright, 2006) [61] found that women's empowerment in terms of making fertility decisions has a greater impact on their access to credit (an important component of financial inclusion).

As women's movements are often restricted, and women use considerable time in household activities, the availability of proximal financial infrastructure makes a difference. It can be seen that the number of commercial bank branches per 100,000 adults (only for *DFIF*) and the number of ATMs per 100,000 adults have a positive and statistically significant effect on female financial inclusions. In an aggregate study (considering both men and women), ATM & bank branch density were found to be closely related to an index of financial inclusion from the demand side (Delechat et al., 2018) [18]. In a country-specific study, the distance to bank branches was also found to enhance women's financial inclusion in Peru, and this effect was more pronounced than for men's financial inclusion (Bermeo, 2019) [62]. However, in the present study, when we focus on women, the number of ATMs has a greater positive impact compared to bank branches (Table 7). This result suggests that women are moving more toward digital services. Further, as far as the *DFIF* indicator is concerned, the bank branch variable is not statistically significant, implying that digital services like those given through ATMs matter the most. This result is of importance for women especially those living in rural and remote areas as brick-and-mortar infrastructure no longer matters in the usage of financial services. Digitization has been observed to help with financial inclusion in other studies as well (Amidzic et al., 2014; Gammage et al., 2017; World Bank, 2020; Chen et al., 2021) [43–46]. Yeyouomo et al. (2023) [63] take more fintech-related variables including electricity availability to show how it reduces the gender gap in financial inclusion. But this study is done for the African region only.

Interestingly, the percentage of urbanization has a negative effect on G*FII*. A reason for this could be that the poor and the deprived themselves develop an aversion to banking in urban regions (Bertrand et al., 2006) [64]. For instance, one of our earlier field surveys in India that examined urban financial exclusion observed that the poor and uneducated, primarily self-employed women who have bank accounts, develop an aversion to banking. They feel they may not be valued as customers due to the smaller transactions required by them (Rajeev & Vani, 2017) [65]. More importantly, they are often overwhelmed by relatively well-to-do and sophisticated customers, who account for a large portion of deposits in an urban bank.

Other indicators revealing the well-being of women such as life expectancy at birth even though not significant for G*FII*, it is positively significant for the digital index in regression 3. Further, countries having women with higher fertility rate also indicates their higher level of engagement with household responsibilities, which makes them more dependent on digital services (the coefficient is positively significant for the *DFIF*). Another cross-country study corroborated the result that life expectancy increased financial inclusion, possibly through more awareness and demand for insurance products for access to better healthcare and longer lives (Datta and Singh, 2019) [66]. While, in this study, the overall index was not affected by this variable, the digital index was, possibly indicating the move towards digital insurance products.

Concentrating further on digital financial services our results indicate that female mean years of schooling have a positive and statistically significant (at 1% level) effect on *DFIF* and G*FII*. The coefficient of 0.11 in regression model 3 indicates that a 10 percent increase in female mean years of schooling increases women's financial inclusion (measured by G*FII*) by 1.1%. Also, with the penetration of digital technology, it appears that women who are in the labour force are also able to use financial services. These are promising trends for the support of fintech services. The results are consistent with the estimated results obtained from FGLS models.

5. Conclusions and Policy Implications

This paper measures financial inclusion for women at the cross-country level for 2011, 2014, 2017, and 2021 by using the World Bank's Global Findex database. A gender-based FI measure (G*FII*) based on the digital financial service usage Index (*DFI*) and conventional financial service usage Index (*CFI*) has been constructed for this purpose by employing principal component analysis. Eight indicators were identified to be incorporated, namely, credit card ownership, debit card ownership, owning a mobile money account, borrowing any money from a formal financial institution or using a mobile money account, making or receiving a digital payment, owning a financial institution account, saving at a financial institution, and borrowing from a formal financial institution. To check the strength of our calculated index, we estimated the correlation between G*FII* and the existing measures of gender development or deprivation: GDI and GII, and the constructed indices were found to be adequately correlated. Our analysis further reveals the names of countries that are progressing, and the countries that are regressing in financial inclusion. Finally, the determinants of G*FII* have been identified using a static panel data model.

Thus, the contribution of the paper is manyfold. It fills a gap in the literature by constructing a comprehensive gender-based FI index focusing in particular on digital access, for all countries across the globe for which data are available. The paper uses a data-driven rigorous method of selecting weights to arrive at the index. This helps us to compare different nations and identify the lagging regions. Interestingly we find that not all economically developed nations are performing well in terms of FI of the women population. Some countries with better gender development are also seen to lag in terms of providing access to finance for the women population. More importantly, the paper identifies the factors that can help improve FI for women thereby deriving policy implications. These findings are delineated in this section.

The estimated values of G*FII* show that developed countries such as Canada, Hong Kong, the United States, Australia, New Zealand, Israel, the United Kingdom, and Germany are ranked high in terms of the inclusion of women in the financial system in 2021. On the contrary, developing countries such as Ecuador, Afghanistan, Pakistan, Iraq, Lebanon, Guinea, and Tanzania are ranked very low. Among the high-income countries, Italy, Uruguay, Chile, Hong Kong, and Japan show higher progress in financial inclusion of women. In contrast, Saudi Arabia, Sweden, Slovenia, Netherlands, Croatia, and the United Arab Emirates show slow progress from 2011 to 2021. During the same period, Bosnia and Herzegovina, Italy, Kazakhstan, Venezuela, Mali, Tajikistan, Uruguay, and India showed the most remarkable improvement among all countries included in the analysis. Costa Rica, Ecuador, Zimbabwe, Tanzania, and Saudi Arabia show the lowest achievement in a similar comparison.

A strong negative correlation was observed between G*FII* and GII (−0.85), which shows that higher gender inequality is associated with lower financial inclusion for women. Similarly, the observed positive association between G*FII* and GDI indicates that higher realization in the basic dimensions of human development for females shows an association with higher financial inclusion for women.

Significantly, the results show that the GII components have more compatible relations than the GDI components with women's financial inclusion. We observe that similar levels of GDI values for countries are associated with significantly different levels of financial inclusion for women. It indicates that women's empowerment in terms of political and labour market participation and higher education levels make a significant difference in achieving women's financial inclusion.

Among the countries that are better placed in terms of gender inequality (GII $\leq$ 0.1), it can be observed that there is considerable variation in achievements in the digital sphere of financial inclusion. While Canada (*DFIF* = 4.22), Japan (*DFIF* = 3.22), and New Zealand (*DFIF* = 3.21) had very high levels of digital financial inclusion among women, others such as Portugal (*DFIF* = 1.12), Croatia (*DFIF* = 1.07) and The United Arab Emirates (*DFIF* = 0.55) still have a lot of ground to cover in improving the reach of digital financial services. Although these countries have made strides in removing inequality for women in certain areas, it is clear that they need to focus on also empowering women through digital financial inclusion. On the other hand, countries that have high levels of gender inequality (GII $\geq$ 0.5) all have similarly low levels of digital financial inclusion for women. Typically, the digital financial inclusion index for these countries ranges between −1 and −2. Significant variations in digital FI for women can, however, also be observed among middle-performing countries. For example, Thailand and Ecuador have similar GII values (0.333 and 0.362), but Thailand's *DFIF* is 0.32 while Ecuador falls far behind with a *DFIF* of −2.27. Perhaps when improving the status of women in the path of development, policymakers in different countries pay markedly different levels of attention to the role of digital financial services, even though this is a powerful tool to empower women and improve their economic participation and conditions. There exists the potential for countries at similar stages of development to learn from each other in this regard.

Finally, the estimated Feasible Generalized Least Squares (FGLS) and IV-2SLS panel data models indicate that female life expectancy at birth, mean years of schooling for females, gross national income per capita for females, the share of seats in parliament for females, female labour force participation rate, number of commercial bank branches per 100,000 adults, and number of ATMs per 100,000 adults are important factors for improvement in female financial inclusion.

As far as policies are concerned, we suggest that low and lower-middle-income countries must take prioritised measures to make their financial system more inclusive for women. Programmes should be put in place to enhance the financial literacy of women for the usage of the internet, credit cards, mobile phones for digital payment, and internet-based access to financial institutions. Recent data shows that 48 percent of women are using the internet globally, compared to 58 percent of men. This scenario is markedly different for developed countries as compared to developing countries.

Interestingly, some countries that belong to the high or upper-middle-income group but still have relatively lower *GFII* include Saudi Arabia, the United Arab Emirates, Lithuania, Denmark, Costa Rica, Ecuador, Kosovo, Mauritius, and the Dominican Republic. Given that GII is closely related to women's financial inclusion, it is necessary to pay attention to women's higher level of education and political and labour market participation in these countries.

Our study suggests that India is one of the countries progressing towards a higher level of financial inclusion for women. The Pradhan Mantri Jan Dhan Yojana is a massive financial inclusion programme in India that was introduced by the government on 15 August 2014. Under this scheme, 15 million bank accounts were opened on the inauguration day. Such a dedicated programme is undoubtedly responsible for India's success in ensuring higher financial inclusion for women. It can be a lesson for other developing countries such as Zimbabwe, Tanzania, Zambia, and the Philippines that are not progressing well, to ensure better financial inclusion for women. Our study identifies countries that need attention in this respect by highlighting their past and current position in terms of *GFII*. We also found that countries like Thailand, Sri Lanka, India, South Africa, and Malaysia rank better in *CFI* but lower in *DFI* for females. Given the mobility restrictions women face, these countries may pay attention to the digital financial inclusion of women which is at par with their performance in conventional mode-based inclusion.

Now, the world is moving towards the dominance of digital technologies in financial services. Especially, after the COVID-19 pandemic, a large increase in digital payments spurred financial inclusion. It is evidenced that the use of conventional financial factors is now suppressed by the use of digital financial factors. For example, the use of a 'female financial institution account' increased by about 5% from 2017 to 2021. At the same time, the indicator 'borrowed any money from a formal financial institution or using a mobile money account for females' increased by about 25% compared to 29% for males during the same period. This expansion opened up new economic opportunities, reduced the gender disparity in account ownership, and strengthened household resilience to better handle financial shocks. Therefore, to boost the financial inclusion of women, greater efforts should be aimed at enhancing access to digital financial services, digital education, and so on.

Though this study is at a macro level we also note that within a country there can be differences in the use of digital financial services across different income groups. For example, Findex data for 2021 for India reveals that while only 3.61 percent of people belonging to the lowest quantile have access to mobile money this percentage is as high as 30 percent for the richest quantile. Thus, there is a need to pay special attention to intra-country disparity and the bottom layer of society. The poorer section without access to the formal sector may depend on the informal money lenders who provide them with finances. Though such facilities from the informal sector may help the poor to get funds, they often come at unfavourable terms and conditions making their situation worse. As the poor are often unable to access the formal banking sector due to a lack of finances, many countries have provided the opportunity to open zero-balance accounts. Many African countries have also provided the opportunity to access digital platforms for financial services through small traders who deal with smaller amounts of money. Such initiatives help people with a low resource base to access formal financial services.

Finally, our analysis suggests that to enhance financial inclusion for women, a holistic gender development approach that includes higher educational attainment, per capita income, labour force participation, and political participation is essential. The better financial infrastructure in terms of a higher number of bank branches and more importantly better availability of ATMs further aids women to accessing financial services. These initiatives will help to achieve sustainable development of a country.

Our result on fintech is similar to the findings of several other studies. For instance, Yeyouomo et al. (2023) [63] find that fintechs mitigate the gender gap in access to and usage of financial services, which narrows the financial inclusion gender gap. Saima et al. (2022) [67] argued that there is no moderating effect of gender on the effects of perceived usability, perceived trustworthiness, and loyalty satisfaction while examining the role of gender diversity in fintech. On the other hand, Alkhwaldi et al. (2022) [68] made the case that legislators and providers of fintech services need to grasp the extremely low rate of fintech usage that is now in place.

Finally, several other indicators also may impact women's financial inclusion some of which we have not considered due to lack of data. For example, the biggest obstacle to account ownership for both men and women is a lack of available funds which may get captured through income inequality between men and women. Though we have considered gender-wise (aggregate) per capita income, income inequality data based on gender is not found across countries. Similarly, governance-related variables including corruption may also influence financial inclusion which this study has not taken due to a lack of gender-specific data and also due to the multicollinearity problem. The latter may arise as these governance deficiencies will impact women's education, income, etc. which are already considered in the paper. Future studies can take some of these aspects to look at financial exclusion for women.

A recent study finds that the quality of governance is crucial in eliminating the trade-off and enhancing the interaction between financial inclusion (FI) and financial stability (FS) (Saha and Dutta, 2022) [69]. Ji (2020) [70] found that both across states of the U.S. and across international borders, higher degrees of religiosity are inversely correlated with the use and adoption of formal financial services. Once gender-specific data are available on these variables, such as the quality of governance, quality of democracy, and religious beliefs the empirical results can be updated and form the future research topic.

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Appendix A.

Table A1. Approaches towards constructing a Financial Inclusion Index.

Author	Study Area	Variables	Data Source	Methodology	Conclusions
		General			
Sarma (2008) [11]	Cross-country	Banking penetration: No. of bank A/C (per 1000 adults); Availability of banking services: No. of Bank Branches (per 100,000 adults); Usage of the banking system: Domestic credit (as % of GDP), Domestic deposit (as % of GDP)	World Development Indicators (World Bank); International Financial Statistics (IMF)	The dimension index; Index of financial inclusion is measured by the normalized inverse Euclidean distance of the point Di from the ideal point I = (1,1,1, . . . 1)	Proposed an index of financial inclusion (IFI): a comprehensive measure that can be used to measure the extent of financial inclusion across economies.
Chakravarty and Pal (2013) [71]	Cross-country, India	Geographic branch penetration: number of bank branches per 1000 sqkm; Demographic branch penetration: number of bank branches per 100,000 people; Geographic ATM penetration: number of bank ATMs per 1000 sqkm; Demographic ATM penetration: number of bank ATMs per 100,000 people; Credit accounts per capita: number of loans per 1000 people 6. Credit-income ratio: the average size of loans to GDP per capita; Deposit accounts per capita: number of deposits per 1000 people; Deposit-income ratio: the average size of deposits to GDP per capita	Beck et al. (2007) [72]	It presents an analysis of banking financial inclusion using an axiomatic approach.	The suggested index of financial inclusion allows the calculation of percentage contributions of different dimensions to the overall achievement. The study made a cross-country comparison of financial inclusion as well as analyze financial inclusion across sub-national regions of India.

Table A1. *Cont.*

Author	Study Area	Variables	Data Source	Methodology	Conclusions
		General			
Sarma (2012) [73]	Cross-country	No. of Bank Accounts per 1000 adults; No. of Bank branches per 100,000 adults; No. of ATMs per 100,000 adults; Loans + Deposits (as a percent of GDP)	Financial Access Survey (FAS) database of the International Monetary Fund (IMF)	Index of Financial Inclusion based on normalized Euclidean distance based on Euclidean distance.	The proposed index is easy to compute and is comparable across countries and over time. It also satisfies some important mathematical properties.
Gupte et al. (2012) [49]	Cross country	Outreach: the number of bank branches and ATMs per 1000 km^2; the number of bank branches and ATMs per 100,000 people; the number of accounts per 1000 adults (deposits and loans); Usage: volume of deposits and loans as % of GDP; Ease of transactions and cost of transactions: annual fees charged to customers for ATM cards; accounts and the cost of international transfer of money.	The World Bank	Financial inclusion index based on maximum and minimum values	This paper aims to study the determinants that measure the extent of financial inclusion and focuses on computing an index that would comprehensively capture the impact of multi-dimensional variables with specific reference to India, using the latest available data.
Sarma (2015, 2016) [52,74]	Cross country	Banking penetration: number of deposit bank accounts per 1000 adults; Availability: the number of bank branches and ATMs per 100,000 adults. (using 2/3rd weight for bank branch index and 1/3rd for ATM index); Usage: the volume of credit and deposit to adult individuals as a proportion of GDP.	Financial Access Survey (FAS) database of IMF	Similar to Sarma (2008) [11], there is more improvement than using the distance from the lowest point (0, 0, 0) to the ideal point (1, 0.5, 0.5).	The proposed index of financial inclusion (IFI) is easy to compute and measure financial inclusion at different time points and different levels of economic aggregation (village, province, state, nation and so on). It is also suggested that even 'well-developed' financial systems have not succeeded in being 'all-inclusive', and certain segments of the population remain outside the formal financial systems.
Camara and Tuesta (2017) [75]		Usage: account, savings and loan; Barriers: distance, affordability, documentation, lack of trust; Access: number of ATMs and bank branches per 1000 km^2; the number of ATMs and bank branches per 100,000 people.	World Bank's Global Findex (2011) [76]	Compute FI index by employing a two-stage PCA method	Their composite index others a comprehensive measure of the degree of financial inclusion, easy to understand and compute.
Mialou et al. (2017) [53]	Cross country	Outreach of financial services: number of ATMs and branches per 1000 km^2; Use of financial services: number of household borrowers and depositors per 1000 adults.	IMF	The composite index uses factor analysis (FA) to derive a weighting methodology	Countries are then ranked based on the new composite index, providing an additional analytical tool that could be used for surveillance and policy purposes on a regular basis.
Bansal (2014) [77]	India	Accounts at a formal financial institution in the rural and urban area; Value-wise share of Paper-based and Electronic transaction	IMF	Descriptive statistics	Studied the contribution of ICT towards financial inclusion in the country and analysed the different applications of ICT which banks are adopting.

Table A1. *Cont.*

Author	Study Area	Variables	Data Source	Methodology	Conclusions
			General		
Park and Mercado (2018a) [78]	Cross country	ATMs per 100,000 adults; Commercial bank branches per 100,000 adults; Borrowers from commercial banks per 1000 adults; Depositors with commercial banks per 1000 adults; Domestic credit to GDP ratio	IMF	Calculate the FI index as the method of Sarma (2008) [11].	The estimation results show that per capita income, rule of law, and demographic characteristics significantly affect financial inclusion for both world and Asia samples.
Park and Mercado (2018b) [55]	Cross country	Access dimension: the percentage share of the adults with an account; Availability dimension: number of bank branches and ATMs per 100,000 adults; Usage dimension: the share of adults who borrowed and saved from a financial institution; the domestic credit-to-GDP ratio.	IMF	Combine the approaches of Sarma (2016) [52] and Camara & Tuesta (2014) [75]	The results provide evidence that high- and middle-high-income economies with high financial inclusion have significantly lower poverty, while no such relation exists for middle-low and low-income economies.
Chatterjee and Das (2021) [79]	India	Credit and Deposit amount as a proportion of GSDP; Number of bank accounts per 1000 population; Number of bank offices per lakh population; Tele-density; Number of internet subscribers per 100 population; Mobile phone per 100 population	Indiastat.com (10 April 2023)	Financial Inclusion Index (*FII*) based on Sharma (2012) [73]; Information Technology Index	The results show that technology does play an important role in improving financial inclusion.
Bhurat (2019) [80]	BRICS	Access to a mobile phone (% age 15+); Access to a mobile phone: male-female (% age 15+); Access to a mobile phone: Income disparity; Account and Active account (% age 15+); Account, male-female (% age 15+); Account: Income Disparity; ATMs and Branches per 100,000 adults; Made or received digital payments in the past year (% age 15+); Borrowed from a financial institution or used a credit card (% age 15+); Used a debit or credit card to make a purchase in the past year (% age 15+); Access to a mobile phone, Access to internet and payments made by using mobile phone or internet (%15+) Saved at a financial institution (% age 15+)	World Bank and Global Findex database	Descriptive statistics	The paper aims to examine the concept of financial inclusion and its relevance with respect to the world's emerging economies Brazil, Russian Federation, India, China and South Africa (BRICS).
Ahamed and Mallick (2019) [29]	Cross country	Financial outreach: Demographics (the number of bank branches and ATMs/100,000 people), Geographic (the number of bank branches and ATMs per 1000 km^2); Usage: number of bank accounts per 1000 populations.	World Bank	Build a multidimensional index by using PCA method	A higher level of financial inclusion contributes to greater bank stability.
Fanta and Makina (2019) [12]	Cross-country	Fixed telephone; Mobile subscriptions; ATMs; Internet access	World Development Indicators	Descriptive statistics and regression analysis	There is evidence that technology fosters both access and usage of financial services.
Van et al., (2021) [13]	Cross-country	The number of commercial bank branches per 100,000 adults; The number of ATMs per 100,000 adults; The ratio of bank credit for the private sector to GDP	Global Findex database and World Development Indicators	Index of Financial Inclusion (IFI) based on Sarma (2008) [11]	The finding supports a positive relationship between financial inclusion and economic growth.

Table A1. *Cont.*

Author	Study Area	Variables	Data Source	Methodology	Conclusions
		General			
Nagpal et al., (2020) [14]	BRICS	Formal saving; Formal credit; Formal account.	Global Findex Database 2017 (World Bank, 2017) [81]	Probit regression	The findings suggest that internet usage and mobile penetration rates have a positive association with financial inclusion indicators in BRICS economies.
Tram et al., (2021) [15]	Cross-country	The penetration dimension (the number of deposit accounts with commercial banks; credit unions; credit cooperatives per 1000 adults; the number of mobile money accounts (mobile money accounts)); The availability dimension (the number of branches and ATMs per 100,000 adults; mobile money agent outlets per 100,000 adults (mobile money agents)); The usage dimension (outstanding deposits (% of GDP); outstanding loans (% of GDP); the value of mobile money transactions (% of GDP) (mobile money transactions).	The World Bank (WB) and International Monetary Fund (IMF)	A measure of financial inclusion is constructed using a two-stage principal component analysis (PCA) method by assigning weights endogenously.	A new detailed index of financial inclusion measurement termed overall FI index was built based on the study.
		Female financial inclusion index			
Asongu and Odhiambo (2018) [16]	48 countries in Africa	Mobile phone penetration; internet penetration; fixed broadband subscriptions; remittances; financial system deposits; financial credit; political stability; female economic participation—female labour force participation; financial stability (likelihood of bank might survive and don't go bankrupt)	The World Bank, International Labour organization	Generalized Method of Moments	The study supports the importance of ICT in moderating financial access for enhanced female economic participation.
Morsy, H. (2020) [17]	Cross country	Banking system ownership: state owned or foreign owned bank; Depth of Credit information index (CII); Strength of legal rights index (LR); Women's rate of participation in the labour market; Educational Attainment Sub index; Inequality in Income; Financial depth; Access to property; Ratio: Financial Inclusion (FINDEX) account; Herfindahl Hirschman index for measuring banking concentration; Financial inclusion—account (Female/male); Account for business purpose (female/male); Savings (female/male); Credit card (female/male); Debit card (female/male); Loan (female/male); Wages (female/male)	Bankscope database, Global Findex database, 2017, The World Bank, World Economic Forum (WEF) database, United Nations Inequality-adjusted Human Development Index, Gender, Institutions and Development Database,	A fixed-effects model, Hausman test	Suggest that women are more likely to be excluded from the financial sector in countries where: (i) foreign-owned banks have a smaller presence; (ii) state-owned banks have a bigger share in the banking system; (iii) credit information is less available through public and private credit registries, (iv) gaps between women and men in educational attainment are large. The results are robust to different specifications and alternative measures of financial inclusion

Table A1. *Cont.*

Author	Study Area	Variables	Data Source	Methodology	Conclusions
			General		
Delechat et al., (2018) [18]	Cross country	Education, at least secondary; Age; Wage employed; Population density; Log of real GDP per capita; Fertility rate; Financial Development; Women's mean age at marriage; Mean years of schooling; ICRG risk rating (composite index and political risk index); Legislation against domestic violence (average; and civil remedies for sexual harassment); Social discrimination against women (SIGI); Corruption Perception Index; Legal rights index; Financial inclusion: having an account	The World Bank, Index IMF, Penn World, UNPD World Fertility and Marriage Database, Barro & Lee, (2013) [82], International Country Risk Guide, Women Business and the Law, Social Institutions and Gender Index, Transparency International, Findex	ordinary least squares	1. Structural country characteristics, such as resource-richness and level of development, and policies, such as stronger institutions, and financial development are significantly related to financial inclusion. 2. A robust negative relationship between being female and financial inclusion as in previous studies, and our analysis points to legal discrimination, lack of protection from harassment, including at the workplace, and more diffuse gender norms as possible explanatory factors.

Source: Synthesized by authors from the review of relevant studies in the area.

Table A2. KMO and Bartlett's test.

Test for Validity of the Data	Estimated Values											
	2011			**2014**			**2017**			**2021**		
	DFI	***CFI***	***FII***	***DFI***	***CFI***	***FII***	***DFI***	***CFI***	***FII***	***DFI***	***CFI***	***FII***
Male												
KMO measure of sampling adequacy	0.500	0.663	0.500	0.568	0.768	0.50	0.762	0.566	0.50	0.645	0.761	0.50
Bartlett's test of sphericity												
Approximate chi-square	91.17	155.1	141	434	258.0	262	266.4	387.1	272.3	634.2	243.1	341.8
Df	1	3	1	6	3	1	3	6	1	10	3	1
Sig.	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.00	0.00	0.000	0.0
Female												
KMO measure of sampling adequacy	0.500	0.617	0.500	0.569	0.759	0.50	0.566	0.573	0.50	0.631	0.749	0.50
Bartlett's test of sphericity												
Approximate chi-square	75.21	162.1	159	414	246	268	387	395	278	635	236	331
Df	1	3	1	6	3	1	6	6	1	10	3	1
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0.0

Note: KMO = Kaiser-Meyer-Olkin. Source: Authors' calculation.

Table A3. Principal Components Estimates for different financial indices for 2011.

	Male				*Female*			
Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
				DFI				
Comp1	**1.7584**	1.51681	0.8792	0.8792	**1.7117**	1.4234	0.8558	0.8558
Comp2	0.241597	.	0.1208	1	0.288301	.	0.1442	1
				CFI				
Comp1	**2.26817**	1.72441	0.7561	0.7561	**2.19285**	1.53649	0.731	0.731
Comp2	0.543762	0.355691	0.1813	0.9373	0.656356	0.505563	0.2188	0.9497
Comp3	0.188071	.	0.0627	1	0.150794	.	0.0503	1
				FII				
Comp1	**1.85696**	1.71391	0.9285	0.9285	**1.88102**	1.76204	0.9405	0.9405
Comp2	0.143043	.	0.0715	1	0.11898	.	0.0595	1

Source: Calculated by the authors.

Table A4. Principal Components Estimates for different financial indices for 2014.

	Male				*Female*			
Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
				DFI				
Comp1	**2.80433**	1.8529	0.7011	0.7011	**2.75449**	1.78801	0.6886	0.6886
Comp2	0.951438	0.735969	0.2379	0.9389	0.966487	0.717478	0.2416	0.9302
Comp3	0.21547	0.186712	0.0539	0.9928	0.24901	0.219	0.0623	0.9925
Comp4	0.028758	.	0.0072	1	0.03001	.	0.0075	1
Comp5								
				CFI				
Comp1	**2.6344**	2.44863	0.8781	0.8781	**2.60549**	2.37767	0.8685	0.8685
Comp2	0.185762	0.005921	0.0619	0.9401	0.227817	0.061122	0.0759	0.9444
Comp3	0.179841	.	0.0599	1	0.166695	.	0.0556	1
				FII				
Comp1	**1.95651**	1.91303	0.9783	0.9783	**1.95869**	1.91738	0.9793	0.9793
Comp2	0.043487	.	0.0217	1	0.04131	.	0.0207	1

Source: Calculated by the authors.

Table A5. Principal Components Estimates for different financial indices for 2017.

	Male				*Female*			
Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
				DFI				
Comp1	**2.84201**	1.95539	0.7105	0.7105	**2.80118**	1.89111	0.7003	0.7003
Comp2	0.886618	0.660532	0.2217	0.9322	0.910064	0.658629	0.2275	0.9278
Comp3	0.226086	0.180797	0.0565	0.9887	0.251435	0.214111	0.0629	0.9907
Comp4	0.045289	.	0.0113	1	0.037324	.	0.0093	1

Table A5. *Cont.*

	Male				***Female***			
Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
				CFI				
Comp1	**2.64445**	2.43724	0.8815	0.8815	**2.63794**	2.40313	0.8793	0.8793
Comp2	0.207215	0.058886	0.0691	0.9506	0.23481	0.10756	0.0783	0.9576
Comp3	0.14833	.	0.0494	1	0.127251	.	0.0424	1
				FII				
Comp1	**1.96046**	1.92091	0.9802	0.9802	**1.9627**	1.92541	0.9814	0.9814
Comp2	0.039543	.	0.0198	1	0.037295	.	0.0186	1

Source: Calculated by the authors.

Table A6. Scoring coefficients for orthogonal varimax rotation (Weights) for 2011.

	Male		***Female***	
		DFI		
Variable	Comp1	Unexplained	Comp1	Unexplained
X1	0.7071	0.1208	0.7071	0.1442
X2	0.7071	0.1208	0.7071	0.1442
		CFI		
X6	0.6024	0.177	0.6256	0.1418
X7	0.61	0.156	0.6203	0.1563
X8	0.5148	0.3988	0.4732	0.5091
		FII		
DFI	0.7071	0.07152	0.7071	0.05949
CFI	0.7071	0.07152	0.7071	0.05949

Source: Calculated by the authors.

Table A7. Scoring coefficients for orthogonal varimax rotation (Weights) for 2014.

	Male		***Female***	
		DFI		
Variable	Comp1	Unexplained	Comp1	Unexplained
X1	0.5515	0.147	0.5492	0.1691
X2	0.576	0.06952	0.5776	0.08111
X4	−0.1965	0.8917	−0.1682	0.9221
X5	0.5705	0.08742	0.5801	0.07317
		CFI		
X6	0.5767	0.124	0.5773	0.1316
X7	0.5777	0.1208	0.5837	0.1124
X8	0.5777	0.1209	0.571	0.1505
		FII		
DFI	0.7071	0.02174	0.7071	0.02065
CFI	0.7071	0.02174	0.7071	0.02065

Source: Calculated by the authors.

Table A8. Scoring coefficients for orthogonal varimax rotation (Weights) for 2017.

	Male		***Female***	
		DFI		
Variable	Comp1	Unexplained	Comp1	Unexplained
X1	0.5452	0.1551	0.542	0.1772
X2	0.5678	0.08371	0.5748	0.07436
X4	−0.2826	0.773	−0.2511	0.8234
X5	0.5481	0.1462	0.5592	0.1239
		CFI		
X6	0.5717	0.1356	0.5694	0.1447
X7	0.5836	0.09945	0.5895	0.08344
X8	0.5767	0.1205	0.573	0.1339
		FII		
DFI	0.7071	0.01977	0.7071	0.01865
CFI	0.7071	0.01977	0.7071	0.01865

Source: Calculated by the authors.

Table A9. Ranking of countries based on G*FII*.

Srl. No.	***Country***	***Rank in 2011***	***Rank in 2021***	***Differences from 2011 to 2021***	***Srl. No.***	***Country***	***Rank in 2011***	***Rank in 2021***	***Differences from 2011 to 2021***
1	Afghanistan	106	108	−2	57	Kyrgyz Republic	86	72	14
2	Albania	80	70	10	58	Latvia	27	34	−7
3	Algeria	97	96	1	59	Lebanon	109	105	4
4	Argentina	57	59	−2	60	Lithuania	33	45	−12
5	Armenia	66	71	−5	61	Malawi	69	90	−21
6	Australia	4	4	0	62	Malaysia	41	41	0
7	Austria	17	14	3	63	Mali	104	78	26
8	Bangladesh	63	79	−16	64	Malta	21	29	−8
9	Belgium	11	20	−9	65	Mauritius	37	49	−12
10	Benin	89	100	−11	66	Moldova	77	58	19
11	Bolivia	60	61	−1	67	Mongolia	23	31	−8
12	Bosnia and Herzegovina	108	51	57	68	Nepal	82	74	8
13	Brazil	44	44	0	69	Netherlands	12	25	−13
14	Bulgaria	51	37	14	70	New Zealand	2	5	−3
15	Burkina Faso	94	98	−4	71	Nicaragua	81	82	−1
16	Cambodia	75	66	9	72	Nigeria	74	83	−9
17	Cameroon	96	89	7	73	North Macedonia	45	54	−9
18	Canada	1	1	0	74	Pakistan	105	107	−2
19	Chile	58	39	19	75	Panama	68	75	−7
20	China	39	24	15	76	Peru	67	64	3
21	Colombia	71	73	−2	77	Philippines	56	76	−20
22	Congo, Rep.	99	91	8	78	Poland	38	33	5

Table A9. *Cont.*

Srl. No.	*Country*	*Rank in 2011*	*Rank in 2021*	*Differences from 2011 to 2021*	*Srl. No.*	*Country*	*Rank in 2011*	*Rank in 2021*	*Differences from 2011 to 2021*
23	Costa Rica	40	88	−48	79	Portugal	36	36	0
24	Croatia	22	35	−13	80	Romania	62	60	2
25	Cyprus	25	32	−7	81	Russian Federation	54	38	16
26	Czech Republic	31	28	3	82	Saudi Arabia	26	48	−22
27	Denmark	6	15	−9	83	Senegal	98	81	17
28	Dominican Republic	53	65	−12	84	Serbia	48	46	2
29	Ecuador	70	109	−39	85	Sierra Leone	83	102	−19
30	Egypt, Arab Rep.	100	93	7	86	Singapore	28	23	5
31	El Salvador	92	87	5	87	Slovak Republic	30	27	3
32	Estonia	20	21	−1	88	Slovenia	13	26	−13
33	Finland	5	11	−6	89	South Africa	59	53	6
34	France	16	18	−2	90	Spain	29	19	10
35	Gabon	95	101	−6	91	Sri Lanka	42	52	−10
36	Georgia	61	57	4	92	Sweden	3	17	−14
37	Germany	15	8	7	93	Taiwan, China	14	13	1
38	Ghana	76	84	−8	94	Tajikistan	102	77	25
39	Greece	46	47	−1	95	Tanzania	78	103	−25
40	Guinea	103	104	−1	96	Thailand	32	42	−10
41	Honduras	87	92	−5	97	Togo	93	86	7
42	Hong Kong SAR	18	2	16	98	Türkiye	49	56	−7
43	Hungary	35	43	−8	99	Uganda	79	68	11
44	India	88	67	21	100	Ukraine	55	40	15
45	Indonesia	72	62	10	101	United Arab Emirates	43	55	−12
46	Iran, Islamic Rep.	34	50	−16	102	United Kingdom	8	7	1
47	Iraq	101	106	−5	103	United States	10	3	7
48	Ireland	7	9	−2	104	Uruguay	52	30	22
49	Israel	19	6	13	105	Uzbekistan	85	80	5
50	Italy	47	16	31	106	Venezuela, RB	90	63	27
51	Japan	24	10	14	107	West Bank and Gaza	107	95	12
52	Jordan	91	97	−6	108	Zambia	65	85	−20
53	Kazakhstan	50	22	28	109	Zimbabwe	64	94	−30
54	Kenya	73	69	4					
55	Republic of Korea	9	12	−3					
56	Kosovo	84	99	−15					

Source: Calculated by authors.

Table A10. Descriptive statistics for panel data.

Variable	Obser-Vation	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation	VIF
GFII	436	−0.25965	6.046691	−122.259	5.82302	−2328.81	
DFIF	436	-4.37×10^{-8}	1.389814	−2.0589	3.26171	-3.2×10^{9}	
leb_f	424	75.92555	7.92105	51.7907	88.3257	10.43265	8.8
mys_f	424	9.125808	3.33553	0.625671	14.00974	36.55052	3.04
gnp_f	424	16077.04	14,433.36	506.14	75,093.99	89.77623	3.28
perliament_f	420	22.82223	10.82223	0	51.80723	47.41969	1.21
lpr_f	424	50.21887	14.52889	11.078	82.953	28.93114	1.41
tfr	324	2.531128	1.294565	1.052	6.545	51.14577	5.7
urban	428	63.23539	21.15469	15.672	100	33.45388	2.17
bank_bran	410	18.43251	14.50634	0.31303	88.42213	78.69975	1.51
atm	400	55.69822	48.7878	0.373619	281.2314	87.5931	2.01
			Mean VIF				3.24

Note: See Table 7 for variable definitions. Source: Authors' calculation.

Table A11. Correlation coefficients.

	GFII	*DFIF*	leb_f	mys_f	gnp_f	perliament_f	lpr_f	tfr	urban	bank_bran	atm
GFII	1.00										
DFIF	0.23	1.00									
leb_f	0.11	0.72	1.00								
mys_f	0.16	0.73	0.77	1.00							
gnp_f	0.20	0.87	0.72	0.69	1.00						
perliament_f	0.15	0.27	0.18	0.12	0.33	1.00					
lpr_f	0.15	0.17	−0.17	−0.01	0.16	0.21	1.00				
tfr	−0.10	−0.62	−0.89	−0.74	−0.59	−0.11	0.12	1.00			
urban	0.04	0.59	0.68	0.60	0.63	0.13	−0.12	−0.53	1.00		
bank_bran	0.06	0.46	0.51	0.47	0.37	0.09	−0.09	−0.54	0.34	1.00	
atm	0.17	0.70	0.64	0.58	0.59	0.08	0.08	−0.59	0.49	0.47	1.00

Note: See Table 7 for variable definitions. Calculation is based on 244 observations. Source: Authors' calculation.

Appendix B. Web References

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