Nexus between Financial Inclusion and Economic Activity: A Study about Traditional and Non-Traditional Financial Service Indicators Determining Financial Outreach

Gerth, Florian

Asian Institute of Management, Makati, Manila, Philippines

2023

Nexus between Financial Inclusion and Economic Activity: A Study about Traditional and Non-Traditional Financial Service Indicators Determining Financial Outreach

Florian Gerth[1,2]

Asian Institute of Management, Makati, Manila, Philippines

[1] Asian Institute of Management, 123 Paseo de Roxas, Legazpi Village, Makati, 1229 Metro Manila, Philippines. Email address: fgerth@aim.edu
[2] I thank Paul Lohmann, Alex Parker, and the participants of the AIB MENA conference in Dubai and the ICGEEE conference in London for their helpful comments and suggestions.

Nexus between Financial Inclusion and Economic Activity: A Study about Traditional and Non-Traditional Financial Service Indicators Determining Financial Outreach

Abstract

This paper empirically analyzes the link between financial inclusion (SDG 8.10) and economic activity. Instead of following the past literature and approximating financial inclusion by variables only capturing traditional financial services, it takes into account non-traditional financial services including mobile money and non-branch retail agent outlets. With the help of the Normalized Inverse of the Euclidian Distance and a one-way fixed effects panel model, this paper documents empirically robust results about the positive link between financial inclusion and the level economic activity. In addition, a break between poverty and financial inclusion is established by regressing the calculated index of financial inclusion on demographic, socio-economic and variables concerning the health and depth of the financial sector. The implications of this finding are two folds. First, it highlights the improvements of low, lower-middle and upper-middle income countries in terms of outreach to financial services in the last decade. Second, it shows that the level of education and the soundness and depth of the local financial sector are important in reaching higher levels of financial inclusion. Overall, our results emphasize the importance of targeted policies to increase the accessibility, availability and usage of the financial sector in attaining sustainable and long-lasting economic prosperity.

Keywords: financial inclusion; non-traditional financial services; economic development; Financial Access Survey (FAS)

JEL Classifications: C23; E13; E44; G20; O16

1. Introduction

Over the last 30 years, the world has made significant progress in lifting people out of poverty. In 1990 the amount of people living below $1.90 per day was 1.9130 billion, and by 2019 this number dropped to 644.7 million. More specifically during the period 2015 to 2019, poverty reduced by more than 13%, and has consequently reached its lowest level ever recorded. The reason for this decline in the poor is inclusive and sustained economic growth. In particular, the long-term economic growth creating jobs and raising real wages. Such achievement has the potential to sustainably benefit the society as a whole.

The growth literature highlights several essential variables for economic progress, namely, the level of investment, educational attainment, productivity, size and growth of the labor force, capital endowment and inflation.[3] However, even when these determinants are performing at their best, insufficient financial development has a tendency to impede sustained economic growth which in turn prevents economies from climbing out of poverty, Berthelemy and Varoudakis (1996). This is because the financial market is a main artery in the economic eco system whereby it facilitates (1) the channeling of savings into investment, (2) risk diversification and (3) the alleviation of information asymmetry, Levine (1997, 2005). It is only after these tasks have been fulfilled that the economy will allocate resources efficiently which in turn will lead to a more sustainable accumulation of physical and human capital and technological growth, Goyal et al. (2004) and Gerth (2017). Nonetheless, Sarma (2012) argues that even when an economy has a well-developed financial system, certain segments of the population may not be financially included. Demirguc-Kunt and Klapper (2012) explain that this can be because of geographical isolations, cost associated with financial services and invalid documentation. According to Sarma (2012), this lack of inclusion (presence of exclusion) hinders the efficient allocation of productive resources, worsens day-to-day finances, supports the growth of informal sources of credit and ultimately hampers economic development.

The overall consensus in the literature suggests a positive relationship between financial inclusion and economic development. For example a study by Bruhn and Love (2014) reinforces the point mentioned in the above paragraph whereby they show how the opening of 800 bank branches by the Mexican bank *Banco Azteca* led to (1) a reduction in unemployment by about 1.4%, (2) an increase in income by about 7% over the span of two years and (3) poverty in the affected areas decreased as the bank catered for low- and middle-income customers that were previously excluded from having access to financial services. Turning to the sub-Saharan African context, Allen et al. (2014) find that recent innovations in providing banking services help to overcome infrastructural deficiencies and consequently foster economic development. Using a sample of 150 countries, Cihak et al. (2016) show that financial inclusion has the ability to produce synergies and to mitigate medium-term instability on the financial sector, consequently supporting economic activity positively.[4] Other studies like Kim (2016) focus on 40 OECD countries to emphasize the

[3] For a deeper and thorough discussion about the determinants of economic growth, see Barro (2000, 2001, 2003, 2013).

[4] See also Gerth and Otsu (2015, 2018) regarding the empirical relationship between financial stability and economic activity.

positive relationship between financial inclusion and economic prosperity. Wang and Guan (2017) adopt and adapt the methodology of Sarma (2008) to illustrate the spillover effects of highly financially inclusive economies on its neighboring countries. According to Wang and Guan financial inclusion has positive economic effects on adjacent countries. Furthermore, Kim et al. (2018) and more recently Van et al. (2021) provide additional empirical evidence supporting the positive relationship using 55 countries belonging to the Organization of Islamic Cooperation (OIC) and 152 countries around the world, respectively. The lessons that we learn from these studies is that financial inclusion is imperative for economic development.

This research contributes and extends the above-mentioned literature in the following three ways. Firstly, instead of relying on demand-side indicators of financial inclusion, this study collects data using the Financial Access Survey (FAS) conducted and organized by the IMF. This supply-side dataset is unrivaled in its depth in terms of time, geography and coverage. It is worth mentioning that this database (1) provides a longer sample size than that of previous studies (2004 until 2019), (2) includes other countries not studied before (189 countries) and (3) has over 120 variables capturing financial access, availability and usage. Secondly, unlike prior studies that focus on traditional measures of financial inclusion (number of bank branches and ATMs), this research uses non-traditional indicators such as the availability and use of mobile money and non-branch retail agent outlets. Thirdly, the methodology developed by Sarma (2008) is extended to empirically determine the respective importance of the three dimensions of financial inclusion (financial access, availability and usage).

The results shown in this research support the prior literature and provide additional evidence not discussed previously. This study shows that regardless of the extension made to build the Index of Financial Inclusion (IFI), the index exhibits a dynamic behavior irrespective of the development stage of the economy. The longer sample period enables us to observe a more realistic view of the trend in the IFI. Our results show a consistent rise for low, lower-middle and upper-middle income economies, and an initial stagnation and subsequent fall for the upper income economies. Furthermore, in the presence of a new index being used, it confirms that countries with a higher IFI score exhibit higher levels of GDP. By contrast, growth in GDP is negatively related to the level of IFI—which is due to the lower average growth rate of high-income economies. In addition, when controlling for non-traditional financial services, the financial inclusion index is not statistically related to poverty—the reason being the increased adoption of mobile money and non-branch retail agent outlets is predominantly in under-developed countries.

This paper is structured as follows. Section 1 introduces the paper and discusses the literature around the topic of financial inclusion and economic activity. Section 2 provides the motivation to construct an alternative financial inclusion index, shows the derivation of the Index of Financial Inclusion (IFI) and provides a descriptive representation of the IFI's time-series behavior. Section 3 presents the empirical models and findings. The last section discusses the policy implications and conclusion.

2. Index of Financial Inclusion (IFI)

2.1 Motivation and Construction

In 2004 Kempson et al. recognized that one single indicator is not enough to gauge the level of financial inclusion within an economy. The authors suggest that merely having access to some traditional form of banking, say a bank account, does not determine the degree of its utilization. Sarma (2012) also criticizes the use of a single indicator as it provides a narrowed view about the services provided by the financial sector. These two criticisms of the single indicator provide the motivation to build another parameter that contains the multi-dimensional nature that better represent the current market situation. Consequently, this research refrains from using a single-indicator approach and constructs a multi-dimensional index to capture financial inclusion.

Based on the consensus in the literature, one single number index must contain different dimensions namely accessibility, availability and usage of financial services. The dimensions are respectively referred to as (1) the "banked" population within an economy, (2) the physical and digital availability of financial service outlets and (3) information about the level of the "underbanked" population.[5] Following Sarma (2008, 2012) and Wang and Guan (2017), the index is constructed.

Each dimension in turn consists of several indicators that capture the contemporary, comprehensive and unique financial environment in each of the 166 countries within our sample, see Table 1.[6]

Table 1: Variables of Financial Inclusion

Dimension	Indicator
Accessibility:	
	Number of deposit accounts with commercial banks per 1,000 adults
	Number of loan accounts with commercial banks per 1,000 adults
	Number of registered mobile money accounts per 1,000 adults
	Number of active mobile money accounts per 1,000 adults
	Number of credit cards per 1,000 adults
	Number of debit cards per 1,000 adults
	Number of life insurance policies per 1,000 adults
Availability:	
	Number of commercial bank branches per 100,000 adults
	Number of ATMs per 100,000 adults
	Mobile money agent outlets: active per 100,000 adults
	Number of registered mobile money agent outlets per 100,000 adults
	Number of non-branch retail agent outlets of commercial banks per 100,000 adults

[5] This view is widely accepted in the literature, see Sarma (2008,2012), Sarma and Pais (2011), Kim (2016), Wang and Guan (2017) and Van et al (2021) among others.

[6] Note that the sample decreased to 166 countries due to the lack of sufficient data for 23 economies.

Usage:	
	Outstanding deposit with commercial banks (% of GDP)
	Outstanding loans with commercial banks (% of GDP)
	Number of mobile money transactions per 1,000 adults
	Value of mobile money transactions (% of GDP)
	Number of mobile and internet banking transactions per 1,000 adults
	Value of mobile and internet banking transactions (% of GDP)

Several of the indicators presented in Table 1 are contemporary financial advancements that need to be considered when trying to determine a consistent degree of country-specific financial inclusion. Their presence is justified by recent developments in under-developed and developing countries where the introduction and usage of non-traditional and digital financial services has accelerated for the past view years, Adrian and Mancini-Griffoli (2019) and Espinosa-Vega et al. (2020). This is especially true for sub-Saharan Africa and Asia, where the availability and usage of mobile money has increased by as much as 500% from 2015 to 2019, FAS (2020). Consequently, it is important to use all of the above indicators as it will provide a better picture of how well a country's citizens are included into the financial sector.

The *Index of Financial Inclusion*, *IFI*, is constructed to lie between the limits of 0 and 1. Where *0* signifies the complete absence of financial inclusion, or complete financial *exclusion*, and *1* signifies complete financial inclusion. This is achieved by first transforming all indicators to lie between these two boundaries and then to calculate the *Normalized Inverse of the Euclidean Distance* for each dimension and for the country as a whole. The result will be one single number that gives the relative degree of financial inclusion for each country within the sample.[7]

To normalize each indicator Equation (1) is used:

$$\varphi_{i,j,c} = \frac{A_{i,j,c} - m_{i,j}}{M_{i,j} - m_{i,j}} \qquad (1)$$

where the variable φ captures the transformed value ($0 \leq \varphi \leq 1$) for indicator *i* in dimension *j* for country *c*, see Table 1. For example, "Number of deposit accounts with commercial banks per 1,000 adults" is indicator *i*=1 for dimension *j*=1 "Accessibility". The variable *A* is the actual observed value, *M* the maximum value of this particular indicator within the respective year and *m* the minimum value of this particular indicator within the respective year.[8]

In a second step, the IFI for each of the three dimensions is calculated, see Equation (2):

[7] This mathematical transformation gives the index the following important and helpful mathematical properties; i) boundedness, ii) homogeneity, iii) unit-free property, and iv) monotonicity.

[8] Due to the possibility of extreme outliers in the maximum value of the data, each indicator is *winsorized*. That is, the highest value is replaced by the second highest. This is sensible, since otherwise the situation might arise where one country has a value of 1 for indicator *i* and all other countries' indicator values range between 0.05 and 0.1. In this particular data set, this is the case for San Marino which, for some reason, has an extremely high number of physical banking outlets and ATMs per 100,000 adults.

$$IFI_{j,c} = 1 - \frac{\sqrt{\omega_{1,j}^2(1-\varphi_{1,j,c})^2+\omega_{2,j}^2(1-\varphi_{2,j,c})^2+\cdots+\omega_{n,j}^2(1-\varphi_{n,j,c})^2}}{\sqrt{(\omega_{1,j}^2+\omega_{2,j}^2+\cdots+\omega_{n,j}^2)}} \quad (2)$$

where ω is the weight parameter for each indicator within each dimension. These weights are important as to avoid possible multicollinearity between the dimensions, Sarma and Pais (2011). Instead of choosing ω arbitrarily, we follow Wang and Guan (2017) and empirically determine each weight according to the coefficient of variation (CV), Equation (3):[9]

$$\omega_{i,j} = \frac{\vartheta_{i,j}}{\sum_{i,j}\vartheta_{i,j}} \quad (3)$$

where ϑ is the CV, defined as the ratio between the standard deviation and the mean of the frequency distributions for each indicator.

Having calculated the indicator weights and IFIs for each dimension in each country within the sample, we calculate the country-wide IFI as follows, Equation (4):

$$IFI_c = 1 - \frac{\sqrt{\omega_{ac}^2(1-IFI_{ac,c})^2+\omega_{av}^2(1-IFI_{av,c})^2+\omega_{us}^2(1-IFI_{us,c})^2}}{\sqrt{(\omega_{ac}^2+\omega_{av}^2+\omega_{us}^2)}} \quad (4)$$

where the weights are being calculated for each of the three dimensions; accessibility (*ac*), availability (*av*) and usage (*us*).

2.2 Financial Access Survey (FAS)

The data used to construct the IFI introduced in section 2.1 comes from the Financial Access Survey (FAS) published by the IMF. Launched in 2009, this unique supply-side dataset covers 189 countries and jurisdictions from 2004 to 2019 and contains more than 120 indicators on the access, availability and usage of the financial sector. The ultimate aim of the FAS is to monitor developments in financial inclusion and to allow a direct comparison of its level and relative progress with other countries within the dataset. To do so, central banks and financial regulators collect data directly from financial institutions and financial service providers within their jurisdictions.

Since its inception in 2009, the FAS has evolved to keep pace with financial advances. In 2014, the need to consider non-traditional financial services was recognized and the mobile money module was introduced. In 2018, information regarding non-branch retail agents was included in the survey. And in 2019, extensive information and observations with respect to mobile and internet banking were added.

After making sure that sufficient information is available for each country, see variables in Table 1, we are left with 166 economies within the dataset, see Table A1. The sample of countries

[9] Papers that choose the dimension weights according to some subjective rule are among others, Sarma (2008,2012), Sarma and Pais (2011), Kim (2016), Kim et al. (2018) and Van et al. (2021).

consists of 19 low-income, 48 lower-middle income, 47 upper-middle income and 52 high income economies, as classified by the World Bank.[10]

2.3 Findings

Figure 1 shows the time series of the *average* IFI score for each development category.

Figure 1: Average IFI scores

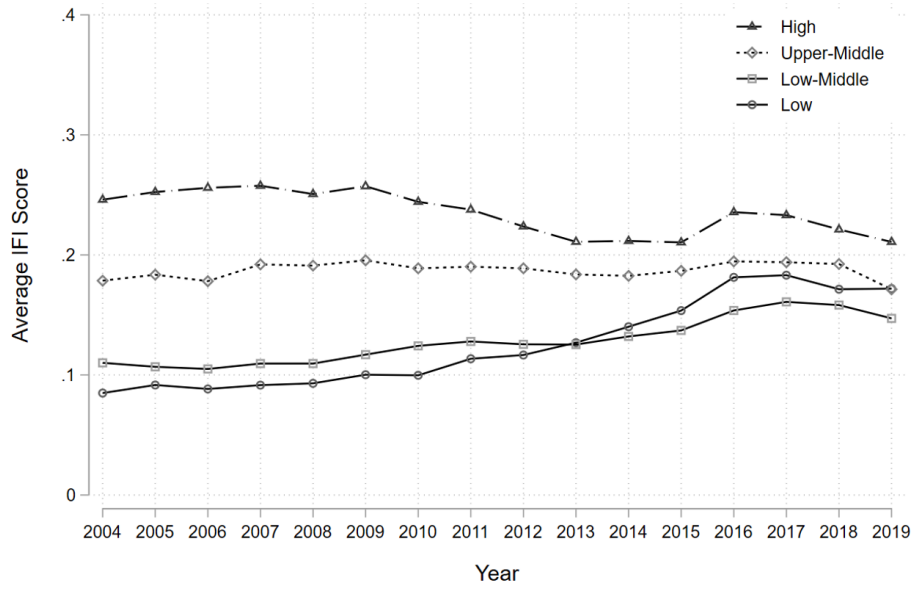

Figure 1 (and Table A2 in the appendix) present several interesting and important findings. First, the IFI score is dynamic and does not stagnate at a particular level. That is, it fluctuates around a trend. Second, this trend is positive for low (circle graph symbol), lower-middle (square graph symbol), and upper-middle income (diamond graph symbol) countries. Consequently, financial inclusion for these economies improves throughout the sample period. For high income (triangle graph symbol) countries, on the other hand, financial inclusion decreases from 2009 onward. For one, this might be due to the collapse of the financial system during the Global Financial Crisis, and for the other, this finding might be driven by the decrease in physical outlets such as commercial bank branches and ATMs, FAS (2020). Furthermore, mobile money adoption in these countries is rare and hence growth rates in financial inclusion are lower compared to less developed countries that have been embracing this kind of technology for the last several years. The third

[10] Using the Atlas method, the World Bank classifies high-income economies as those with a GNI per capita of $12,696 or more, upper middle-income economies as those with GNI per capita between $4,096 and $12,695, lower-income economies as those with a GNI per capita between $1,046 and $4,095 and low-income economies as those with a GNI per capita of $1,045 or less, World Bank (2021).

point to note is that the average IFI score increases the more developed an economy becomes. Whereas in 2009 the average IFI for low income countries was 0.0849, its increases to 0.2460 for high income countries; almost three times the size. This gives a descriptive indication of the importance of financial inclusion and the level of economic activity.

3. Empirical Analysis

3.1 Financial Inclusion and Economic Prosperity

To analyze how financial inclusion, as measured by the IFI, affects the level of economic activity throughout time and throughout the 166 countries in our sample, we estimate a one-way fixed effects model. Such a panel model allows us to exploit the longitudinal dimension of the data while accounting for country-level heterogeneity.

$$GDP_{c,t} = \beta' x_{c,t} + \theta IFI_{c,t} + \gamma t + \alpha_c + u_{c,t} \quad (5)$$

$$u_{c,t} \sim iid(0, \sigma_u^2) \quad (6)$$

$$corr(\alpha_c, u_{c,t}) = 0 \quad (7)$$

where *GDP* in Equation (5) is the level of real economic activity for time *t, (t = 2004,…,2019),* and for country *c, (c = 1,…,166)*. The intercept α_c is the unobservable country-specific effect, β the vector of coefficients associated with the control variables contained by the vector *x, θ* the coefficient for the variable capturing the degree of financial inclusion, *IFI, γt* a time trend meant to capture possible trend-stationarity in the variables expressed in levels and *u* the error term. Since the purpose of this model is to find the statistical relationship between financial inclusion and the level of economic activity, the statistical significance of the coefficient *θ* is of special interest. In order to find a statistically robust representation, the General-to-Specific approach is taken. That is, a general model is being estimated and subsequently reduced to its most efficient form.[11] Equation (6) and (7) are necessary assumptions regarding the independence of the error terms to each other and throughout time, their homoscedasticity and their uncorrelation with the country-specific intercept.

The final model contains the explanatory variables in Table 2.[12]

Table 2: Explanatory variables – GDP Regression

Variable Name	Variable Description
Investment	Private gross capital formation (% of GDP)
Consumption	Household final consumption expenditures (% of GDP)
Schooling	Enrollment ratio between secondary and total enrollment
Population	Population (ages 15 to 64)
Trade	Trade (% of GDP)
Unemployment	Unemployment rate (as % of the labor force)
IFI_trans	Index of Financial Inclusion, see section 2

[11] For a comprehensive discussion on the General-to-Specific approach and its automation see Krolzig (2001, 2003).
[12] With the exception of the variable IFI, all variables come from the World Bank Development Indicators database.

The choice of variables is motivated by Barro (2000, 2001, 2003, 2013); where the aggregates for private investment (*investment*), private consumption (*consumption*), and exports and imports (*trade*) are to capture demand-side factors affecting economic activity. The variable *schooling* is included to approximate the level of human capital or labor productivity within the economy. The ratio between secondary education and total education was chosen, since secondary education includes primary education and in addition more subject- or skilled-oriented instructions. To control for the size of the potential labor force, the variable *population* is added. This variable includes all the people within an economy that are of working age. Since any variable representing the labor force does not contain discouraged workers, the size of the population is preferred. The variable *unemployment* measures the degree of capacity utilization within the labor market. Finally, following Sarma and Pais (2011), the variable of interest, *IFI*, is transformed so as to lie between $-\infty$ and $+\infty$. This is done using Equation (8).

$$IFI_{trans} = \ln\left(\frac{IFI}{1-IFI}\right) \qquad (8)$$

This modification is done to make the variable a logit transformation. The reconfigured variable is monotonically increasing in IFI and consequently retains its original ordering.[13]

Table 3 presents the estimated panel regression model.

Table 3: Regression results – GDP Regression

investment	Consumption	schooling	population	trade	unemployment	IFI_trans
0.0035	-0.0031	0.0028	0.0034	-0.0014	-0.0103	0.421
*(7.22***)*	*(-5.75***)*	*(8.15***)*	*(12.08***)*	*(-9.05***)*	*(-9.91***)*	*(9.57***)*

Note: Values in brackets below the coefficients represent their respective t-statistics. ***, ** and * signify significance at the 1%, 5% and 10% level, respectively.

Regarding the control variables, with the exception of the variables capturing private consumption and trade, all variables have the theoretically consistent sign; higher levels in private investment, labor productivity and population and lower levels in unemployment are statistically relevant in explaining higher levels of economic activity. The negative sign for private consumption and trade might signify that more developed countries rely proportionally less on consumption and trade to maintain their level of economic prosperity compared to developing and under-developed countries.[14] This is because more developed countries have higher GDP than under developed countries. Most importantly, the regression results clearly state that the variable measuring the degree of

[13] This step is less important for the regression model presented by Equation (5). Once financial inclusion becomes a dependent variable itself however, this transformation is necessary to estimate the model via OLS. In the interest of consistency, the transformation is already applied at this step.

[14] As Myint (1958) and his contemporaries argue, underdeveloped countries import manufactured goods and therefore contribute negatively towards their economic prosperity. This is because instead of expanding domestic economic activity, they use foreign factors of production which support economic well-being abroad.

financial inclusion, *IFI_trans*, is positively related to the level of economic activity. This implies that an economy where financial inclusion is more advanced enjoys more economic prosperity. This is a fundamentally important finding, since it empirically guides policy makers to strengthen financial literacy in the process of reaching a more developed economy.[15]

3.2 Financial Inclusion and its determinants

While section 3.1 empirically shows that financial inclusion is a necessary determinant in explaining the level of economic activity, this section tries to find demographic, socio-economic and financial variables important to describe the degree of financial inclusion. Contrary to the previous section, where only a specific model was presented and discussed, this section estimates a regression model that includes some of the most widely discussed variables in the literature regarding the determinants of financial inclusion.

$$IFI\_trans_{c,t} = \varphi' z_{c,t} + \delta + \varepsilon_{c,t} \qquad (9)$$

where the dependent variable, *IFI_trans*, is the transformed index of financial inclusion, as constructed in section 3.1.[16] The score is calculated for country *c, (c = 1,…,166)* and time *t, (t = 2004,…,2019)*. The coefficient δ is the intercept and φ the vector of coefficients associated with the independent variables contained by the vector z. Lastly, ε is the error term and is assumed to be independent and identically distributed with a mean of 0 and a variance of σ_ε^2.

For comparison purposes and ease of reproducing our results, we use ordinary least squares (OLS) to model Equation (9). We apply adequate care during the estimation process to ensure we comply with the classical linear regression function assumptions. Consequently, the statistical behavior of the residual terms and the parameter values were analyzed, and where necessary, adopted. Furthermore, to prevent misleading diagnostic tests, we calculate the variance as an exponential function of the covariates specified in the model. The last step is necessary because OLS explicitly assumes that the residuals of the variables are constant—which does not apply to our data. Concerning the stability of our results, we use the method-of-moments estimation technique as a robustness test. We obtain the same qualitative and quantitative results by assuming predeterminedness and imposing the moment condition of non-stochastic covariates.

The explanatory variables contained by vector z and included in the regression model are shown in Table 4.

[15] The same model is estimated with the *growth rate of GDP* as dependent variable. Not surprisingly, and in line with neo-classical growth theory, the growth rate is negatively related to financial inclusion. This comes from the theoretical argument and empirical finding that highly developed economies have relatively lower growth rates compared to less developed economies. Consequently, richer countries have already experienced their catch-up process and on its way experienced financial inclusion to rise.

[16] See Equation (8) and the corresponding paragraph for the motivation and technical construction of the transformation of the IFI.

Table 4: Explanatory variables – IFI Regression

Variable Name	Variable Description
Socio-economic:	
education	Enrollment ratio between secondary and total enrollment
poverty	Gini coefficient
Demographic:	
urban	Urban population (% of total population)
Financial:	
npl	Bank non-performing loans (% of total gross loans)
car	Capital-to-asset ratio
credit	Domestic credit to private sector by banks (% of GDP)

The first socio-economic variable, *education*, is calculated as the ratio between secondary to total education. Its purpose is to approximate the level of education within a country. According to Sarma and Pais (2011), education level is important for the degree of financial inclusion, since banks are more likely to welcome well-educated customers. The variable *poverty* is included to measure the possibility of social exclusion and inequality and is approximated by the Gini coefficient. Kempson and Whyley (1998), Barr (2004) and Buckland et al. (2005) argue that people who belong to low-income groups suffer from income inequality and are consequently less likely to be connected to the financial sector. As a result, the theoretically consistent sign of this variable is negative. The variable *urban* measures the proportion of population living in urban areas. Leyshon and Thrift (1995) claim that geographical proximity to urban financial centers is expected to be positively related to financial inclusion since people living in urban areas are more able to access physical banking outlets. The third category contains variables that control for the soundness and health of the banking system. The variable *npl* measures the ratio of non-performing loans to total gross loans as provided by the banking sector. According to Wang and Guan (2017), the relationship to financial inclusion can be either positive or negative. With regards to the positive, they contend that NPL will rise as soon as banks include previously excluded customers which are more likely to default on their loans. Consequently, the statistical relationship is expected to be positive. Contrary to that, the relationship can also be negative. The reason is that a high level of NPL may imply an unhealthy banking sector whereby one needs to be more cautious in terms of the lending decisions (that is excluding potentially risky and low-income customers). The second variable, *car* represents the capital-to-asset ratio and is the extent of the banks' available capital to their risk-weighted assets. As with the variable capturing the degree of non-performing loans, its theoretical relationship to financial inclusion can be two-fold. The last variable, *credit*, measures domestic credit to private sector by banks as a percentage of GDP. This variable captures financial depth and therefore considers the importance of a well-developed financial system, Beck et al. (2007). Its relationship to financial inclusion is expected to be positive.

Table 5 presents the estimated regression model.

Table 5: Regression results – IFI Regression

education	poverty	urban	npl	car	credit
0.0083	0.0030	0.0092	-0.0118	0.0319	0.0055
*(3.34***)*	*(0.55)*	*(2.91***)*	*(-3.05***)*	*(2.64***)*	*(6.53***)*

Note: Values in brackets below the coefficients represent their respective t-statistics. ***, ** and * signify significance at the 1%, 5% and 10% level, respectively.

With the exception of the variable *poverty*, all variables are significant at a 1% level. The statistical insignificance of inequality towards financial inclusion is an important economic finding. It underscores current financial advances in that under-developed and developing countries nowadays depend much less on traditional financial services. Instead, they are likely to employ non-traditional financial services like mobile money and non-retail agent outlets to access the financial service sector, Espinosa-Vega et al. (2020). Consequently, the link between inequality and poverty and financial inclusion breaks. This is a new and unprecedented finding. While constructing indices of financial inclusion, previous literature focuses only on traditional banking services. They do not consider variables like mobile money outlets, non-branch retail agent outlets of commercial banks, registered and active mobile money accounts and the number and value of mobile money transactions and consequently draw incomplete conclusions, see section 2.1.[17]

The sign of the coefficients for the variables *education* and *urban* are in accordance to economic theory. That is to say, a higher degree of education and proportionally more people living in urban areas increases the level of financial inclusion. The variable capturing the financial depth of a country, *credit*, also contributes positively to the IFI score. This emphasizes the positive relationship between the size and development of financial institutions and markets and the inclusion of the financial sector. The latter finding is in line with the analysis done by Beck et al. (2007). The variable capturing non-performing loans, *npl*, is negatively correlated to *IFI*. According to Wang and Guan (2017), this has to do with the health of the financial institution giving out loans; the unhealthier a financial service provider becomes, the less willing it is to issue loans to disadvantaged borrowers. Therefore, financial inclusion will drop and less credit-worthy customers will not be able to access traditional banking services. In line with the precautionary motive of banks and their institutional risk aversion, the variable capturing the capital-to-assets ratio, *car*, is positively correlated to the financial inclusion score. Indeed, this is in alignment with the previous finding; meaning, the healthier and more financially robust financial institutions become, the more willing they are to include previously excluded customers. Should their health deteriorate, they are likely to exclude their riskiest customers.

[17] Some articles that fail to include non-traditional banking services in determining the level of financial inclusion are Barr (2004), Buckland et al. (2005), Honohan (2008), Al-Hussainy et al. (2008), Sarma and Pais (2001), Arora (2014), Kim (2016), Wang and Guan (2017), Kim et al. (2018) and Van et al. (2021) among others.

4. Discussion, Policy Recommendation, and Conclusion

Contrary to past literature and indeed contrary to the UN's Sustainable Development Goals, incorporating non-traditional financial services into measuring financial inclusion is rather an exception to the rule. Consequently, this paper refrains from using a single-indicator approach to gauge the level of financial outreach and instead relies on a multi-dimensional index that takes accessibility, availability and usage into account. Given that over the span of a few years some low-income countries have been experiencing growth of about 500% in adopting mobile money, this does seem like a sensible thing to do.

In order to calculate this augmented Index of Financial Inclusion, the Financial Access Survey (FAS) is used together with further developments of the technique developed by Sarma (2008). While maintaining important mathematical properties, 16 variables are transformed into the Normalized Inverse of the Euclidean Distance. This implies that this augmented index rivals all existing measures and postulates that the proposed measure is more appropriate.

In order to determine the statistical relationship between the level of the newly generated variable and economic activity and growth, a one-way fixed effects panel model is estimated. The results are confirmatory to economic theory. That is, the more financially inclusive an economy, the higher its level of economic activity. Furthermore, and consistent with the neo-classical growth theory, more inclusion is related to less economic growth. The latter finding emphasizes the empirical fact that highly developed countries grow less strong than their less developed counterparts.

In order to find the statistical determinants of financial inclusion, socio-economic, demographic, and variables concerning the health and depth of the financial sector are used. Results indicate that, when considering non-traditional financial services, the empirical link between poverty and financial inclusion breaks. This confirms the widely debated issue that mobile money plays a key role in the financial development of the low and lower-middle income world. Furthermore, the health and depth of the financial sector is also crucial. In other words, the deeper and the healthier the financial sector, the higher the propensity to cater for lower-income customers. On the other hand, should the solvency of the financial sector deteriorate, riskier customers may be financially excluded.

These findings augment and support the arguments made by Levin (1997) that financial development and economic growth are closely intertwined and that public policy needs to do everything in its power to foster the viability of the financial sector. Consequently, this paper recommends that designing optimal financial sector policies should be paramount in lifting the under-developed world out of poverty. For one, increasing financial literacy by improving basic financial education might be beneficial. For the other, making sure that the financial sector is safe and sound will make banks much more open to low-income borrowers. A deep and thorough discussion about particular policies and their calibrations are left for further research.

APPENDIX

Table A1: Countries within Sample

Country	Country	Country	Country
Afghanistan	Dominica	Kyrgyz Republic	Poland
Albania	Dominican Republic	Lao PDR	Portugal
Algeria	Ecuador	Latvia	Qatar
Angola	Egypt, Arab Rep.	Lebanon	Romania
Argentina	El Salvador	Lesotho	Russian Federation
Armenia	Equatorial Guinea	Liberia	Rwanda
Australia	Estonia	Libya	Samoa
Austria	Eswatini	Lithuania	San Marino
Azerbaijan	Ethiopia	Luxembourg	Saudi Arabia
Bahamas	Fiji	Macao	Senegal
Bangladesh	Finland	Madagascar	Serbia
Barbados	France	Malawi	Seychelles
Belarus	Gambia	Malaysia	Singapore
Belgium	Georgia	Maldives	Slovak Republic
Belize	Germany	Mali	Slovenia
Benin	Ghana	Malta	South Africa
Bhutan	Greece	Mauritania	Spain
Bolivia	Granada	Mauritius	Sudan
Bosnia and Herzegovina	Guatemala	Mexico	Suriname
Botswana	Guinea	Micronesia	Sweden
Brazil	Guinea-Bissau	Moldova	Switzerland
Brunei Darussalam	Guyana	Mongolia	Tanzania
Bulgaria	Haiti	Montenegro	Thailand
Burkina Faso	Honduras	Morocco	Timor-Leste
Burundi	Hong Kong	Mozambique	Togo
Cabo Verde	Hungary	Myanmar	Tonga
Cambodia	Iceland	Namibia	Trinidad and Tobago
Cameroon	India	Nepal	Tunisia
Canada	Indonesia	Netherlands	Turkey
Central African Rep.	Iran	New Zealand	Uganda
Chad	Iraq	Nicaragua	Ukraine
Chile	Ireland	Niger	United Arab Emirates
China	Israel	Nigeria	United Kingdom
Colombia	Italy	North Macedonia	United States
Comoros	Jamaica	Norway	Uruguay
Costa Rica	Japan	Oman	Uzbekistan
Core d'Ivoire	Jordan	Pakistan	Vanuatu
Croatia	Kazakhstan	Panama	Vietnam
Cyprus	Kenya	Papue New Guinea	Zambia

Czech Republic	South Korea	Paraguay	Zimbabwe
Denmark	Kosovo	Peru	
Djibouti	Kuwait	Philippines	

Table A2: Average IFI scores

Year	Low	Low-Middle	Upper-Middle	High
2004	0.0849	0.1101	0.1785	0.2460
2005	0.0916	0.1068	0.1835	0.2524
2006	0.0883	0.1050	0.1781	0.2559
2007	0.0915	0.1095	0.1921	0.2576
2008	0.0930	0.1095	0.1911	0.2507
2009	0.1002	0.1169	0.1955	0.2572
2010	0.0997	0.1242	0.1888	0.2442
2011	0.1135	0.1279	0.1902	0.2377
2012	0.1166	0.1255	0.1888	0.2237
2013	0.1269	0.1253	0.1837	0.2109
2014	0.1402	0.1321	0.1825	0.2116
2015	0.1536	0.1371	0.1867	0.2104
2016	0.1813	0.1537	0.1946	0.2356
2017	0.1831	0.1609	0.1939	0.2331
2018	0.1714	0.1582	0.1924	0.2212
2019	0.1719	0.1471	0.1713	0.2108

REFERENCES

Adrian, T. and Mancini-Griffoli, T. (2018). The Rise of Digital Money. *IMF – Fintech Notes,* Note/19/01.

Al-Hussainy, E., Beck, T., Demirguc-Kunt, A. and Zia, B. (2008). Household Use of Financial Services. *World Bank Development Economics Research Group Working Paper Series.*

Allen, F., Demirguc-Kunt, A., Klapper, L., Peria, M.S.M. (2012). The foundations of financial inclusion. *World Bank Policy Research Working Paper*, No. 6290.

Arora, R. U. (2014). Access to Finance: An Empirical Analysis. *The European Journal of Development Research,* 26(5), 798-814.

Barr M. (2004). Banking the poor. *Yale Journal on Regulation,* 21, 122-239.

Barro, R.J. (2000). Education and Economic Growth. *Working Paper,* Harvard University.

Barro, R.J. (2001). Economic Growth in East Asia before and after the Financial Crisis. *NBER Working Paper Series*, Working Paper 8330.

Barro, R.J. (2003). Determinants of Economic Growth in a Panel of Countries. *Annals of Economics and Finance,* 4, 231-274.

Barro, R.J. (2013). Inflation and Economic Growth. *Annals of Economics and Finance,* 14(1), 85-109.

Beck, T., Demirguc-Kunt, A. and Martinez Peria, M. S. (2007). Reaching Out: Access to and Use of Banking Services across Countries. *Journal of Financial Economics*, 85, 234-266.

Berthelemyje, A.-C. V. and Varoudakis, A. (1996). Economic Growth, Convergence Clubs, and the Role of Financial Development. *Oxford Economics Papers,* 48(2), 300-328.

Bruhn, M. and Love, I. (2014). The real impact of improved access to finance: Evidence from Mexico. *The Journal of Finance,* 69(3), 1347-76.

Buckland, J., Guenther, B., Boichev, G., Geddie, H. and Mutch, M. (2005). There Are No Banks Here: Financial and Insurance Exclusion Services in Winnipeg's North End. *Winnipeg Inner-City Research Alliance (WIRA)*. University of Winnipeg: Canada.

Cihak, M., Mare, D. S. and Melecky, M. (2016). The nexus of financial inclusion and financial-stability: a study of trade-offs and synergies. *World Bank Policy Research Working Paper*, No. 7722.

Demirguc-Kunt, A., and Klapper, L. (2012). Measuring Financial Inclusion: The Global Findex Database. *World Bank Policy Research Working Paper*, No. 6025.

Espinosa-Vega, M., Shirono, K., Villanova, H. C., Chhabra, E., Das, B. and Fan, Y. (2020). Measuring Financial Access: 10 Years of the IMF Financial Access Survey. *Departmental Papers/Policy Papers*, 20(8).

FAS (2020). Financial Access Survey – 2020 Trends and Developments https://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C

Gerth, F. (2017). Allocative Efficiency of UK firms during the Great Recession. *School of Economics Discussion Paper Series*, KDPE 1714.

Gerth, F. and Otsu, K. (2018). The Post-Crisis Slump in Europe: A Business Cycle Accounting Analysis. *The B.E. Journal of Macroeconomics*, 18(1), 1-25.

Gerth, F. and Otsu, K. (2015). A neoclassical analysis of the Great Recession: a historical comparison. *Economics Bulletin*, 35(4), 2363-2373.

Goyal, R., Creane, S., Mobarak, A. M. and Sab, R. (2004). Financial sector development in the Middle East and North Africa. *IMF Working Paper*, No WP/04/201.

Honohan, P. (2008). Cross-Country Variation in Household Access to Financial Services. *Journal of Banking & Finance*, 32, 2493-2500.

Kempson E., Atkinson A. and Pilley, O. (2004). Policy level response to financial exclusion in developed economies: lessons for developing countries. *Report of Personal Finance Research Centre*, University of Bristol.

Kempson, E. and Whyley, C. (1998). Access to Current Accounts. *British Bankers' Association*: London.

Kim, J. H. (2016). A study on the effect of financial inclusion on the relationship between income inequality and economic growth. *Emerging Markets Finance and Trade*, 52(2), 498-512.

Kim, D.-W. and Yu, J.-S and Hassan, M. K. (2018). Financial inclusion and economic growth in OIC countries. *Research in International Business and Finance*, 43, 1-14.

Krolzig, H.-M. (2001). General-to-specific reductions in vector autoregressive processes. In Friedmann, R., Knüppel, L., and Lütkepohl, H. (eds.*), Econometric Studies - A Festschrift in Honour of Joachim Frohn*, 129-157.

Krolzig, H.-M. (2003). General-to-Specific Model Selection Procedures for Structural Vector Autoregressions. *Oxford Bulleting of Economics and Statistics*, 65, 769-801.

Levine, R. (2005). Finance and growth: Theory and evidence. In *Handbook of economic growth*, ed. P. Aghion, and S. Durlauf. Amsterdam, The Netherlands: Elsevier Science.

Leyshon, A., Thrift, N. (1995). Geographies of financial exclusion: financial abandonment in Britain and the United States. *Transactions of the Institute of British Geographers*, 20(3), 312-341.

Myint, H. (1958). The "Classical Theory" of International Trade and the Underdeveloped Countries. *The Economic Journal*, 68(270), 317-337.

Sarma, M. (2008). Index of Financial Inclusion. *ICRIER Working Paper*, No.215.

Sarma, M. (2012). Index of financial inclusion – A measure of financial sector inclusiveness. *Berlin Working Papers on Money, Finance and Trade Development*, Working Paper No: 07/2012.

Sarma, M. and Pais, J., (2011). Financial inclusion and development. *Journal of International Development*, 23(5), 613-628.

Van, L. T.-H., Vo, A. T., Nguyen, N. T. and Vo, D. H. (2021). Financial Inclusion and Economic Growth: An International Evidence. *Emerging Markets Finance and Trade*, 57(1), 239-263.

Wang, X. and Guan, J. (2017). Financial inclusion: measurement, spatial effects and influencing factors. *Applied Economics*, 49(18), 1751-1762.

World Bank (2021). World Bank Country and Lending Groups. https://data-helpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups