Determinants of Financial Inclusion in Argentina and Ireland: A Comparative Perspective

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Determinants of Financial Inclusion in Argentina and Ireland: A Comparative Analysis

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Abstract

A comparison of the factors influencing financial inclusion in Argentina and Ireland, at both macro and micro levels over a ten-year time period (2012-2022) is conducted through this study. By using Fixed Effects Regression method, with the objective to discover which socioeconomic factors from World Bank's World Development Indicators (WDI) database along with other demographic indicators like Health Development Index (HDI) have impact in both countries. The level of financial inclusion in these countries has been calculated using a two-stage principal component analysis (PCA), based on metrics of financial access-ownership, availability and usage sourced from International Monetary Fund's Financial Access Survey (FAS) as well as Global Findex Database (Findex). The results show that Ireland, with better economic freedom and a more digitized environment, always leads to higher levels of financial inclusion than Argentina. Still, Argentina has been successful in achieving financial inclusion in terms of traditional banking. The study illustrates a contradictory inverse relationship between HDI and financial inclusion, showing complex dynamics that need further scrutiny. Policymakers need to develop tailored strategies to enhance financial literacy and adoption of fintech in both countries, with particular attention to bridging the digital gap in Argentina.

1 Introduction

1.1 1.1 Background of the study

Financial inclusion policy has grown in most countries recently, especially in the developing countries. It is currently at the centre of policies aiming to battle against poverty rates (Nuzzo & Piermattei, 2020). Inclusion in the financial system has turned into one of the most important goals for many governments. This is also considered the highest priority among the 17 United Nations Agenda 2030 (Onerci, 2021) and features in 7 of the 17 Sustainable Development Goals -SDGs- (UNGC & KPMG, 2017). The reason this is considered important is clear: financial inclusion is expected to make a significant difference in economic and social growth, be a factor for general happiness, and help micro and small businesses grow.

According to the World Bank has defined financial inclusion as the condition in which individuals and enjoy access to useful and affordable financial products and services that meet their needs (Demirgüç-Kunt and Klapper, 2012; Financial Inclusion Global Initiative (FIGI), 2020). Financial inclusion comprises transactions, payments, savings, credit, and insurance service being done in a responsible and sustainable manner. The same viewpoint is advocated by the Organization for Economic Cooperation and Development (OECD) which calls for

accessibility, quality of use, and improvement to the financial well-being of families and enterprises. (Banik and Roy, 2023; Jennah, 2022).

Ireland and Argentina are chosen for this comparative study due to their similar agrarian backgrounds and stories of crisis. Economists, even the president-elect of Argentina, Javier Milei, look at Ireland as a model of an economy that Argentina could aspire to. These liberal reforms brought about considerable growth and huge investments in technology to Ireland. The current research is aimed at determining whether Argentina will be able to reproduce the Irish scenario and what is achievable, in which context the changes can take place, and the corresponding expected benefits for these changes. Given the rapid growth of fintech, it is crucial to consider financial inclusion as a key element of this transformation (Beker, 2024).

To elucidate the importance of financial inclusion as one of the key development goals under the 2030 Sustainable Development Goals, being referenced as eight out of the 17 of these goals, in this paper, the relationship between the Financial Inclusion Index developed by this research and other global databases that quantify other aspects of economic and social development is analysed; among them are the Index of Economic Freedom, Human Development Index, and the World Happiness Report (The Principal, 2023). This is to establish the likely effects of increased financial inclusion on economies and their citizens.

1.2 Research Question

The research question for this study is:

"To what extent do the supply of financial services, availability, strong infrastructure, and other socioeconomic factors like income, education, gender, and other relevant factors impact financial inclusion (financial ownership, access, usage) and fintech adoption between Argentina and Ireland?"

The research objectives are:

- Compute financial ownership and usage index for Argentina and Ireland and fintech adoption, acknowledging the limitation of available information.
- Explore these two different countries in detail to determine the degrees of similarities and differences.
- Provide policy recommendations based on the findings.

The investigation follows a methodical approach in fulfilling its purpose, using Principal Component Analysis for computation of the Financial Inclusion Index and Fixed Effects Regression for examination of the socioeconomic and demographics determinants and relationship with the FII between two countries. Different dimensions of Financial Inclusion will be considered, like ownership, availability and usage of financial services. An ideal analysis should be contemplating financial technology elements, like mobile bank accounts, digital payments, among others, but there is no data available for these countries concerned.

The study is structured as follows: Section two comprises a comprehensive review of the literature, in which previous relevant research is contrasted and discussed. In sections three and four, the research method implemented, and the design specifications are described. Section five focuses on the implementation of the model described above, while section six comprises the results. After this, in section seven presents a discussion of these results. Finally, section eight comprises the conclusion and recommendations for future work.

2 Related Work

This literature review focuses on financial inclusion the case of Argentina and Ireland, while the general international research field is used as inputs to related findings for the understanding of the subject.

2.1 Financial Inclusion in Argentina

In Argentina, the Central Bank has taken a proactive role in documenting and analysing financial inclusion. The Central Bank of Argentina publishes the *'Informe de Inclusión Financiera'* with an analysis in detail of the state of financial inclusion. These semi-annual reports have shown that, while 92.5% of the population is banked, a gap remains in understanding and using more complex financial products. This gap indicates the requirement of financial education and digital infrastructure development in order to enhance financial inclusion in the region: Banco Central de la República Argentina (Central Bank of Argentina, 2023).

Furthermore, research has described the emerging landscape of Fintech in Argentina (Sánchez et al., 2020). This study presented a detailed case analysis of Mercado Pago, one of the major companies in Argentine fintech, as an example of how fintech increased the possibilities of financial inclusion and facilitated online transactions. However, generalizability across the sector will only be possible if this research is extended based on a multiple-case methodology

2.2 Financial Inclusion in Ireland

In contrast to Argentina, Ireland has observed a lack of comprehensive local assessments of financial inclusion conducted by its Central Bank. However, studies by organisations such as NALA's report by Cohen & Lajoie, (2022) and the Banking Division and Department of Finance, (2023) have addressed this gap in literature. The NALA report identifies significant disparities in financial literacy across different demographic groups, particularly among younger adults and women, who exhibit lower levels of financial knowledge. Furthermore, the Financial Wellbeing report (CCPC, 2023) elucidates Ireland's primary objectives, which are to enhance financial literacy, reduce exclusion, and narrow the digital divide. However, these initiatives are confined to the conventional banking structure. Even though 94% of adults in Ireland possess bank accounts, the focus is on promoting active utilisation of these accounts for savings, investments, and prudent financial management, rather than merely expanding access.

2.3 Worldwide Outlooks on Financial Inclusion

Globally, research has increasingly focused on the intersection of financial literacy and fintech adoption. In particular, the relation of Japan is on the adoption of fintech and using higher financial literacy for mobile payments and fintech services according to Yoshino et al., (2020). Similarly, it was also found by Singh et al., (2024) that fintech adoption moderates the relationship between financial literacy and financial well-being, highlighting the importance of enhancing financial literacy to fully leverage new financial technologies.

In developing countries, the dynamics of financial inclusion have been further explored by Ayayi & Dout, (2024), who used a two-stage principal component analysis (PCA) to assess the financial inclusion index. Their findings indicate a downward trend in financial inclusion in many developing countries, primarily due to low utilization and unequal access to financial services.

Other notable studies include those by Ferilli et al., (2024), who used regression analysis to explore the impact of fintech innovation on digital financial literacy in Europe, finding that fintech has the potential to reduce the digital financial divide. Similarly, Nandru et al., (2021) examined the determinants of digital financial inclusion in India, finding significant socio-demographic influences on the accessibility and usage of digital financial services.

2.4 Cross-Country Comparison

International cross-country comparisons have been central to understanding the gaps in financial literacy and inclusion across the globe. The Latin America Fintech Rankings by Findexable Limited (2022) provide an insight into how development in fintech differs from one region to another, focusing primarily on growth and impacts in Latin America. The report underscores that fintech widens access to credit and brings low-income populations into the formal banking system.

Lyons et al. (2022) conducted a comparative analysis of emerging economies in relation to the development of fintech and financial inclusion. Their results indicated a robust positive association, showing that countries with high levels of fintech development also exhibit strong indicators of financial inclusion, although they noted significant heterogeneities across different population groups.

The study by N.P. and Nasira, (2021) addressed the rural-urban financial literacy gap in India, identifying key differences in financial literacy between rural and urban populations in the states of Kerala and Uttar Pradesh. This study emphasizes the need for targeted interventions in underdeveloped regions of less developed countries. In Europe, Ferilli et al., (2024) explored how fintech innovation in digital financial literacy varies across regions, using checks of variance inflation factor to control for multicollinearity through regression analysis. The authors highlighted the role of digital infrastructure and social development in reducing the digital financial divide.

3 Research Methodology

This section elucidates the research methods employed in this study, accentuating the techniques of data selection, preprocessing, transformation, and analysis.

3.1 Data selection

This cross-country study analyses financial inclusion indicators alongside demographic and socioeconomic variables by integrating macro and micro-data from diverse sources, with a particular emphasis on Argentina and Ireland.

3.1.1 Financial Inclusion Indicators

For the comparative scope of financial inclusion in Argentina and Ireland over a decade from 2012 to 2022, a distinct dataset was constructed by bringing together two leading diverse resources:

- The Financial Access Survey (FAS), developed by the International Monetary Fund (IMF) in 2009, represents a pivotal global resource for measuring how individuals and businesses access financial services. The survey collects administrative data from central banks and regulatory authorities across 189 countries, with a particular focus on key indicators such as the number of bank accounts, bank branches and ATMs, as well as the volume of bank credit and deposits.

- The World Bank's Global Financial Inclusion Database (Findex), which has been published triennially since 2011, offers a more comprehensive and individualised perspective on financial inclusion. The Findex database is based on extensive surveys involving over 100,000 interviews conducted across a range of economies. The findings offer insights into how the populations use financial products in different economic contexts. The database tracks data such as the percentage of adults with formal bank accounts, their saving and borrowing behaviours, and the ownership of financial tools like credit cards, mortgages, and insurance. Furthermore, this database illuminates' financial practices and behaviours, providing a comprehensive and detailed account of financial inclusion (Demirgüç-Kunt & Singer, 2017).

In this analysis, the variables for the years (2012-2022) were selected, considering these two sources:

Variables of dimensions	Description	Data sources
Account_15+	Percentage share of adults (% age 15+) having an account	Global Findex[1]
Fin_Inst_Acc_15+	Proportion of adults who report having a financial institution account (% age 15+)	Global Findex
Owns_DC_15+	Percentage of adults (% age 15+) who report having a debit card	Global Findex

[1] https://www.worldbank.org/en/publication/globalfindex/Data

Variables of dimensions	Description	Data sources
Owns_CC_15+	Proportion of adults (% age 15+) who state having a credit card	Global Findex
Bank_branches_100k	Number of bank branches per 100,000 adults	FAS-IMF[2]
Atm_100k	Number of ATMs per 100,000 adults	FAS-IMF
Insurance_100k	Number of insurance corporations per 100,000 adults	FAS-IMF
Dep_account_ cbank_1000	Number of deposit accounts with commercial banks per 1,000 adults	FAS-IMF
Out_dep_cbank_GDP	Outstanding deposits with commercial banks (% of GDP)	FAS-IMF
Out_dep_other_GDP	Proportion of Outstanding Deposits with other deposit takers (% of GDP)	FAS-IMF
Out_loan_cbank_GDP	Outstanding loans from commercial banks (% of GDP)	FAS-IMF
Number_deposit_ cbank_account	Number of Deposit Accounts with commercial banks	FAS-IMF
Saved_Fin_Inst_15+	Saved at a financial institution (% age 15+)	Global Findex
Borrowed_15+	Percentage of respondents (% age 15+) who report borrowing any money for any reason and from any source	Global Findex
Saved_15+	Percentage of respondents (% age 15+) who report personally, saving or setting aside any money for any reason and using any mode of saving	Global Findex
Saved_Fin_Inst2_15+	Percentage of respondents (% age 15+) who report saving or setting aside any money at a financial institution	Global Findex
Borrowed_Fin_Inst_15+	Percentage of respondents (% age 15+) who report borrowing any money from a bank or another type of financial institution	Global Findex
Utility_Pay_Acc_15+	Percentage of respondents (% age 15+) who report making regular payments for water, electricity, etc	Global Findex

Table 1: Indicators of Financial Inclusion

3.1.2 Demographic and socioeconomic metrics

In addition to the financial inclusion indicators, demographic socioeconomic metrics were obtained from different resources, including the World Bank's (WDI) database, International Telecommunication Union (ITU), World Happiness Report and Freedom of Economic Index, among others.

Variable	Description	Data Source
Population_15+	Total population aged 15+ based on midyear estimates.	World Development Indicators (WDI)[3]

[2] https://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C

[3] https://databank.worldbank.org/source/world-development-indicators

Variable	Description	Data Source
Individuals_using_Internet	Number of people who used the Internet in the last three months.	International Telecommunication Union (ITU)[4]
Life_satisfaction	Self-reported life satisfaction based on the Cantril Ladder question.	World Happiness Report[5]
HDI	Human Development Index measures average achievement in key dimensions of human development.	UNDP[6]
GDP_per_capita	GDP per capita in constant 2015 USD.	World Development Indicators (WDI)
Economic_Freedom_Index	Measures the impact of liberty and free markets around the globe to assess the relationship between economic freedom and progress.	Heritage[7]
Inflation_GDP_deflator	Inflation, GDP deflator (annual %).	World Development Indicators (WDI)

Table 2: Demographic and socioeconomic metrics

3.2 Data preprocessing

This preprocessing phase had several steps for preparing the datasets for analysis. In the beginning, an initial exploration was needed so as to comprehend the setup and essential characteristics of data which is named Exploratory Data Analysis (EDA) (Camizuli and Carranza, 2018). In the case of the data used for financial inclusion indicators, as one of the sources is the Findex database of data available in the waves (2011, 2014, 2017 and 2021), a computation based on linear interpolation is performed for the missing data 2012, 2013, 2015, 2016 and 2022. This is a method used to estimate missing data points within the range of known data by assuming a linear change between the data points. In this study, it was used to fill gaps in the financial inclusion dataset, particularly for years where data from the Global Findex survey were not available.

Then, indicators were made comparable by normalizing them across both countries and years. It was necessary to normalize the data as they are on different scales (for instance, number of bank branches per 100,000 adults compared with outstanding deposits as a percentage of GDP). Furthermore, Min-Max Scaling technique has been used for this purpose which adjusts all variables so that they fall within a specified range usually [0,1]. This technique can assist in removing scale inconsistencies, making the analysis stronger and fairer as it concentrates on relative alterations rather than total values (Google, 2023).

The Min-Max Scaling formula is given by:

[4] https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
[5] https://worldhappiness.report/
[6] https://hdr.undp.org/data-center/human-development-index#/indicies/HDI
[7] https://www.heritage.org/index/

$$X_{norm} = \frac{X_{max} - X_{min}}{X_i - X_{min}}$$

- *Xi* is the observed value,
- *Xmin* is the minimum observed value,
- *Xmax* is the maximum observed value,
- *Xnorm* is the normalized value.

3.3 Model description

In general, there are two core approaches that are usually considered for measuring financial inclusion through the construction of a compound Financial Inclusion Index (FII) are described (Ayayi and Dout, 2024; Dout and Kebalo, 2021).

3.3.1 Non-parametric methods

In the initial approaches, non-parametric methods were considered, (Sarma, 2008) assigning weights to all variables of dimensions and subindices arbitrarily based on the authors' experience, intuition, or simple heuristics. Another key characteristic of this method is that no assumptions are contemplated, in other words, these methods do not require any conventions about the data distribution or relationship between variables. Moreover, many authors in this financial inclusion field presume that all parameters have an equal impact on financial inclusion. This approach may be simple and much more intuitive for many analyses. However, the fact that the weights are so subjective can lead to biased analysis.

3.3.2 Parametric methods

To overcome the nonparametric criticisms, other methods such as parametric methods were developed. This model uses a specific statistical method, the two most used according to Amidžic et al., (2014) and Cámara and Tuesta, (2014) are Factor Analysis or One characteristic of this approach is the endogenous weighting, where the weights are estimated from the data themselves, based on the relationship between the variables. Finally, unlike the non-parametric model, these methods often require assumptions to be made about the distribution of the data (e.g. normalisation) or the relationship between the variables (e.g. linearity). Karl Pearson originally conceived Principal Component Analysis in 1901, while researchers such as Harold Hotelling and Karhunen Loeve subsequently refined the methodology (Maccone, 2009; Younes et al., 2021).

Given these advantages of PCA in reducing dimensionality while trying to keep as much variance as possible, this study follows a two-step PCA approach in computing the FII. It is widely recognized in financial inclusion research and considered one of the most robust methods for construction (Park and Mercado, 2015; Tram et al., 2023).

3.3.3 Principal Component Analysis (PCA)

The primary objective that PCA is applied to in this research is a reduction in dimensionality of the data from micro and macro elements with minimum mean square error through the generation of a new coordinate system having an orthonormal basis for the variables.

3.3.4 Fixed Effects Regression

This has been described as the most popular statistical method when analyzing panel data, particularly in instances where one seeks to find out how the time-invariant characteristics of a country or region have an impact on a dependent variable such as an index for financial inclusion. The method accounts for unobserved heterogeneity because it allows each unit to have an intercept and, hence, isolates the effects of time-changing variables. In financial inclusion, fixed effects regression caters for factors specific to the country that may influence the index and thus leads to far more precise and reliable estimates of the relationships between financial policies and inclusion levels (Mose and Thomi, 2022; Pham and Doan, 2020).

4 Model Specification

The model developed in this study is expressed as:

$$FII_{it} = f\left(OwnershipAccess_{it}, Availability_{it}, Usage_{it}\right) \quad (1)$$

Where $OwnershipAccess_{it}$, $Availability_{it}$, $and\ Usage_{it}$represent the independent variables for each country *i* and year *t*.

4.1 Principal Component Analysis (PCA)

The objective of the Financial Inclusion Index (FII) is to quantify the multifaceted dimensions of financial inclusion across a range of entities *(i)* over a specified period *(t).*

The main characteristic of this well-known methodology is the two-stage approach. In the first one, financial inclusion indicators are combined into dimensions, and in the second stage, these dimensions are aggregated into the final FII. This method follows a similar approach to that of Cámara and Tuesta, (2014), where a two-stage PCA was used to address potential bias towards highly correlated indicators.

The first phase of PCA generates indices for **ownership**, **availability**, and **usage** of financial services. These indices are used as explanatory variables in the construction of the FII. The FII is derived in equation 3 as follows:

$$FII_{it} = \omega_1 OwnershipIndex_{it} + \omega_2 AvailabilityIndex_{it} + \omega_3 UsageIndex_{it} + \varepsilon_{it}\ it \quad (3)$$

The error term ε is expected to show minimal variance, as the variation in the variables included in the ownership, availability, and usage dimensions will explain the variation in financial inclusion (FII).

4.1.1 First Stage (PCA)

In the first stage of PCA, indices for ownership, availability, and usage dimensions are created from the selected indicators:

The *OwnershipAccessIndex* is calculated according to the following formula:

$$OwnershipAccessIndex_{i,t} = \gamma_1 \cdot Account15_{+i,t} + \gamma_2 \cdot FinInst15_{i,t} + \gamma_3 \cdot OwnsCC15_{i,t} + \gamma_4 \cdot OwnsCD15_{i,t} + u_{i,t} \quad (4)$$

The *AvailabilityIndex* is derived using the following equation:

$$AvailabilityIndex_{i,t} = \lambda_1 ATM100k_{i,t} + \lambda_2 BankBranches100k_{i,t} + \lambda_3 Insurance100k_{i,t} + v_{i,t} \quad (5)$$

The *UsageIndex* is derived through application of the following equation: *(6)*

$$UsageIndex_{i,t} = \theta_1 DepAccountCBank_{i,t} + \theta_2 OutDepCBankGDP_{i,t} + \theta_3 OutDepOther\ GDP_{i,t} + \cdots + \theta_{11} UtilityPayAcc15_{i,t} + w_{i,t}$$

The components of every sub-index were described in Table 1, section 3.11.

4.1.2 Second Stage (PCA)

In the second stage of PCA, the analysis aggregates the sub-indices generated in the first stage—*OwnershipAccessIndex*, *AvailabilityIndex*, and *UsageIndex*—to construct the comprehensive Financial Inclusion Index (FII), encompassing the subsequent steps. The standardization of each sub-index to a mean of 0 and a standard deviation of 1 facilitates their comparability and meaningful integration, with the standardized sub-indices denoted as follows:

$$Standardized OwnershipIndex_{it}, Standardized AvailabilityIndex_{it}, Standardized UsageIndex_{it}$$

One this Standardization process is done, those new sub-indices are then combined to form the Financial Inclusion Index (FII) using a weighted sum. In this study, equal weights are assumed for simplicity, but weights could also be derived from the variance explained by each sub-index in the first stage of PCA.

The overall Financial Inclusion Index is calculated as:

$$FII_{it} = \omega_1 OwnershipAccessIndex_{it} + \omega_2 AvailabilityIndex_{it} + \omega_3 UsageIndex_{it} + \varepsilon_{it}\ it$$

The FII achieved provides a comprehensive measure of financial inclusion for each country *(i)* and each year (*t)*. This index captures the multidimensional aspects of financial inclusion by integrating the key dimensions of ownership, availability, and usage.

This two-stage PCA method, as used in studies like that of Cámara and Tuesta, (2014) effectively reduces the dimensionality of financial inclusion indicators while preserving the most significant information, resulting in a robust and interpretable Financial Inclusion Index.

4.2 Fixed Effect Regression

To examine the influence of varying dimensions of financial inclusion on the FII, a fixed effects regression model is selected as the analytical tool. This method controls time-invariant characteristics within each country by allowing each entity to have its own intercept. This approach helps to isolate the effects of variables that change over time, thereby providing more accurate estimates of the relationships between financial inclusion and the selected indicators (Pham and Doan, 2020). The primary distinction between a fixed effects model and the standard panel data regression model lies in their treatment of the intercept.

For this study, the model is specified as follows:

$$FII_{it} = \alpha_i + \beta_1 Population15 + \beta_2 InternetUsage_{it} + \beta_3 LifeSatisfaction_{it}$$
$$+ \beta_4 HDI_{it} + \beta_{it} EconomicFreedomIndex_{it} + \beta_6 GDPperCapita_{it}$$
$$+ \beta_7 Inflation_{it} + \varepsilon_{it}$$

Where:

FII_{it} is the Financial Inclusion Index for country *i* in year *t.*

α_i represents the country-specific intercept, capturing all time-invariant characteristics of each country.

$\beta_1 Population$ captures the effect of the population aged 15 and above on financial inclusion.

$\beta_2 InternetUsage$ represents the impact of internet usage on financial inclusion.

$\beta_3 LifeSatisfaction$ measures the influence of life satisfaction on financial inclusion.

$\beta_4 HDI$ is the effect of the Human Development Index on financial inclusion.

$\beta_5 EconomicFreedom$ captures the impact of economic freedom on financial inclusion.

$\beta_6 GDPperCapita$ represents the effect of GDP per capita on financial inclusion.

$\beta_7 Inflation$ measures the influence of inflation on financial inclusion.

ε is the error term, capturing all other unobserved factors affecting the FII in country *i* at time *t*.

In this model, FII_{it} is regressed on an intercept α_i that differs for each country and the rest of the independent variables. It accounts for unobserved heterogeneity within countries, hence reducing the biases in estimates of financial inclusion effects by its observable determinants.

5 Implementation

5.1 Data selection

To achieve this research, secondary data was retrieved from different resources—those on financial inclusion indicators and on demographic and socioeconomic variables. The sources for the first set of variables are the Global Findex and the IMF's FAS database. Other indicators had the following sources: World Development Indicators (WDI), World Happiness Report, (2012), UNDP, (2024), and The Heritage Foundation, (2024). The data from the Global Findex and FAS databases were downloaded based on Argentina and Ireland. There were 10 variables involved in the data from the Global Findex dataset, while in the FAS dataset, there were four considered for each country.

5.2 Pre-processing and Transformation

To be able to successfully answer the research question, a balanced panel dataset was used in this study. A balanced panel dataset contains the same set of observations in every unit over a given period. Multiple pre-processing of data was applied to each dataset before they were merged.

5.2.1 FAS Dataset

To pre-process the FAS dataset for Argentina and Ireland, the first step was to identify the relevant indicators related to financial services. A close inspection of the dataset revealed that over the entire time covered by the study, there was no information from any of the countries on mobile money, digital payments, and other modern financial technologies. Furthermore, data related to these new financial services is fully missing even from more recent years.

Consequently, the analysis focused on accessible data regarding traditional financial services, encompassing information on bank accounts, branches, deposits, loans, and insurance. However, the absence of mobile money indicators reduced the exploration of these aspects of financial technology adoption within this study's parameters. After these omissions, the dataset yielded a robust backdrop against which to compare financial inclusion in Argentina and Ireland with the emphasis on conventional banking services instead of digital or mobile financial innovations. The third move in data cleaning on the FAS dataset was a linear interpolation for the missing entries, which were executed wherever data was available on the variable for either the previous and/or subsequent year. The names of columns were all changed and reordered in such a way that the chances of errors were reduced.

5.2.2 Global Financial Inclusion Database (Findex) Dataset

This has been one of the fundamental resources for this study in providing a rich source of data regarding several indicators of financial inclusion across the world. The dataset, however, had serious shortcomings in terms of coverage related to fintech indicators like digital payments and mobile money, which were available only for the last two years of the study period and characterized by high proportions of missing values; therefore, less reliable for fundamental analysis.

To assure a more coherent dataset, with this approach we followed the Nuzzo & Piermattei, (2020) procedure and used linear interpolation to fill in the gap between waves of the Findex survey conducted in 2011, 2014, 2017, and 2021. This approach was important to assure data integrity over the study period, which then allowed an analysis strongly grounded on traditional financial services within a consistent and well-documented dataset. Despite all these efforts, the analysis was restricted by the lack of comprehensive data on fintech, indicating that reliance on more conventional measurements of financial inclusion continues to be necessary.

5.3 First stage (PCA)

This study uses PCA for the construction of the three sub-indices—Ownership, Availability, and Usage—to explain the different dimensions of financial inclusion in both nations. Each of these sub-indices gives insights into specific areas of financial engagement within the Argentinean and Irish residents. This method was chosen because it allows to reduce the dimensionality of the data while retaining the most significant variance.

5.3.1 Tendencies of each Sub-Index

Regarding the Ownership Sub-Index, as can be seen in Figure 2, in the case of Argentina, the trend shows an increase in the variable of bank account and debit card ownership, which suggest a broadening base of financial inclusion with the traditional banking services. Similarly with Ireland, demonstrating a strong trend toward the ownership of accounts, however, it shows a higher emphasis on credit card usage compared to Argentina.

In terms of availability, it is proved that in Argentina the financial services are largely driven by ATMs, showing that ATM networks are a central part of the financial infrastructure. However, there is less emphasis on insurance services. In contrast with these trends, Ireland confirmed a more balanced availability of financial services, with significant contributions from both ATMs and bank branches, alongside a stronger presence of insurance services.

Finally, talking about the Usage Sub-Index in the case of Argentina is heavily focused on savings, with a robust emphasis on deposit accounts and savings activities. While in Ireland, the usage sub-index highlights a greater reliance on borrowing and loan activities, reflecting a different approach to financial management and credit usage compared to Argentina.

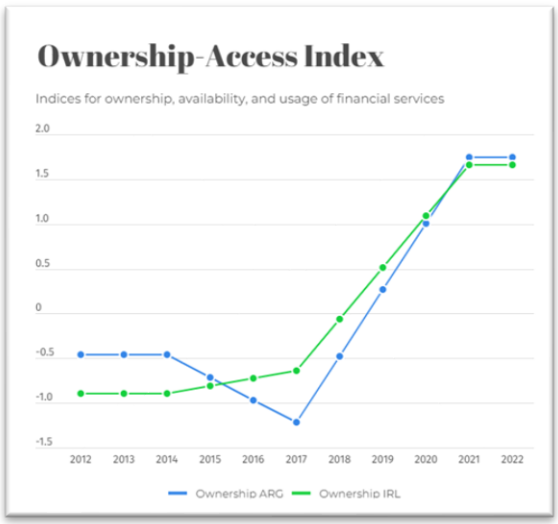

Figure 2: Ownership-Access Index

Figure 3: Availability Index

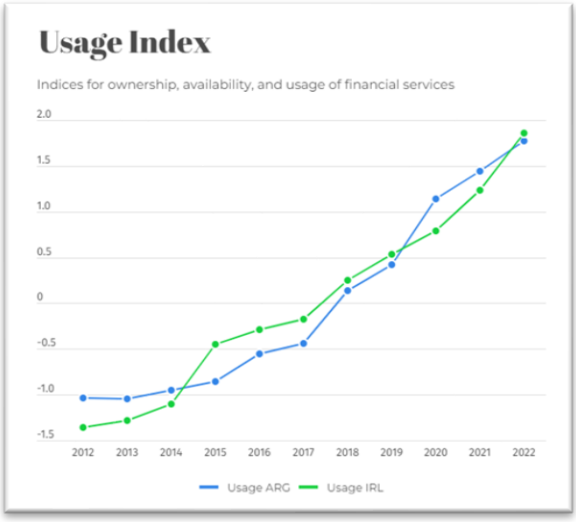

Figure 1: Usage Index

5.3.2 Sub-Indices components

To analyse the Ownership, Availability and Usage sub-indices, Principal Component Analysis (PCA) was employed to simplify the information of the plenty of indicators that describe the complex dimensions of financial inclusion. This method enables to identify among all those indicators which contribute more to each sub-index, while simultaneously helping to reduce the dimensionality of the data keeping the most significant information. Below, the components which explain each sub-index will be described, followed by a table with the specific numbers.

The first principal component (PC1) is the one that most explains the Ownership Sub-Index. This component captures the general trend in account and card ownership. The indicators Account_15+ and Fin_Inst_Acc_15+ have the highest loadings on PC1, which means that the access to basic financial accounts is the factor that most contributes to the Ownership Sub-Index in both nations.

For the Availability Sub-Index, PC1 represents also the component that most describes this index. In the case of Argentina, the availability of ATMs (atm_100k) has a high loading on PC1, indicating that the ATM network is a key element in the accessibility of financial services for Argentineans. In contrast what happens with Ireland, where there is a more balanced distribution between ATM availability and bank branches.

For the Usage Sub-Index, PC1 captures the general trend in the usage of financial services, such as deposits, savings, and loans. In both countries, variables related to deposits and savings (dep_account_cbank_1000 and Saved_Fin_Inst_15+) have the highest loadings on PC1, signifying that the use of these services is the main driver of the Usage Sub-Index.

Indicator	Argentina PC1	Argentina PC2	Ireland PC1	Ireland PC2
Ownership Sub-Index				
Account_15+	0.506091	0.406756	0.511806	-0.187064
Fin_Inst_Acc_15+	0.511893	0.289735	0.511806	-0.187064

Indicator	Argentina PC1	Argentina PC2	Ireland PC1	Ireland PC2
Owns_CC_15+	0.462887	-0.862024	0.471626	0.863839
Owns_DC_15+	0.517275	0.086707	0.503665	-0.428714
Availability Sub-Index				
atm_100k	0.647463	0.345288	-0.574619	-0.776751
bank_branches_100k	-0.350282	0.926558	-0.580432	0.164688
insurance_100k	-0.676827	-0.149219	-0.576985	0.607895
Usage Sub-Index				
dep_account_cbank_1000	0.320554	0.145396	0.191105	0.290371
out_dep_cbank_GDP	0.294861	0.335617	-0.309962	-0.369305
out_dep_other_GDP	0.253516	0.031012	-0.241500	0.182610
out_loan_cbank_GDP	-0.242157	0.637525	-0.340628	-0.261698
number_deposit_cbank_account	0.321625	0.122134	0.274029	0.214042
Saved_Fin_Inst_15+	0.319993	0.162494	0.340457	-0.302780
Borrowed_15+	0.325173	-0.061247	0.013016	0.595595
Saved_15+	0.319494	0.170076	0.361210	-0.210317
Saved_Fin_Inst2_15+	0.319993	0.162494	0.340457	-0.302780
Borrowed_Fin_Inst_15+	0.256493	-0.593951	0.368760	-0.150858
Utility_Pay_Acc_15+	0.324894	-0.075109	0.345706	0.163022

Table: Principal Component Loadings for Argentina and Ireland

5.4 Second Stage (PCA)

FII is computed by aggregating these three standardized sub-indices, that is ownership, availability, and usage into a composite indicator. These sub-indices are weighted either at par or by the variance explained by data. The final FII provides a score indicating the overall state of financial inclusion in a country.

In this period, Ireland improved at a faster rate than Argentina, moving from -3.29 to -1.11. From 2018 to 2022, both countries were on the rise. Argentina's FII grew from -0.22 to 5.21, thus displaying the great strides that the country has made in financial services. Ireland's Financial Inclusion Index (FII) experienced a significant increase, rising from 0.18 to 5.56, indicating substantial progress in improving financial accessibility. It is noteworthy that in both Ireland and Argentina, the COVID-19 pandemic accelerated existing trends in financial inclusion. Lockdowns led to a broader adoption of digital financial services for routine transactions. In Argentina, this shift was particularly evident in the increased use of mobile banking. Meanwhile, in Ireland, which already had a strong digital infrastructure, there was a noticeable move towards online financial services during the pandemic.

Although Ireland initially had a lower FII, it quickly gained momentum and surpassed Argentina by 2018, reflecting a faster rate of improvement. By 2022, both countries had achieved commendable levels of financial inclusion, with Ireland slightly ahead, highlighting its comprehensive and well-rounded strategy.

The Financial Inclusion Index (FII) is composed of three standardized sub-indices—Ownership, Availability, and Usage—combined into a single measure. These sub-indices may

be equally weighted or adjusted based on their significance within the data. The final FII provides a comprehensive score that captures the overall level of financial inclusion in a country.

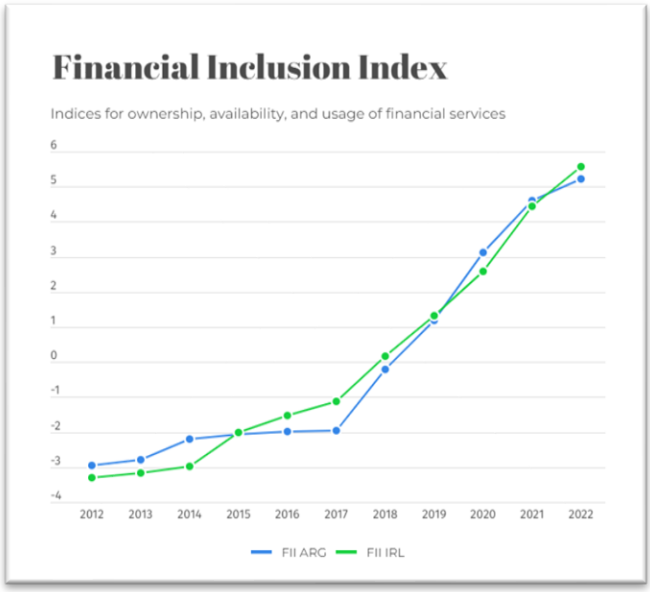

Figure 2: Financial Inclusion Index

6 Evaluation of Results, Discussion and Limitation

The results of the fixed effects model analysing the Financial Inclusion Index (FII) for Argentina and Ireland from 2012 to 2022 are summarized below.

Variable	Coefficient (β\betaβ)	P-Value	Standard Error
Intercept	-5.1358	0.000	(0.709)
C(Country)[T.Ireland]	1.1873	0.005	(0.351)
Population (Age 15+)	7.0691	0.041	(3.119)
Individuals using Internet	1.4460	0.612	(2.783)
Life Satisfaction	0.4334	0.599	(0.803)
Human Development Index (HDI)	-2.9476	0.003	(0.815)
Economic Freedom	1.3100	0.162	(0.884)
GDP per Capita	1.8516	0.061	(0.904)
Inflation (GDP Deflator)	0.7574	0.415	(0.899)
R-Squared	0.961		
Adjusted R-Squared	0.937		
F-Statistic	40.35***	6.04e-08	

Table 4: Fixed Effects Model Results

6.1 FII Results

The regression analysis discloses several important relationships between the Financial Inclusion Index (FII) and the explanatory variables for Argentina and Ireland. In the following part, it will be explained in more details (Mummolo and Peterson, 2018).

The impact of country-specific factors on the outcome variable is examined in this section. The coefficient for C(Country) [T.Ireland] is 1.1873, with a p-value of 0.005, indicating that, on average, Ireland's FII is higher than Argentina's by approximately 1.19 units, controlling for other factors. This suggests that Ireland has higher levels of financial inclusion, which is attributable to its more developed financial infrastructure and stable economic conditions.

- **Population (Age 15+)**: The positive coefficient of 7.0691 (p-value = 0.041) indicates that an increase in the working-age population significantly enhances financial inclusion. This may be attributed to the fact that a larger working-age population is more likely to engage in financial activities, thereby increasing the FII.

- **Human Development Index (HDI)**: Interestingly, the **HDI** has a negative coefficient of -2.9476, with a p-value of 0.003. This suggests that higher HDI scores are associated with lower FII values in this model, which is counterintuitive and may reflect underlying complexities in how HDI interacts with financial inclusion in different contexts, or potential multicollinearity with other variables.

- **GDP per Capita**: This indicator is 1.8516, with a p-value of 0.061, which is close to the threshold for significance. This suggests that countries with higher levels of wealth tend to exhibit greater levels of financial inclusion, as anticipated. However, the strength of this relationship is not as pronounced as that observed with other factors.

- **Internet Usage and Life Satisfaction:** The percentages of individuals who use the internet and life satisfaction have positive coefficients (1.4460 and 0.4334, respectively), however neither shows statistical significance with p-values at 0.612 and 0.599 respectively; this means that these elements might impact financial inclusion, but they are not immensely powerful or regular in this model.

- **Inflation (GDP Deflator):** The positive coefficient of 0.7574 for inflation shows a small positive connection with financial inclusion. Still, this outcome holds no statistical importance (p-value = 0.415). It means that the effect of inflation on financial inclusion in this set of data is weak or inconsistent in this dataset.

- **Economic Freedom:** Economic freedom has a positive coefficient of 1.3100, but it is not statistically significant at p-value = 0.162. This indicates that even though more economic liberty could improve financial inclusion, the proof for this connection is not robust in this specific setting.

6.2 Correlation Matrix

The results of the correlation analysis described in the Figure 5, indicate that there is a strong positive correlation between financial inclusion (FII) and several key factors, including the working-age population, internet usage, and economic freedom.

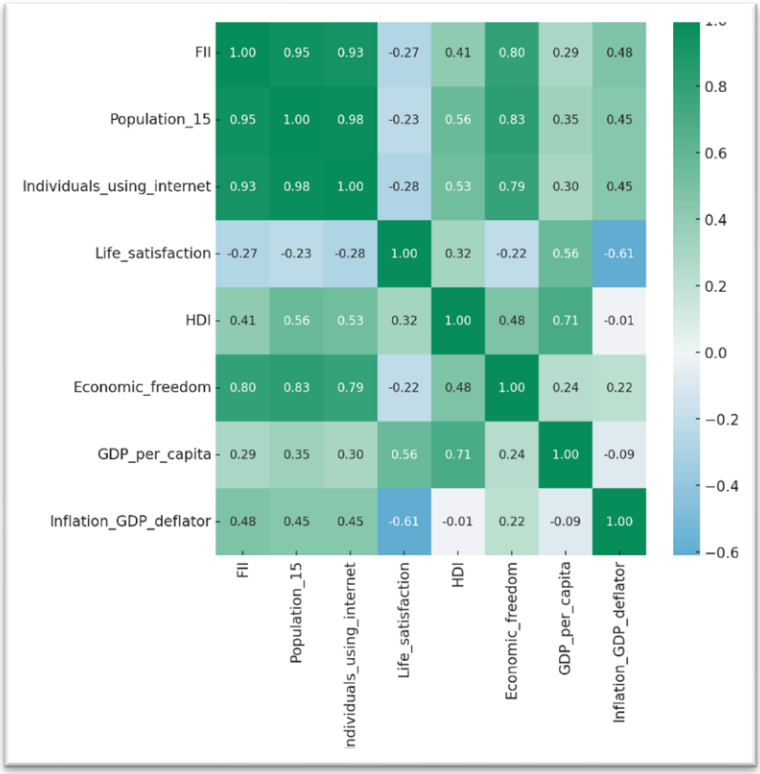

Figure 3: Financial Inclusion Correlation

6.3 Discussion

The regression analysis gives a good understanding about what affects the financial inclusion in Argentina and Ireland. It shows that variables related to economy and society, like working-age population or GDP per person, have a strong impact on Financial Inclusion Index (FII). This highlights how crucial economic activity and demographic factors are for ensuring people have access to financial services in these countries. Ireland's edge in financial inclusion stems from its well-established financial infrastructure and consistent policies, which are characteristic of the country. In the case of Argentina, yet the opposite and not anticipated relationship between Human Development Index (HDI) and FII could signify complex interactions or multicollinearity with other variables like GDP per capita. Moreover, it is important to consider the part played by informality and how some underrepresented areas do not get included in official data (Vargas and Lahura, 2022). Regions that have low financial inclusion might not show up accurately in figures, especially if much of their economic activity happens outside of formal finance systems. The insignificance of variables like internet usage and life satisfaction implies they have a less important part, even if their indirect impacts are not to be ignored.

7 Limitations

It is essential to recognize the boundaries of this analysis, which encompass: The assumption that there exists a straight relationship between the independent variables and Financial Inclusion Index (FII) might over-simplify complex interactions. This is especially true for variables such as the Human Development Index (HDI), where unexpected results were seen. Additionally, even though the fixed effects model manages time-fixed characteristics, hidden

variables changing over time can still result in prejudice. This makes understanding outcomes harder.

The small sample size, limits the ability to apply the findings broadly and decreases the statistical strength, particularly in identifying notable impacts for variables that are less strongly related. Also, it is challenging to make comparations between Ireland, a developed EU country and Argentina, which is an emerging economy in Latin America. This difficulty arises from the stark economic differences between the two countries. Despite the focus of most studies on comparing countries with similar traits and features, it is also crucial to understand the differences between them, even if there are inherent limitations in comparing data.

Furthermore, the presence of variations in the data presents a challenge. There are significant disparities between developed and emerging economies regarding the availability and quality of data, particularly in fintech adoption. This difference could result in an analysis that is not complete. This is particularly central as fintech has had a significant impact on improving financial inclusion after the global pandemic. Additionally, measuring financial inclusion accurately is inherently challenging due to the existence of different definitions, methods of data collection and the rapidly evolving nature of the finance sector, which collectively make it more difficult to achieve consistent and reliable measures.

8 Conclusion

The results of this study bring into perspective the importance of adopting a multi-faceted approach when analyzing financial inclusion, especially for countries like Argentina and Ireland, which stand at opposite extremes in terms of their economic landscapes. Besides the conventionally recognized access and ownership of financial products, there is a need to represent the bigger picture of the concept of financial inclusion in a world digitizing at a very rapid pace. Hand in hand, the level of financial literacy, fintech adoption, and access to innovative financial products have also become important. Fintech, especially, has proved very crucial in filling up the gaps in financial infrastructure by providing other channels toward financial access, such as peer-to-peer lending and mobile payment platforms.

However, a persistent challenge in measuring financial inclusion is the lack of consistent and updated data on fintech adoption and the informal economy. The findings suggest that additionally, while Ireland has made substantial steps in leveraging fintech for financial inclusion, Argentina faces more complex challenges that require tailored approaches, regarding informality, inflation, and currency instability. Including fintech innovations into formal economic structures presents a viable solution for expanding access to financial services, but it will require focused policymaking and strategic investments.

9 Policy Recommendations

To address the challenges presented in this paper and promote more comprehensive financial inclusion, it is essential that governments, international organizations and other stakeholders take the following actions:

A Standardization Measurement is key. It is imperative that a global consensus is reached on the manner in which financial inclusion and fintech adoption should be measured. The

availability of quantifiable and standardised data is crucial for the formulation of effective policies and the evaluation of existing programmes.

Furthermore, the implementation of standardized measurements will facilitate cross-country comparisons, thereby enabling policymakers to identify and learn from best practices in regions that have successfully developed inclusive economies with robust financial infrastructures. By gaining insight into the strategies that prove effective in countries such as Ireland, emerging economies can adopt comparable approaches to foster financial inclusion and economic growth.

It is imperative that efforts are made to promote equitable fintech adoption. It is compulsory for governments and international organizations to provide support to startups and fintech companies in order to ensure that affordable and diverse financial products are accessible to all segments of the population. The greater the extent of adoption of these products, the greater the impact on financial inclusion. In other words, the increased adoption of fintech can result in enhanced company profits, GDP growth and overall societal well-being, while simultaneously reducing economic inequalities and exclusion.

In the case of Argentina, fintech could play a pivotal role in bridging the financial inclusion gap by reaching underserved and rural populations These findings also suggest that Ireland has made substantial strides in leveraging on Fintech for financial inclusion, but in Argentina, challenges are more complex and demand tailor-made strategies, especially towards informality, inflation, and currency instability. In this line, therefore, the inclusion of fintech innovations into formal economic structures is one such intervention that would help to expand financial services, but this will need some focused policy-making and well-placed investments.

In response to the challenges before mention, a comprehensive strategy is needed to promote financial inclusion, particularly in countries like Argentina. Policymakers will have to take into account the implementation of a multi-pronged approach to increase digital financial inclusion, which addresses specific economic challenges facing the country. Investment in digital infrastructure, particularly in the underserved rural areas, is one key strategy where restricted mobile and broadband access keeps them away from active participation in the digital economy. Greater connectivity through public-private partnerships can improve the access to digital financial services and give the backbone to an inclusive economy.

Additionally, efforts to improve financial literacy are crucial. Policymakers must consider the implementation of a multi-pronged approach to increase digital financial inclusion, which addresses specific economic challenges facing the country. Amplification of the current programmes and initiatives within Argentina should be done to ensure that knowledge of digital means of finance reaches every nook and corner of the country. For instance, financial education in Buenos Aires should be scaled up accordingly.

In conclusion, while the present analysis elucidates the principal motivating factors of financial inclusion, it also underscores the necessity for a more sophisticated comprehension and assessment of this intricate phenomenon. The incorporation of factors such as financial literacy and fintech adoption into future studies will facilitate the generation of a more comprehensive picture, thereby enabling the formulation of more effective policies and interventions to promote inclusive economic development.

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