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**Financial inclusion and human development in Morocco: Long-run equilibrium,
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Statements and Declarations

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- Ethics approval

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- Consent to participate

Not applicable.

- Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

- Author contributions

All authors contributed equally to the conception, writing, and revision of this article. All authors read and approved the final manuscript.

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Abstract

Financial inclusion positively affects human development in Morocco, evidenced by a long-term structural relationship observed over thirty-three years, despite major macroeconomic disruptions, including the COVID-19 pandemic. While financial inclusion and the Human Development Index (HDI) progress simultaneously, short-term growth in per capita income primarily drives HDI. The effects of financial inclusion are gradual and do not manifest immediately, emphasizing a need for caution in interpreting their impact on well-being. Furthermore, findings reveal that the relationship is symmetrical, differing from regions with higher financial volatility. This suggests that temporary credit slowdowns are unlikely to irreversibly harm human development. Significant reductions in short-term claims and improvements in banking profitability highlighted the dual impact of financial systems on human development. Finally, the study questions the assumption of immediate feedback from human development to financial inclusion, indicating it may occur over a longer time frame.

Key words: Human development, Economic growth, financial inclusion, NARDL, Morocco

JEL classification : O15 ; O40 ; O16 ; C22 ; O55

1. Introduction

In 1991, fewer than one in five Moroccan adults had effective access to bank credit, and the branch network was almost non-existent beyond the major cities. Thirty years later, Morocco has a banking penetration rate of around 82%, a network of more than 6,600 branches and a standardized IIF that borders on the unity that ranks the kingdom among the emerging economies with the fastest financial transition on the African continent. Over the same period, the Human Development Index rose from 0.469 to 0.705, an increase of 50% that allowed the country to leave the category "low human development" to join the category "high human development". These two parallel trajectories raise a question that is not obvious. However, is there a causal link between financial deepening and the improvement of living conditions, or are they simply two concomitant manifestations of the same dynamic of global economic development?

The question deserves to be raised with precision because the answer has considerable practical implications. If financial inclusion is a stand-alone driver of human development and not just an epiphenomenon of growth, then public policy has a powerful instrument that does not necessarily go through traditional fiscal channels. Access to credit, formal savings, payment services and insurance theoretically allows poor households to smooth their consumption, invest in the education of their children, to cope with health shocks and to gradually emerge from the poverty traps described by Banerjee and Newman (1993) and since then repeated in an abundant literature. From this perspective, financial inclusion policies would not simply be accessories to banking regulation, but instruments in their own right for social development.

However, this optimistic vision faces several difficulties that the empirical literature has not fully resolved. On the one hand, financial inclusion could be only a retarded indicator of economic growth; households enter the banking system only when their income allows them to meet the minimum requirements for opening an account and repaying credit. Causality would then move from development to inclusion, not the other way around. On the other hand, even assuming that financial inclusion promotes human development, it is largely unknown whether this effect is symmetrical, that is, whether episodes of credit contraction or banking network rollbacks degrade the HDI to the same extent as expansions improve it. This potential asymmetry is all the more relevant because emerging economies' financial cycles are notoriously more volatile than those of advanced countries (Demirgüç-Kunt et al., 2018). Finally, a growing literature highlights that mass financial inclusion can weaken the banking system if conducted without an adequate prudential

framework. This hypothesis is illustrated by Lim et al. (2020) in the context of Asian microfinance, and makes perfect sense in the case of Morocco. where the crisis in the microcredit sector in 2008 led to a temporary increase in outstanding debts.

It is in this space of questions that the present study fits. It pursues three complementary objectives. The first is to assess the long-term impact of financial inclusion on human development in Morocco over the period 1991–2023, distinguishing the often non-existent or marginal short-term effects from the underlying dynamics that are gradually taking hold. The second objective is to test whether this impact is asymmetrical, that is, if episodes of financial contraction produce damages on the HDI greater than the gains associated with an equivalent expansion. Question addressed via the NARDL framework of Shin et al. (2014), little mobilized in the literature on financial inclusion in North Africa. The third objective concerns the effects of financial inclusion on the soundness and efficiency of the Moroccan banking system itself, a dimension that is rarely addressed in conjunction with human development from a country perspective.

On the methodological level, the study mobilizes several innovations compared to the existing literature on the Moroccan case. The construction of a composite financial inclusion index through a principal component analysis on six dimensions covering access, use and financial depth avoid the measurement biases inherent to univariate proxies. The application of the ARDL procedure of Pesaran et al. (2001), combined with the test of Zivot and Andrews (1992) which endogenises a structural rupture in 2006, takes into account the inherent non-linearity of the Moroccan financial inclusion trajectory. Finally, the robustness of the estimates is verified via the FM-OLS and DOLS estimators, which explicitly correct for endogeneity and serial correlation in long-term relationships.

The rest of the article is organized as follows. Section 2 discusses the different relevant theoretical and empirical studies and clarifies the positioning of our contribution in relation to the existing literature. Section 3 presents the data, describes the construction of the financial inclusion index and explains the estimation strategy. The results are presented and discussed in Section 4. Section 5 concludes and formulates policy implications.

2. Revue de la Littérature

Financial inclusion is one of those concepts that circulate easily between the reports of international organizations and academic publications, to the point that they end up overlapping

quite different realities according to the authors who take it. In its most common formulation, it refers to the access of households and businesses to useful and affordable formal financial services provided by deposit accounts, credit, insurance, payment through regulated intermediaries (World Bank, 2008). This seemingly simple definition raises two practical difficulties. Indeed, the first concerns the distinction between access and use. However, one can have a bank account and never use it; the phenomenon of "dormant accounts" is documented in all three countries (Bangladesh, India, and Pakistan) in the comparative study by Chowdhury and Chowdhury (2023). The second difficulty is the intrinsically multidimensional nature of the phenomenon, which Sarma (2008) formalized for the first time in her three-dimensional financial inclusion index (penetration, availability, use), taken up by Mialou et al. (2014), which relies on data from the IMF's Financial Access Survey (FAS) to construct a new composite index of financial inclusion.

These definitional debates have direct consequences on measurement and, consequently, on the empirical results. Studies that select a single proxy, most often the private credit/GDP ratio or the number of accounts per thousand adults, show heterogeneous results depending on whether the chosen proxy captures more of the supply of credit, monetary depth, or actual use of services. Demirgüç-Kunt and Klapper (2012), using Global Findex data from 148 countries, show that the gaps between access and use indicators can be considerable, especially in North Africa where cultural and informational barriers hinder the use of formal accounts even when physical infrastructure is present. In this context, the composite-index approaches on which our approach is based allow us to capture a larger share of the real variance of financial inclusion, at the cost of higher data requirements.

The issue of measurement is particularly acute in developing economies, where financial inclusion has had very different trajectories across countries, with different modes of government engagement in banking and a relatively large informal sector. However, Mani (2018) analyzed comparatively the levels of financial inclusion in South Asian countries. Their result indicates that physical access indicators have caught up with median levels in upper-middle-income economies; usage indicators remain low. This mismatch between infrastructure and actual use is a potential bias if only one indicator is used to measure inclusion, which justifies the double specification adopted in this study. The theoretical link between the financial system and economic development has a long genealogy, going back at least to Schumpeter (1912), for whom the banker who finances the innovator is a central actor of economic progress. The contemporary reformulation of this link

is based on Levine (1997), whose synthesis of the mechanisms for mobilizing savings, allocating capital, and monitoring projects, risk-sharing, trade facilitation remains the canonical reference for explaining how financial development leads to growth. These mechanisms initially concern firms and entrepreneurs, and their extension to poor households is theoretically less immediate. This is precisely what Banerjee and Newman (1993) have undertaken through a poverty trap model, revealing that in the absence of access to formal credit, agents with low initial capital endowments can only undertake projects with low returns, thus perpetuating their situation of poverty independently of their productive capacities. Financial inclusion breaks this vicious circle by loosening the external financing constraint.

The articulation with human development in the broad sense, that is, beyond income alone, was theorized by Sen (1992), whose capacity-based approach provides the most convincing conceptual framework. For Sen (1992), human development is the expansion of individuals' real capacities to lead a dignified life; access to financial services improves these capacities in several ways. Indeed, it makes it possible to finance children's education without being constrained by the income cycle of parents, to protect oneself against health shocks without having to sell productive assets, and to invest in decent housing. Collins et al. (2009), studied the budgets of poor households in Bangladesh, India and South Africa, empirically show that these households use formal financial services primarily to smooth their consumption and manage medical emergencies, and not to finance productive investments as is often assumed by theoretical models. This observation leads to qualify the discourse on microcredit as a tool for entrepreneurship and to place greater emphasis on the insurance functions of financial inclusion.

The transmission of financial inclusion to human development operates through several channels identified in the literature, whose relative importance varies according to the institutional context. The first is the poverty reduction channel. Indeed, access to credit allows low-income households to increase their consumption and invest in income-generating assets (Jeanneney and Kpodar, 2011). The second is the channel of income equalisation: a more inclusive financial system reduces the comparative advantage of the rich in access to capital and helps to compress income inequality, an outcome established empirically by Beck et al. (2007) on a panel of 72 countries. The third, more indirect channel is women's economic empowerment. However, Swamy (2014) has examined that women's access to formal credit in India significantly improves the indicators of

girls' education and access to health care, an effect that passes through an intra-family redistribution of decision-making resources rather than a direct income-effect.

The empirical literature on the link between financial inclusion and human development presents a heterogeneity that reflects both the diversity of contexts studied and the variety of methodological approaches used. The first large-scale studies are essentially descriptive and rely on correlation analyses or cross-sectional regressions. Nanda and Kaur (2016), in a study covering 59 countries, found a robust positive correlation between their composite index of financial inclusion and the HDI, but remained cautious about causal conclusions. Raichoudhury (2016), in a similar vein, confirms these findings and points out that the effect is more pronounced in low- and middle-income countries than in developed economies, suggesting a diminishing return effect of financial inclusion.

A second generation of studies uses panel data and more sophisticated econometric methods to try to isolate a causal effect. Sarma and Pais (2011), in an analysis covering 49 countries, show that the HDI and the financial inclusion index are positively correlated, but that the relationship is bidirectional: countries with high levels of human development create an institutional environment conducive to financial inclusion, and vice versa. Laha (2015), for South Asian countries, finds a positive association between financial inclusion and HDI, more pronounced for countries that combine financial inclusion and institutional quality. Thathsarani et al. (2021) used a panel of seven South Asian countries over the period 2004-2018. Their results indicate a positive long-term impact of financial inclusion on human capital, but a short-term effect that turns out to be non-significant result that prefigures what we get for the Moroccan case.

In the African context, Matekenya et al. (2021) have studied the impact of financial inclusion on human development in sub-Saharan Africa and conclude that there is a significant positive effect, the magnitude of which varies depending on the dimension of the chosen inclusion. However, the use of services (borrowers, depositors) produces more pronounced effects than mere physical access (agencies, ATMs). In addition, Abdelghafar et al. (2023) compared the analysis of (Matekenya et al. (2022)) to the MENA region and confirm the existence of a positive "nexus" between financial inclusion and human development, while emphasizing the mediating role of institutional quality in the strength of the relationship. These results constitute the major pillars closest to our study, without treating the Moroccan case in isolation or mobilizing asymmetric estimation techniques that allow us to go beyond the simple quantification of an average effect.

Furthermore, Datta and Singh (2019) used international data is particularly useful for mapping methodological divergences. It notes that studies using Granger's causality in a VAR framework frequently lead to bidirectionality conclusions, while panel cointegration approaches mean group, DOLS tend to highlight robust long-term effects with less clear short-term dynamics. This difference between the short and long term is not a statistical obstacle, but it reflects transmission mechanisms at varying speeds, depending on whether we consider the effects of inclusion on income (relatively fast) or on life expectancy and education (much slower). This justifies our choice of the ARDL/UECM framework, which precisely allows us to distinguish between the two horizons without confusing them.

If the relationship between financial inclusion and human development concentrates most of the literature, the return effects of inclusion on the financial system itself are much less analyzed which is one of the gaps that this study intends to fill. Focusing on overly aggressive financial inclusion, which pushes banks to extend credit to customer segments for which they do not have sufficient information, could degrade portfolio quality and weaken the sector's creditworthiness. The Moroccan microcredit crisis of 2008-2010, which saw the rate of defaults by microfinance institutions exceed 15% in less than two years (Lim et al., 2020), is a warning that theoretical models of optimistic inclusion have long underestimated.

Study on this subject adopts nuanced positions. On the one hand, Beck et al. (2007) argue that inclusive financial development reduces inequalities in access to capital without necessarily increasing systemic risk, provided that supervisory institutions accompany expansion. On the other hand, Morgan and Churchill (2018) show that in low-income economies, the rise of financial inclusion has often been accompanied by an increase in overdue debts in the early years, before learning and selection effects reverse the dynamic trend in J that we find in our estimates of the IIF-ROA relationship. Mohieldin et al. (2019), in an analysis of the Egyptian case, document that credit expansion to SMEs and unbanked households is associated with higher solvency ratios over the long term, via a diversification of risk results consistent with our long-term estimate for the Moroccan case.

In terms of the efficiency of the financial system, the relationship with inclusion is theoretically positive. However, a wider and more competitive banking market should reduce intermediation margins and improve capital allocation. But this theoretical prediction is fully realized only if inclusion is accompanied by effective competition between institutions, a reduction of information

asymmetries and a deepening of capital markets. For economies where the banking sector is oligopolistic such as Morocco, where five banking groups control more than 80% of assets, the efficiency gains associated with inclusion could be partially captured as an annuity by dominant institutions rather than passed on to clients in the form of narrower spreads. Jeanneney and Kpodar (2011) formalized this paradox in their model of the "financial inclusion puzzle" and show that the net effect on efficiency depends on the initial market structure.

Similar study on the link between financial inclusion and development in the african region remains relatively limited compared to the literature on South Asia or Sub-Saharan Africa, and even more so with regard to Morocco. Mani (2018) examined a useful panoramic view of the situation in South Asia, but its analytical scope remains descriptive. However, Abdelghaffar et al. (2023) used an econometric study for several MENA countries to fill the gap in Mani (2018), but their panel data approach masks national specificities and does not allow us to isolate the structural ruptures specific to each trajectory. For Morocco, the available literature has long been focused either on the description of institutional reforms in the banking sector (liberalization of the 1990s, reform of the statute of Bank Al-Maghrib in 2006), or on studies of microeconomic scope concerning the impact of microcredit on rural households whose conclusions, often mixed, have fueled the debates on the crisis of the sector in 2008.

Moreover, asymmetric approaches are well established in the study of the relationships between financial development and economic growth as shown (Ibrahim and Alagidede 2018, 2020) but have been very little applied to the issue of financial inclusion and human development. This methodological flaw is all the more damaging because financial inclusion trajectories in emerging economies are characterized by phases of expansion and contraction whose welfare effects may not be symmetrical. By applying this framework to the Moroccan case, we contribute not only to the country literature but also to the methodological literature on this field of study. Finally, the literature converges towards a fragile consensus. Indeed, financial inclusion contributes positively to human development, more in the long term than in the short term, with more pronounced effects on low-income households and in high-quality institutional contexts. But this consensus is based on an empirical foundation that remains insufficient for the MENA middle-income economies in general and for Morocco in particular. The present study attempts to provide a rigorous answer by exploiting a 33-year-long series and combining several estimation methods whose conclusions are mutually reinforcing.

3. Données et Méthodologie

3.1 Sources et couverture temporelle

Cette étude allant de 1991 à 2023 sur le Maroc. Cependant, Le choix de cette période dépend à l'année qui suit le lancement du programme d'ajustement structurel, moment à partir duquel les premières réformes de libéralisation financière commencent à produire leurs effets sur les structures bancaires. Ainsi, cette période dictée par la disponibilité des données de l'UNDP pour l'indice de développement humain dans sa méthodologie unifiée de 2021. Par ailleurs, les données proviennent principalement par des sources nationales et internationales. L'IDH et ses composantes proviennent des rapports annuels du Programme des Nations Unies pour le Développement (PNUD, 2023). Les indicateurs macro-financiers crédit privé/PIB, masse monétaire M2/PIB, spread de taux, PIB par habitant, inflation et ouverture commerciale sont extraits des World Development Indicators de la Banque mondiale. Les données d'accès au système bancaire (agences, distributeurs automatiques, déposants, emprunteurs) proviennent de l'IMF Financial Access Survey (FAS), disponible depuis 2004. Les ratios prudentiels (NPL, solvabilité, ROA) sont tirés des rapports annuels de Bank Al-Maghrib complétés par la base WDI. Table 1 presents the descriptive statistics for our series.

Table 1. Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Median	Max	Skewness
HDI (UNDP)	33	0.5938	0.0730	0.469	0.602	0.705	-0.164
Poverty rate (%)	33	10.421	7.307	1.500	8.900	24.800	0.397
Private credit / GDP (%)	33	46.485	21.287	17.800	49.800	73.500	-0.089
M2 / GDP (%)	33	95.964	28.366	59.100	98.600	145.200	0.184
Bank branches (/100k adults)	20	14.322	4.566	5.820	15.915	19.020	-0.658
ATMs (/100k adults)	20	47.979	22.904	9.520	51.525	78.850	-0.273
Bank capital ratio (%)	24	9.596	1.153	7.820	9.300	11.620	0.422
Non-performing loans (%)	24	9.933	5.021	4.800	7.900	19.400	0.877
Interest rate spread (%)	33	4.486	0.506	3.380	4.520	5.350	-0.369
Return on assets (%)	29	0.905	0.240	0.420	0.920	1.350	-0.230
GDP per capita (USD 2015)	33	3158.2	726.1	2085.2	3178.8	4298.5	-0.005
Inflation, CPI (%)	33	2.525	2.112	0.220	1.620	8.020	1.047
Trade openness (%)	33	70.512	10.463	50.200	70.500	87.200	-0.248

Source: Authors Calculations.

The descriptive statistics reveal several elements worth highlighting before entering the heart of the econometric analysis. The average human development index (HDI) over the period considered stands at 0.594, evolving from 0.469 in 1991 to 0.705 in 2023, which corresponds to an absolute increase of 0.236 points, higher than that observed in most countries in the MENA region over the same period (Abdelghaffar et al., 2023). The ratio of private credit to GDP has increased more than fourfold, from 17.8% to 73.5%, illustrating the extent of the transformation of the Moroccan banking sector following major reforms in the 1990s. The marked asymmetry of the non-performing loan rate (0.877) attests to the presence of extreme values at the beginning of the period, linked to the difficulties of public banks inherited from the controlled economy era, followed by their gradual reduction during the 2000s. These structural properties motivate the implementation of a methodology to assess the non-linearity of the correlation between financial inclusion and human development.

3.2 Construction de l'Indice d'Inclusion Financière (FII)

The assessment of financial inclusion immediately raises a fundamental question for obtaining reliable results regarding its effects. Indeed, no single indicator can reliably capture the multidimensional complexity of the phenomenon, which encompasses simultaneously physical access to banking services, their effective use, and the financial depth of the economy (Sarma, 2008; Mialou et al., 2017). This constraint is particularly pronounced in the Moroccan context, where access indicators (branch network, number of ATMs) and usage indicators (number of depositors, borrowers) have evolved according to distinct temporal dynamics, the expansion of physical infrastructure having preceded by about a decade the actual growth in usage. We therefore develop two indices that complement each other. The first, called FIIBase, exploits the two variables available over the entire period 1991–2023. Each variable is normalized by the min-max transformation, and then the two scores are averaged:

$$FII_{Base,t} = \left(\frac{1}{2}\right) \times [norm(PrivateCredit_{GDP_t}) + norm(M2_{GDP_t})] \quad (1)$$

Where $norm(xt) = \frac{(xt - xmin)}{(xmax - xmin)}$, ensure that $FII_{Base,t} \in [0, 1]$ for all t . The second index, FII_{Full} , mobilizes six dimensions for the subperiod 2004–2023 agencies, DAB, depositors,

borrowers, credit/GDP, and M2/GDP, and is constructed by Principal Component Analysis (PCA) on standardized variables.

3.3 Stratégie d'estimation

The adoption of co-integration techniques requires a prior review of the order of time series integration. Three additional tests are used. The ADF test, developed by Dickey and Fuller (1981), as well as the PP test, proposed by Perron (1990), are carried out taking into account a constant and a linear trend; the times for the ADF test are chosen according to the Akaike criterion. However, these two traditional tests do not take into account the structural breaks present in the data, which is a particularly constraining assumption for a country that has undergone major institutional reforms around the 2000s. We add the test of Zivot and Andrews (2022), which considers a break in both trend and constant (specification "both"). The three test statistics are compared with their corresponding critical values. The general null hypothesis is the existence of a unitary root.

Table 2. Unit Root Tests

Variable	ADF Level	ADF D(1)	PP Level	PP D(1)	Integration Order
ln(HDI)	0.513	−5.685***	−0.134	−5.780***	I(1)
ln(FII)	−0.270	−4.676***	−5.832***	−12.014***	I(1)
ln(GDPpc)	−1.079	−4.405***	−1.746	−6.896***	I(1)
Trade	−2.187	−4.232***	−2.220	−6.429***	I(1)
Inflation	−1.865	−3.454*	−2.155	−9.616***	I(1)

Note : *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Source: Author's calculations.

All series being I(1), the ARDL procedure with the cointegration test by Pesaran et al. (2001) constitutes the fundamental methodological framework. It has two key advantages for our problem. First, it remains valid regardless of the exact order of integration of the I(0) or I(1) regressors. Thus, it allows the simultaneous estimation of short-term dynamics and long-term relationships in the same model. The unconstrained error correction model (UECM) is written as:

$$\begin{aligned}\Delta \ln(HDI)_t = & \alpha^0 + \rho \cdot \ln(HDI)_{t-1} + \theta^1 \cdot \ln(FII)_{t-1} + \theta^2 \cdot \ln(GDPpc)_{t-1} + \theta^3 \cdot Trade_{t-1} \\ & + \theta^4 \cdot Inflation_{t-1} + \sum_{i=0}^p \varphi_i \cdot \Delta \ln(FII)_{t-i} + \sum_{i=0}^g \gamma_i \cdot \Delta \ln(GDPpc)_{t-i} \\ & + \sum_{i=0}^s \delta_i \cdot \Delta Trade_{t-i} + \sum_{i=0}^u \eta_i \cdot \Delta Inflation_{t-i} + \varepsilon_t\end{aligned}\quad (2)$$

The coefficient ρ measures the speed of adjustment towards long-term equilibrium; we expect $\rho \in (-1, 0)$ to confirm the cointegration. The long-term coefficients are retrieved according to the formula $\beta LR, j = \frac{-\theta_j}{\rho}$. Wald's F-statistic on level terms $(\rho, \theta_1, \dots, \theta_4)$ is compared to the tabulated bounds by Pesaran et al. (2001) for $k = 4$ regressors, Case III. However, the parametric stability is verified by two tests (CUSUM and CUSUMSQ tests) applied to the recursive residuals of the model, as pointed out by Brown et al. (1975). Moreover, the assumption of linearity in equations (2a and 2b) may obscure relevant asymmetries; the impact of a contraction of financial inclusion is not necessarily symmetrical to that of an expansion. The NARDL framework proposed by Shin et al. (2014) describes this problem by decomposing the variations of $\ln(FII)$ into positive and negative partial sums:

$$FII_t^+ = \sum_{i=1}^t \max(\Delta \ln(FII)_i, 0) \quad (3)$$

$$FII_t^- = \sum_{i=1}^t \min(\Delta \ln(FII)_i, 0) \quad (4)$$

The NARDL model incorporates these two components (3 and 4) in place of $\ln(FII)$ in equation (2):

$$\begin{aligned}\Delta \ln(HDI)_t = & \alpha^0 + \rho \cdot \ln(HDI)_{t-1} + \beta^+ \cdot FII_{t-1}^+ + \beta^- \cdot FII_{t-1}^- + \theta \cdot \ln(GDPpc)_{t-1} \\ & + \sum_{i=0}^p [\varphi_i^+ \cdot \Delta FII_{t-i}^+ + \varphi_i^- \cdot \Delta FII_{t-i}^-] + \sum_{i=0}^g \gamma_i \cdot \Delta \ln(GDPpc)_{t-i} \\ & + \varepsilon_t\end{aligned}\quad (5)$$

The asymmetrical long-term coefficients are $\tilde{\beta}^+ = -\frac{\beta^+}{\rho}$ et $\tilde{\beta}^- = -\frac{\beta^-}{\rho}$. Long-term symmetry ($H_0 : \beta^+ = \beta^-$) and short-term ($H_0 : \sum \varphi^+ = \sum \varphi^-$) is tested by the Wald test. The rejection of these null hypotheses (H_0) validates the asymmetry and thus the relevance of NARDL compared to standard ARDL.

Long-run estimates from ARDL are consolidated by two estimators designed for cointegration relationships. The *Fully Modified OLS* simultaneously corrects the serial correlation and the

potential endogeneity of FII via nonparametric Newey-West adjustments (Phillips and Hansen, 1990). The *Dynamic OLS* increases the long-run regression by the advances and delays of the first estimating differences ($n.\text{leads} = n.\text{lags} = 1$) inspired by Stock and Watson, 1993. These two estimators make it possible to verify that the sign and significance of the FII coefficient on $\ln(\text{HDI})$ remain stable regardless of the estimation method.

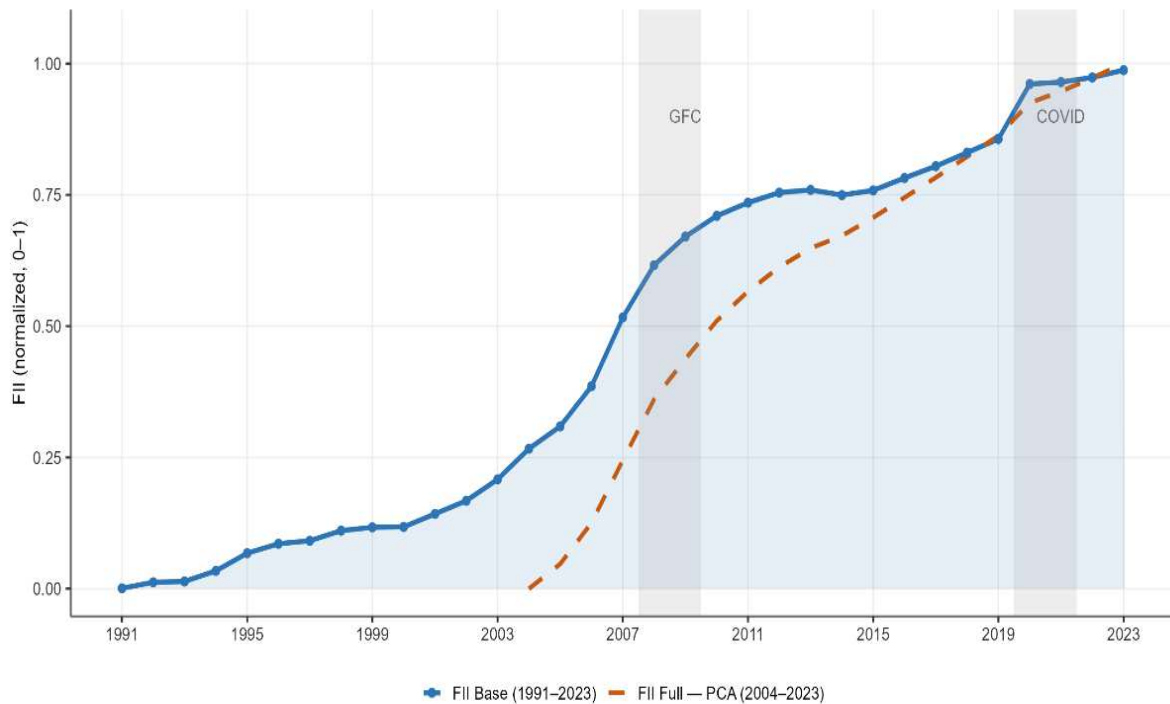
Standard Granger causality tests are invalid in the presence of series $I(1)$ or co-integrated. We adopt the procedure of Toda and Yamamoto (1995), which circumvents this problem by estimating an increased VAR of order $(p + d_{\max})$, where p is the optimal number of delays according to the AIC and $d_{\max} = 1$ the maximum order of integration. The Wald test is then applied only to the first p delays, the additional $d_{\max}$ delays are used exclusively to ensure the asymptotic validity of the χ^2 distribution of the test. The trivariate system used includes $\ln(\text{HDI})$, $\ln(\text{FII})$ and $\ln(\text{GDPpc})$. The selection of the optimal number of delays by the AIC gives $p = 4$, hence an estimated VAR(5) over the available period. Indeed, two causality analyses are carried out, first, $\text{FII} \rightarrow \text{IDH}$ (direction 1, hypothesis H4). Then, $\text{IDH} \rightarrow \text{FII}$ (direction 2, feedback postulated). In addition, the effects of financial inclusion on the soundness (H2) and efficiency (H3) of the banking system are estimated using four separate ARDL(1,1,1) models, whose dependent variables are respectively the NPL ratio, the solvency ratio, the interest rate spread and the ROA. The IIFBase is the estimator of interest, with log GDP per capita acting as the control variable.

4. Results and Discussion

4.1 Trends in financial inclusion and human development

Figure 1 examines the progression of the core financial inclusion index over the entire period 1991–2023. The trajectory is far from linear. We first distinguish a phase of slow and steady expansion until the early 2000s, mainly driven by the growth of bank credit, without any significant increase in the distribution network. Then comes a marked acceleration between 2003 and 2012, which coincides with the institutional reform of Bank Al-Maghrib in 2006, the rise of microcredit, and the sustained deployment of agencies in rural areas. Since 2019, there has been stabilization at a high level of inclusion, with the credit/GDP ratio reaching its historical ceiling thanks to the support measures deployed during the Covid-19 pandemic.

Fig 1. Financial Inclusion Index (FII)

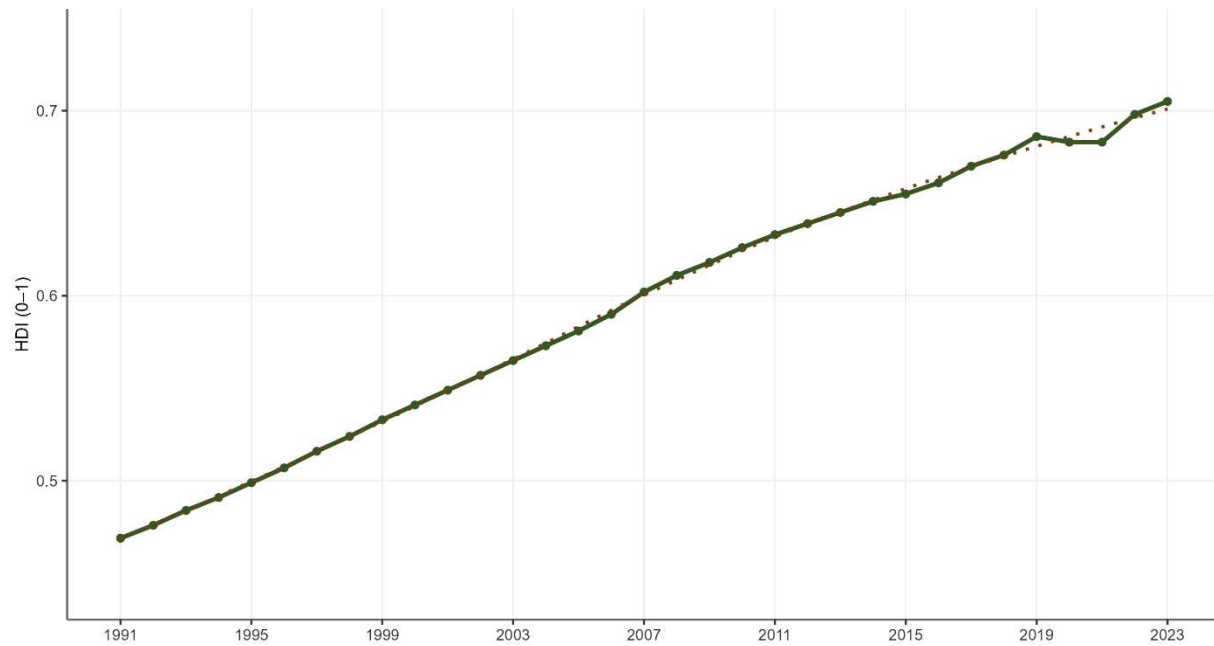


Notes: *FII_base* is the average of normalized private credit_GDP and M2_GDP; *FII_Full* is the first principal component from PCA on six access usage dimensions (96.7% variance explained). Shaded areas (Global financial crisis (GFC) = 2008-2009 and COVID-19= 2020-2021).

Source: Author's calculations.

The correlation of $r = 0.985$ between the two IIF specifications over the common period 2004–2023 attests that both indices measure the same latent phenomenon, which validates the basic specification as a proxy representative of Moroccan financial inclusion over a long period. Figure 2 shows the evolution of HDI over the same period. The trajectory is remarkably steady, rising almost linearly from 0.469 in 1991 to 0.705 in 2023, a cumulative increase of 50.3%, with two notable exceptions. The first is a slight inflection in 2020, owing to the pandemic's health and economic effects on life expectancy and income. The second is a slight acceleration visible from 2019, which could reflect the delayed consequences of the financial deepening phase that began a decade earlier.

Fig 2. Human Development Index (HDI)

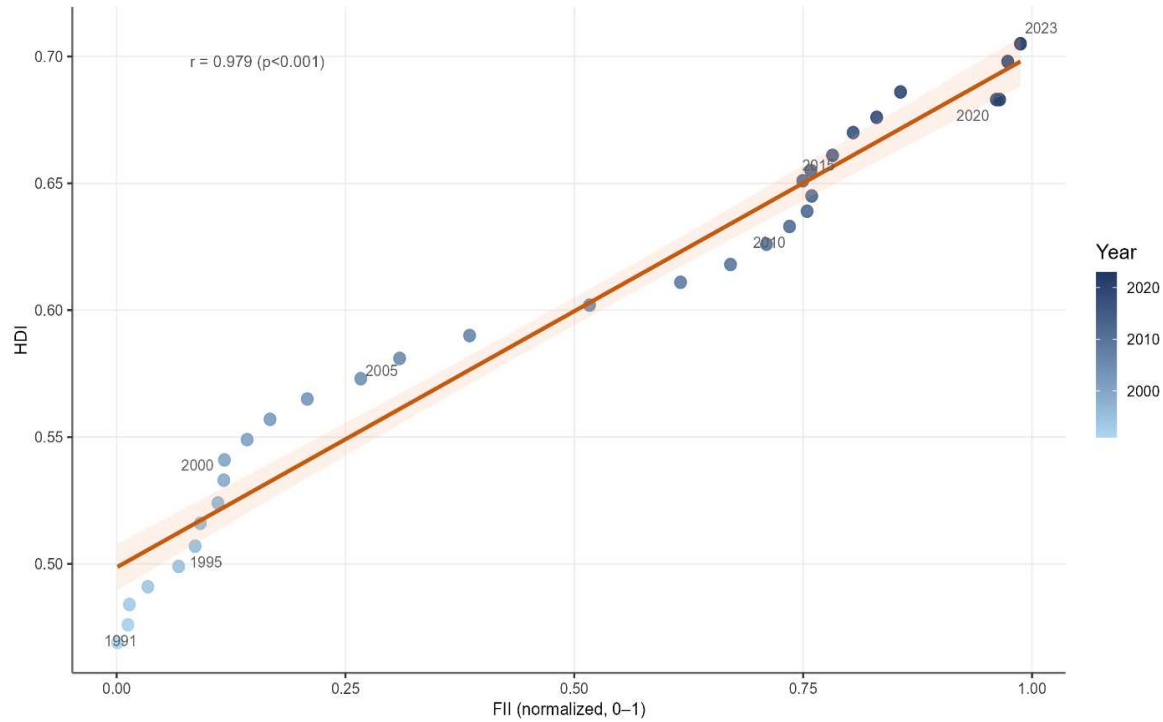


Source: HDI increased by 50.3% over the period (0.469 in 1991 to 0.705 in 2023). Dotted line = LOESS trend.

Source: Author's calculations.

Figure 3 additionally appears at the raw relationship between the IIFBase and the HDI. Indeed, the Pearson correlation reaches $r = 0.979$ ($p > 0.001$), and the dot plot demonstrates a near-perfect positive connection, with the color gradient reflecting the chronological evolution from 1991 (light blue) to 2023 (dark blue). However, this bivariate association is insufficient to infer a causal influence. However, it integrates the impact of financial inclusion with factors common to all emerging economies throughout the period, especially growth in per capita income. It is precisely to disentangle these impacts that the multivariate econometric analysis laid out in the following sections is required.

Fig 3. Financial Inclusion Index vs HDI

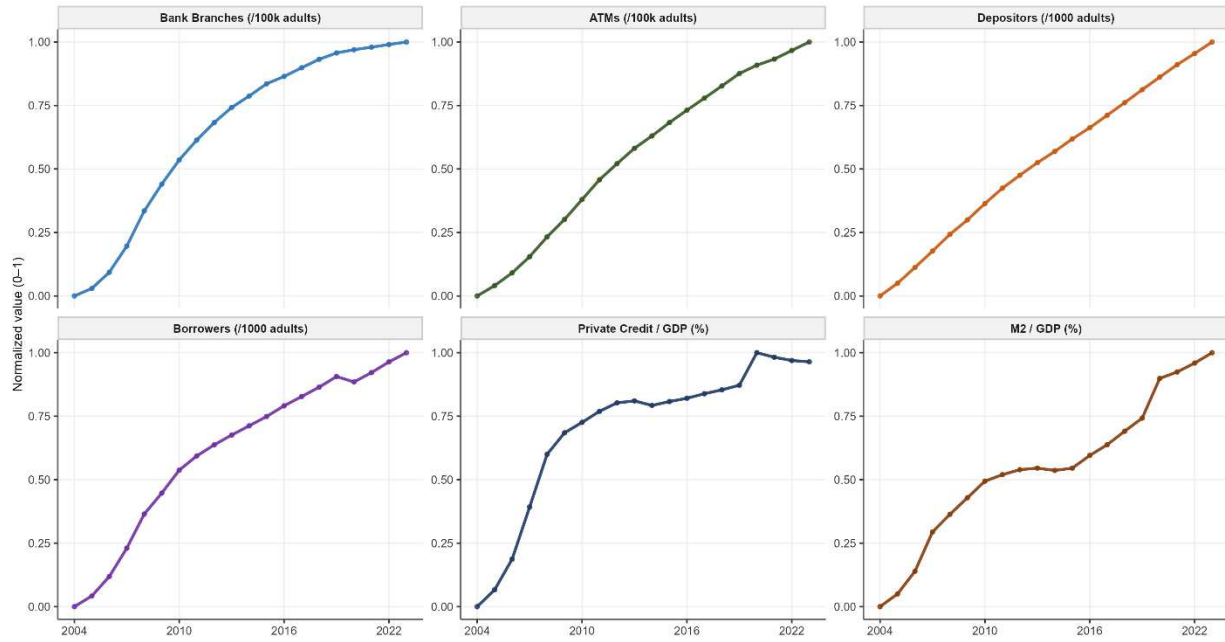


Note: OLS fitted line with 95% confidence interval. Color intensity reflects time progression.

Source: Author's calculations.

Figure 4 eliminates the six constituent dimensions of FIIFull over the 2004–2023 subperiod. A remarkable result is that the expansion of physical infrastructure, agencies, and vending machines precedes by about five years the increase in actual service use, measured by the number of depositors and borrowers per thousand adults. This time lag between access and use is consistent with the theory of the gradual adoption of formal financial services in middle-income economies (Demirgüç-Kunt et al., 2018), and it reflects the existence of non-physical barriers, financial illiteracy, cultural mistrust, and maladaptation of products, which the mere densification of the banking network is not enough to overcome. The co-evolution of the six dimensions, whose first main axis explains 96.74% of the total variance, justifies the construction of a composite index and validates the relevance of the PCA approach used in this study.

Fig 4. FII sub-components



Note: All six dimensions normalized to (0, 1) for cross component comparability.

Source: Author's calculations.

4.2 Unit Root Tests and Cointegration Results

Table 2, presented in the section (Estimation strategy), confirms that all the series selected are non-stationary in level and stationary in first differences at the 1% threshold, except for one result from the Phillips-Perron test, which rejects the unit root of $\ln(\text{FII})$ in level, a sign of long-memory behavior or a regime transition rather than strict first-order integration. This finding is compatible with the structural failure discovered in 2006 by the Zivot and Andrews (1992) test on the $\ln(\text{FII})$ series and does not dispute the application of the ARDL test by the limits, whose validity is exactly assured for regressors with mixed or unknown integration order. The lack of notable breaks on $\ln(\text{IDH})$ and $\ln(\text{GDPpc})$ demonstrates that these two series follow a steady deterministic trend across the whole time.

Table 3 indicates the results of the ARDL model. Indeed, the F statistic of the cointegration test by the bounds reaches 4.454 ($p = 0.026$), exceeding the upper bound $I(1)$ at the 5% threshold for $k = 4$ regressors. The null hypothesis of no long-term relationship between financial inclusion, human development, and control variables is therefore rejected.

Table 3. ARDL résultats (dynamiques et cointégration)

Variable	Coeff.	Std. Err.	t-stat.	p-value
<i>Panel A — Error Correction Term and Long-Run Level Variables</i>				
ECT [L(HDI, 1)]	−0.1507	0.0986	−1.529	0.140
L(FII, 1)	0.0022	0.0030	0.748	0.462
L(ln GDPpc, 1)	0.0578	0.0496	1.166	0.256
L(Trade, 1)	−0.0001	0.0003	−0.247	0.807
L(Inflation, 1)	0.0009	0.0005	1.642	0.115
<i>Panel B — Short-Run Dynamics (first differences)</i>				
Δln(FII)	−0.0031	0.0040	−0.796	0.435
Δln(GDPpc)	0.1369	0.0518	2.641	0.015**
ΔTrade	−0.0001	0.0003	−0.424	0.675
ΔInflation	0.0010	0.0005	1.805	0.085*
Constant	−0.5279	0.4346	−1.215	0.237

Notes: Long-run coefficients computed as $\beta_{LR} = -\frac{\theta_X}{\theta_{ECT}}$ from the unrestricted ECM (UECM).

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Source: Author's calculations.

This result establishes the existence of a sustainable structural balance between the variables in the model, converging with the study of Thathsarani et al. (2021) for South Asia and Matekenya et al. (2021) for Sub-Saharan Africa, which study similar cointegrating relationships between financial inclusion and human capital. However, the short-term dynamics reveal an outcome that deserves special attention. The error correction term is negative (ECT = −0.151) but remains nonsignificant at the 10% threshold ($p = 0.140$). This result means that the adjustment pace towards the long-term equilibrium is sluggish and difficult to estimate precisely with thirty-three annual observations.

This reluctance is not unusual. The channels through which financial inclusion enhances human development, progressive poverty reduction, accumulation of human capital, and improved coverage of health hazards operate over a ten-year horizon, well beyond the annual cycles that time series methods are designed to capture. Only per capita GDP growth ($\Delta \ln(GDPpc) = 0.137$; $p = 0.015$) has an immediate and robust effect on the short-term HDI, a result consistent with inclusive growth models according to which income dynamics precede and condition human development progress (Datta and Singh, 2019).

Moreover, the long-term coefficients provide more substantial insights. The coefficient associated with the IIF is 0.0147, which indicates that a 10-point increase in the normalized index is associated with a 0.15% increase in the long-term HDI. Related to the total progression of the IIFBase over the period from 0 to 0.99 points, this coefficient entails a cumulative contribution to the HDI of about 0.15 points, or about 64% of the total increase in the HDI observed over the thirty-three years. The robustness of this positive sign is confirmed by the estimators FM-OLS (0.093) and D-OLS (0.121), whose higher amplitudes reflect the correction of endogeneity and serial correlation biases that the ARDL model only imperfectly neutralizes.

4.3 Asymmetric analysis (NARDL model)

Table 4 provides the results of the NARDL estimation. Examination of the Wald tests leads to a result that deserves cautious discussion. Neither the long-term symmetry ($\chi^2 = 0.014$; $p = 0.993$) nor the short-term symmetry ($\chi^2 = 0.734$; $p = 0.693$) is refuted. The long-term coefficients $\tilde{\beta}^+$ and $\tilde{\beta}^-$ exhibit opposite signs (-0.00041 and $+0.01593$, respectively), but neither is statistically distinguishable from zero, so the positive and negative shock decomposition does not produce an operable result. The symmetrical ARDL model is thus the most parsimonious and appropriate representation of the relationship between financial inclusion and human development in the Moroccan case.

Table 4. Résultat asymétrique du modèle NARDL

Variable	Coeff.	Std. Err.	t-stat.	p-value
Constant	-0.44152	0.34383	-1.284	0.212
L(HDI, 1)	0.87883	0.08326	10.556	0.000***

L(FII ⁺ , 1)	0.00036	0.00314	0.114	0.911
L(FII ⁻ , 1)	-0.01400	0.24636	-0.057	0.955
L(ln(GDPpc), 1)	0.04808	0.03738	1.286	0.211
Δ (FII ⁺)	-0.00413	0.00533	-0.774	0.447
Δ (FII ⁻)	0.15095	0.33145	0.455	0.653
Δ ln(GDPpc)	0.12988	0.03343	3.885	0.001***
Adj. R ² = 0.999 F-stat. = 4055.8 S.E. = 0.00375				
Asymmetry tests: Wald LR ($\beta^+ = \beta^-$): $\chi^2 = 0.014$, p = 0.993 Wald SR ($\delta^+ = \delta^-$): $\chi^2 = 0.734$, p = 0.693 $\tilde{\beta}^+ = -0.00041$ $\tilde{\beta}^- = +0.01593$ Bounds F(NARDL) = 3.728 (p = 0.104)				

Notes: FII⁺ (cumulative sum of positive changes in ln (FII)), FII⁻ (cumulative sum of negative changes), ***p<0.01.

Source: Author's calculations.

This symmetry conclusion separates the Moroccan example from some scenarios with more financial volatility. Abdelghafar, Emam, and Samak (2022) show asymmetric impacts in various MENA nations where periods of financial contraction create disproportionate harm to human development compared to the advantages associated with corresponding expansions. In Morocco, by comparison, the trajectory of financial inclusion has not suffered any equivalent dramatic interruption. However, the growth of the IIF is supported by ongoing governmental policies since the reforms of the late 1990s, without any incident of unexpected reversal. This regularity primarily explains the lack of apparent asymmetry.

Thus, the findings demonstrate that the routes via which financial inclusion increases HDI, human capital accumulation, progressive poverty reduction, and enhanced access to health care are cumulative processes and not readily reversed in the near term. Unlike income effects, which may react symmetrically to liquidity shocks, these processes accrue slowly and do not reverse rapidly, even during financial contraction. Sarma and Pais (2011) presented a similar point in their worldwide comparative study. Indeed, the symmetry of the impacts of financial inclusion on human development would be indicative of nations where the institutional framework is sufficiently robust such that accumulated gains are not wiped out by cyclical downturns.

4.4 Banking soundness, financial efficiency and causality

Table 5 illustrates the findings for the H2, H3, and H4 hypotheses. The findings demand a distinct interpretation according to the hypothesis. On bank strength, the result of the H2a hypothesis is the clearest. The contemporary coefficient of the IIF on the ratio of outstanding debts is strongly negative and significant. The broadening of the banking client base diversifies the credit portfolio and improves the selection of borrowers, thus reducing the concentration of risk. mechanism theorized by Beck et al. (2007) and empirically found in studies on Sub-Saharan Africa. (Matekenya et al., 2020). However, the cointegration test does not confirm a long-term relationship between the IIF and the NPL. This credit risk reduction effect is therefore cyclical, rooted in short-term diversification and learning mechanisms, rather than structurally embedded in a long-term equilibrium. This fragility calls for prudential vigilance: the effect can be quickly reversed if credit expansion to unbanked segments is not accompanied by an appropriate risk-rating framework (Lim et al., 2020).

Table 5. Financial soundness, efficiency and causality

<i>Panel A. ARDL Results for H2 (Financial Soundness) and H3 (Financial Efficiency)</i>				
Hypothesis	Dep. variable	FII coeff. (t-stat.)	L(FII,1) coeff. (t-stat.)	Bounds F (p-value)
H2a:	NPL (%)	−28.242**	29.090**	0.318 (0.981)
FII→NPL		(−3.80)	(3.86)	
H2b:	Bank capital (%)	−5.247***	3.531**	3.807 (0.132)
FII→Capital		(−4.85)	(3.13)	
H3a:	Spread (%)	−3.335**	2.702*	1.018 (0.857)
FII→Spread		(−3.15)	(2.54)	
H3b:	ROA (%)	1.072	−1.573*	7.760 (0.002)
FII→ROA		(1.76)	(−2.78)	
<i>Panel B. Toda-Yamamoto Granger Causality Tests (H4)</i>				
Hypothesis	Null hypothesis	F-stat.	d.f.	p-value
H4 dir. 1	FII does not Granger-cause HDI	1.521	(20)	0.172

H4 dir. 2	HDI does not Granger-cause FII	1.124	(20)	0.372
Control	GDPpc does not Granger-cause HDI	1.936	(20)	0.072

Note: All models: ARDL (1,1,1). H4: VAR(5) – $p = 4$ (AIC) + $d_{max} = 1$, Wald test on first 4 lags only (Toda-Yamamoto procedure). Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Source: Author's calculations.

Regarding the H2b hypothesis, the negative and significant coefficient of the IIF on the solvency ratio calls for a cautious reading. An aggressive financial inclusion policy is stimulating the growth of the bank balance sheet. If this expansion is faster than the accumulation of equity capital, it mechanically compresses the ratio capital/assets phenomenon observed in Morocco between 2005 and 2012, during the most sustained credit phase. The cointegration test lies within the uncertainty zone, signaling a marginal long-term relationship that deserves careful prudential monitoring. This finding is consistent with the study of Morgan and Churchill (2018), who analyze similar short-term effects in low-income economies, and it argues for a gradual increase in capital requirements for exposures to new banking segments.

The most important result on financial efficiency is that of H3b. The cointegration between IIF and ROA is robustly established, but the contemporary coefficient is only marginally significant, while the delay of IIF is negative and significant. This dynamic of immediate deterioration in profitability followed by long-term structural improvement is consistent with the literature on the diffusion of banking technologies in emerging economies. However, initial integration costs (training of agents, product adaptation, digital infrastructure) precede the profitability gains that accumulate as economies of scale materialize (Haddad and Hornuf, 2019). For H3a, the negative coefficient of the IIF on the rate spread confirms that financial deepening compresses intermediation margins. However, this compression is part of a stable long-term equilibrium.

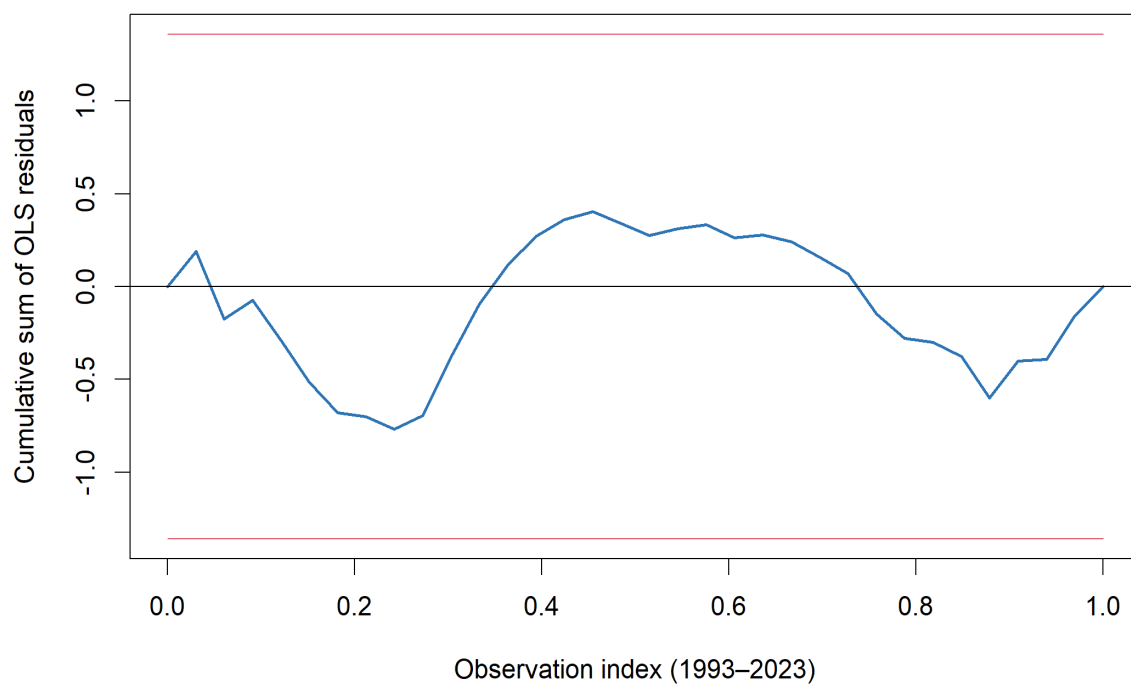
The results of the Toda-Yamamoto causality test (Panel B of Table 5) invalidate the H4 hypothesis of bidirectionality. Neither the relationship (IFI-HDI) nor the feedback (IFI-HDI) is statistically significant at the 10% threshold. Only GDP per capita has a marginally significant causal influence on the HDI. Three factors shed light on this gap compared to panel studies that generally document bidirectionality (Thathsarani et al., 2021; Matekenya et al., 2020). The power of the test is limited by the sample size. 33 observations for a VAR(5) leave few degrees of freedom. The variance

decomposition (FEVD, results available on request) shows that shocks to the IIF explain only 8% to 17% of the forecast variance of the HDI over the four-year horizon, with the remainder attributable to the HDI's own dynamics and income shocks. Finally, the feedback from HDI to IIF could operate on generational horizons. Indeed, the accumulation of human capital and cultural changes in the demand for financial services that the Granger tests, designed to capture short-term antecedents, are not able to detect. (Nanda and Kaur, 2016).

4.5 Parametric stability and robustness

Figures 5 and 6, respectively, present the OLS-CUSUM and CUSUMSQ tests applied to the recursive residuals of the ARDL model over the period 1993–2023. Both statistics remain within the critical bands at 5% over the entire estimation window, leading not to reject the parametric stability assumption.

Fig 5. OLS-CUSUM Parameter stability test

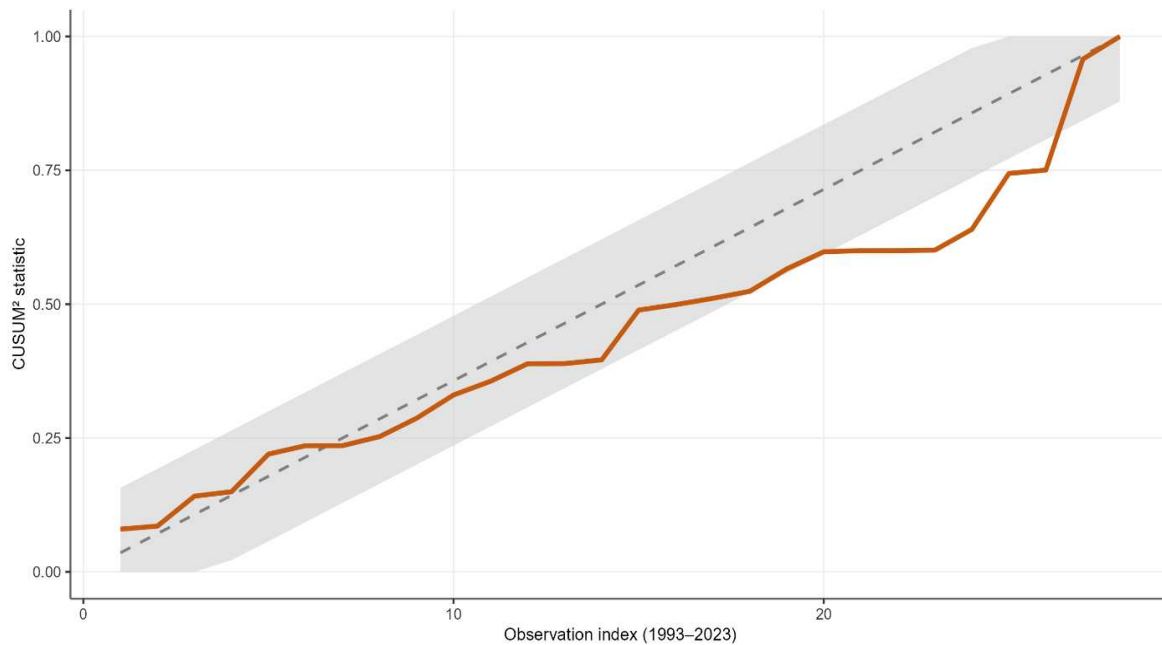


Source: Author's calculations.

The stability of the parameters is all the more notable as it covers three major macroeconomic shocks. However, the global financial crisis of 2008, the reversal of the Moroccan credit cycle in 2013, and the Covid-19 pandemic in 2020. This result argues for the structural and sustainable

nature of the relationship between financial inclusion and human development in Morocco, regardless of cyclical turbulences. Thus, it validates the specification of the model, showing that no parametric break should have been treated by the introduction of a dummy variable or by a change in specification during the period.

Fig 6. CUSUM-Squared stability test



Source: Author's calculations.

The robustness of long-term estimates is also confirmed by the convergence of the three estimators. The positive sign of the IIF coefficient on $\ln(\text{IDH})$ is invariably found in ARDL (0.0147), FM-OLS (0.0934), and D-OLS (0.1214), with increasing amplitudes that reflect the progressive correction of endogeneity bias. The convergence of these three estimators on sign and significance constitutes, in our opinion, the most rigorous validation of the reality of the link between financial deepening and human development in the Moroccan case.

5. Conclusion

At the end of this study, the initial question emerges confirmed in its broad outlines but enriched with nuances that deserve to be carefully presented. Financial inclusion contributes well to human development in Morocco, and not only because the two variables progress simultaneously under the same dynamic of growth. The cointegration test by bounds establishes the existence of a

structural equilibrium relationship between IIF and HDI, independent of common trends, and the estimators FM-OLS (0.093) and D-OLS (0.121) confirm the positive sign by correcting the residual endogeneity that the ARDL model cannot fully neutralize. This result is based on thirty-three years of observation and has been through three episodes of major macroeconomic turbulence the 2008 global financial crisis, the slowdown in the 2013 credit cycle, and the COVID-19 pandemic, and is resistant to changes in estimation methods. However, in the case of Morocco, there is something structural and sustainable about the link between financial deepening and human development.

This relationship operates on a time horizon that goes far beyond the scope of economic analysis. In the short term, per capita income growth is what drives the HDI, not financial inclusion. The term "error correction," negative but not significant, indicates a slow and difficult-to-identify adjustment with thirty-three annual observations. This slowness is not a statistical artifact. However, it reflects the nature of transmission channels, gradual accumulation of human capital, and progressive reduction of poverty, which produce their effects on the HDI only at the decade scale. This finding calls for caution when considering studies that conclude on the immediate effects of financial inclusion on human well-being. Indeed, these exist, but they assume an incubation time that short annual series generally do not allow to capture.

The NARDL framework leads to a somewhat unexpected outcome. The effects of financial inclusion on the HDI in Morocco are symmetrical; none of the Wald tests allows rejecting the hypothesis of linearity, neither in the long term nor in the short term. This symmetry distinguishes the Moroccan case from contexts with higher financial volatility, where recent studies document marked asymmetric effects in favor of positive shocks (Abdelghafar et al., 2022). It is likely to be explained by the regularity of Morocco's financial inclusion trajectory, a progression supported by continuous public policies since the reforms of the 2000s, without any episode of sharp contraction, and by the very nature of transmission channels to the HDI, whose cumulative nature makes the effects insensitive to short-term reversals. For policymakers, these results suggest that a temporary credit slowdown or partial decline in banking access is unlikely to produce irreversible damage to human development, provided the long-term trajectory remains intact.

With regard to the financial system, the results provide an original insight into two dimensions rarely studied in conjunction with human development. On the strength side, financial inclusion

significantly reduces the ratio of short-term claims, an effect of portfolio diversification empirically documented in Morocco for the first time in this study, but this reduction is not structurally anchored in a long-term equilibrium, which makes it potentially reversible if the quality of credit instruction deteriorates. The simultaneous pressure on solvency ratios merits close prudential attention. On the efficiency side, the compression of the interest rate spread confirms that financial deepening reduces the intermediation rent, while the long-term relationship between the IIF and the ROA, robustly established by the cointegration test, indicates that financial inclusion improves structural banking profitability, despite the initial integration costs that produce a characteristic short-term J dynamic. Finally, the absence of Granger's causality in the sense of Toda and Yamamoto (1995) invites us to put into perspective the models that postulate an immediate feedback from human development towards financial inclusion. However, this feedback may exist, but it operates over a longer time horizon than our data allow to capture.

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