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Leveraging fintech mobile money to expand banks' financial services in developing countries

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ABSTRACT

Mobile money consists of payments through mobile devices using Fintech platforms. Despite the accelerated mobile money adoption in developing countries, financial inclusion levels lag those in the developed world. We unveil how disruptive Fintech can foster financial inclusion, by examining a sample of nearly 70,000 observations from 70 emerging countries in 2021. Our results indicate that mobile money and its associated epidemic effects enhance the transition to deposit and credit-based financial services if institutional conditions and banks' financial technologies are well aligned. This suggests that non-banks' Fintechs can facilitate the uptake of financial services provided by conventional banks.

1. Introduction

In developing economies, the proliferation of mobile money (m-money) services from non-banks' Fintech platforms enables safe and quick transfers among the previously unbanked population (Demirgüç-Kunt and Singer, 2017; Lashitew et al., 2019). GSMA (2022) defines m-money as payment services through mobile applications from disruptive Fintech or telecommunication companies, explicitly excluding mobile access to traditional banking. M-money offers an alternative to the unbanked by overcoming the barriers to formal financial inclusion, such as documentation requirements or account fees (Beck et al., 2007; Demir et al., 2022). Its widespread adoption, particularly for internal small remittances (Ahmad et al., 2020; Jack & Suri, 2014), enables transaction recording, transparency, traceability, and familiarity with financial services, potentially integrating the unbanked into the formal financial system (Aron, 2018).

Despite the global m-money revolution, with 5.2 billion mobile users (GSMA 2022), financial inclusion in developing economies still lags behind the rates in the developed world (World Bank, 2021). Financial inclusion -or access to valuable and affordable financial services provided by incumbents (Dermigüç-Kunt et al., 2018)-should be understood broadly, encompassing a wide spectrum of financial services (Ahmad et al., 2020; Arun and Kamath, 2015) from deposits to credits. The divide in financial inclusion is more pronounced in credit-based financial inclusion (CFIN) compared to deposit-based financial inclusion (DFIN) (World Bank, 2021), which represents the initial stage of financial inclusion (Fig. 1). This uneven progression may obey to easier credit through informal channels or to banks' risk aversion, which is problematic since access to formal credit (CFIN) mitigates reliance on predatory lending (Donovan, 2012). In addition, a deeper financial system is crucial for efficient capital allocation and welfare (Levine, 2005).

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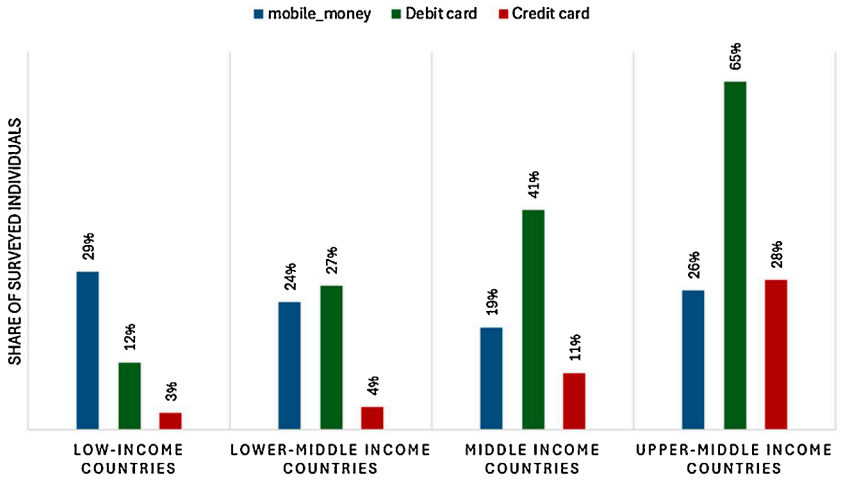

Mean and t-test for selected financial inclusion indicators

Indicator	Condition	Low income	Lower-middle income	Middle income	Upper-middle income
Debit card	With *m-money*	22.90%	39.99%	66.13%	71.54%
	Without *m-money*	8.01%	21.09%	29.70%	41.15%
	Difference	14.89%	18.90%	36.42%	30.38%
	Diff ≠0 (p-value)	0.000	0.000	0.000	0.000
Credit card	With *m-money*	7.14%	8.95%	22.15%	37.75%
	Without *m-money*	1.48%	2.60%	6.37%	14.01%
	Difference	5.67%	6.34%	15.78%	23.74%
	Diff ≠0 (p-value)	0.000	0.000	0.000	0.000

Fig. 1. M-money and financial inclusion across countries.
Note: Average for selected financial inclusion indicators (source: Global Findex 2021). Country classification based on their GDP per capita quartile position within the sample

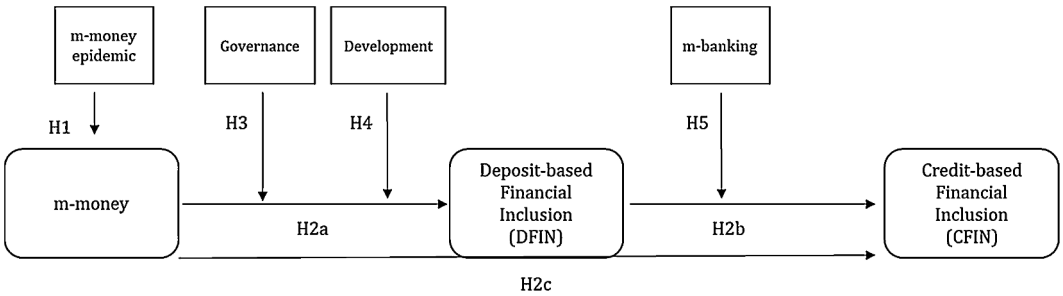

Fig. 2. Theoretical framework.

A growing stream of literature analyzes the drivers of m-money (Kabengele & Hahn, 2021) and its implications for financial inclusion (see Ahmad et al., 2020 for a review). However, research has not examined the role of Fintechs' m-money as a precursor of deeper formal financial inclusion, in a progressive transition from m-money to DFIN and, ultimately, to CFIN. This implies a gradual adoption of a plethora of financial services beyond the basic ones and a potential synergistic effect between disruptive Fintechs and conventional banks in fostering extended financial inclusion. We present empirical evidence for a sample of approximately 70,000 observations across developing economies worldwide, expanding the scope of research beyond Africa, home of most studies on m-money (Ahmad et al., 2020; Demir et al., 2022). We find that mobile money exerts a direct positive effect on DFIN and an indirect impact on CFIN. These findings deepen our understanding of the role of Fintechs' m-money as a precursor of further formal financial inclusion.

2. Literature review and hypotheses development

Fig. 2 shows the theoretical framework that we develop next.

2.1. Mobile money and epidemic effects

Epidemic effects refer to the spread of behaviors and practices through social interactions, where technology adoption occurs as individuals observe and imitate others within their social networks (Adaba and Ayoung, 2017; Della Peruta, 2018).[1] That is, the widespread diffusion and utilization of a given technology within a community can create a ripple effect, encouraging its adoption (Dahlke et al., 2024). Prior research has shown that epidemic effects are crucial in fostering acceptance of technological innovations, particularly in low-income groups (Foster and Heeks, 2013). In the context of m-money, epidemic effects capture the social mechanisms -such as familiarity, trust, and social learning-, that drive its spread and adoption. Nonetheless, other factors like convenience, safety, and reduced transaction costs may also contribute to its adoption (Jack & Suri, 2014). We argue that m-money epidemic effects promote m-money use and adoption, since individuals realize the benefits of m-money through its extended social acceptance, fostering trust and familiarity.

H1. M-money epidemic effects enhance m-money adoption.

2.2. From m-money to progressive financial inclusion

Since finance builds on trust (Xu, 2020), we argue that the use of Fintechs' m-money by the unbanked can foster trust in the financial system. Trust is built by using simple products -like mobile payments- that lower risk perceptions and encourage access to formal finance such as DFIN. In turn, DFIN can help build trust and confidence in formal financial services (Cihak et al., 2016), often lacking in most emerging economies. This can encourage individuals to explore and use broader financial services, such as investment products, insurance, and credit, thus enhancing CFIN. Moreover, m-money generates a digital record of transactions, which facilitates creating histories and credit scores (Aron, 2018), easing the inclusion in formal finance.

H2a. M-money positively influences DFIN.

H2b. DFIN positively influences CFIN.

H2c. M-money indirectly influences CFIN through DFIN.

2.3. Moderating role of institutions and mobile banking

Following the 'institutions-based trust' line of thought (Zucker, 1986), we argue that deepening relationships with banks through DFIN requires confidence in the overall institutional context. Solid and trustable institutions and transparent and effective regulations can ensure banks' security and integrity, thereby promoting the transition to financial inclusion. Qualifying the m-money-financial inclusion channel with these blocks of institutional conditions is critical to understand the enabling factors that allow further steps towards formal finance (Ahmad et al., 2020).

H3. Governance strengthens m-money positive influence DFIN.

H4. Development strengthens m-money positive influence on DFIN.

Financial technologies from traditional banks such as mobile banking (m-banking) may strengthen the transition from DFIN to CFIN. In contrast to Fintechs' m-money, m-banking refers to electronic services offered by banks (Gomber et al., 2017). Thus, m-banking differs from m-money in terms of the service provider, its regulation under banking laws, and the wider range of products it offers (Ahmad et al., 2020). The use of m-banking fosters trust in a broad spectrum of financial services by providing users with digital financial tools that are perceived as secure and trustable (Beck et al., 2007). Moreover, m-banking integrates payments, savings and credit services within a single platform, enhancing awareness and facilitating the transition from DFIN to CFIN. As a result, we hypothesize that m-banking can strengthen the transition from DFIN towards a full spectrum of financial services, including CFIN.

H5. M-banking strengthens the positive influence of DFIN on CFIN.

3. Empirical approach

3.1. Sample

We gather financial inclusion and m-money data from the Global Findex World Bank's database, a cross-section household survey

[1] Unlike epidemic effects, network effects refer to the economic benefits derived from the size of a user base or network, which influences an individual's decision to adopt a technology. In telecommunications, network effects often manifest as cost savings that arise when individuals select the same mobile operator, lowering call and text charges within the network (Grzybowski, 2015). This creates a feedback loop where a large customer base leads to lower pricing (Ahmad et al., 2020). However, since our study focuses on the social mechanisms driving the popularity of m-money, we adopt the concept of epidemic effects.

(+15-years old). Our main model focuses on the 2021 survey, which include m-money accounts and urban/rural distinction. For robustness checks at country-level, we use the 2014, 2017, and 2021 waves. Our sample consists of nearly 70,000 individual observations across 70 emerging countries worldwide.[2]

3.2. Variables

Data sources, descriptive statistics, reliability estimates, and correlations are presented in Table 1. Our main financial inclusion variables, DFIN and CFIN, are built from individual financial indicators using principal component analysis. For details on variables construction refer to Supplementary Material - Variables.[3]

3.3. Methods

We apply different methods given the different nature of our dependent variables. As *m-money* and the components of DFIN and CFIN are binary variables, we use probit models to estimate the probability of an individual using each financial service. For continuous dependent variables -DFIN and CFIN- we rely on OLS with country fixed effects. To simultaneously estimate all equations in the model and capture direct, indirect and total effects, we conduct a Structural Equation Modelling (SEM). Finally, we run robustness checks with instrumental variables to control for endogeneity, as well as estimations with country-averages to incorporate fixed and random effects, lags, and a falsification test.

4. Results

4.1. Probit and OLS results

We estimate the drivers of *m-money* through probit models. Results in Table 2 show a positive and significant role of *epidemic effects* in driving *m-money* adoption as predicted by hypothesis 1 (β=0.618 in Model 2), with young, males, educated, and higher-income individuals more prone to adopt *m-money*.

Table 3 shows estimations for *DFIN* drivers. Consistent with hypothesis 2a, *m-money* is a significant driver for each *DFIN* component (Models 3–5) and for the overall *DFIN* (Model 6). The interactions *m-money*GOV* and *m-money*DEV* show positive and significant relationships with *DFIN* (β= 0.53 and β= 0.274, respectively in Model 6), denoting that the conversion of *m-money* usage into *DFIN* is strengthened by a sound institutional setting, supporting hypotheses 3 and 4. The effect of *m-money* on DFIN is stronger for older, richer, more educated, and male individuals.

Turning into *CFIN* drivers, results in Table 4, suggest a positive effect of *DFIN* on its individual components (Models 7–9) and on the construct (Model 10), verifying Hypothesis 2b. The coefficient of *DFIN*m-banking* (β =0.122) indicates that *m-banking* plays a significant moderating role in the *DFIN—CFIN* relationship, in line with hypothesis 5. That is, financial technologies reinforce financial sophistication once the basic financial services have been adopted. The effect of *DFIN* on *CFIN* is more relevant in individuals with higher income, educated, and males.

4.2. SEM results

To estimate the complete system of equations under a same routine, we run the baseline models under the SEM approach. Estimates for Model 11 (Table 5) present direct, indirect, and total effects that, in most cases, are significant at the 0.01 level. The structural model presents a good fit as indicated by the comparative fit index (CFI) and the root mean square of approximation (RMSEA) tests.

Focusing on the total effects, results reveal a significant and positive impact of *Epidemic* in driving indirectly *DFIN* (β= 0.053) and *CFIN* (β= 0.018). This confirms that *DFIN* mediates the relationship between *m-money* and *CFIN* in accordance with hypothesis 2c (β= 0.022 for the total effect from *m-money* to *CFIN*).

4.3. Robustness checks

We develop several robustness tests to address potential concerns on reverse causality between *m-money* and *DFIN*. We conduct instrumental variables (IV) estimations, treating *m-money* as endogenous (Table 6). We select two different instruments for *m-money*.

First, we use *Epidemic* (Model 12). The under identification and weak identification tests suggest that the instrument is very strong, and the effects of *m-money* on *DFIN* are verified. However, as the system is exactly identified, we were unable to assess the instrument's exogeneity. Additionally, critiques about using group averages as instruments (Betz et al., 2018), require complementing this estimation with another set of instruments.

As a second set of instruments, we rely on country-level mobile market indicators that should correlate with *m-money* adoption but not directly with financial inclusion. Specifically, 3 G coverage and competition intensity measured by the Herfindahl-Hirschman Index, both 5-year lagged to further ensure exogeneity. Given their collinearity with the country fixed effects, we interact them

[2] See country sample here.
[3] Downloadable here.

Table 1
Descriptive statistics and correlations (Cronbach's alpha in brackets).

Variable	Description	Source	Mean	St. Dv.	Min	Max	DFIN	CFIN	DEV	GOV	Internet	m-money	Epidemic	m-banking	Transfers	Income	Education	Age	Male
DFIN	Construct measured through: (i) having a bank account, (ii) owning a debit card, and (iii) having used it.	Global Findex	−0.516	1.433	−1.835	1.721	(0.870)												
CFIN	Construct measured through: (i) having a credit card, (ii) having used it, and (iii) having borrowed money from a financial institution.	Global Findex	0.000	1.434	−0.831	4.187	0.427***	(0.789)											
DEV	Construct measured through: (i) GDP per capita and (ii) Labor Productivity	World Bank	−0.742	0.606	−1.496	0.972	0.409***	0.228***	(0.890)										
GOV	Construct measured through: (i) rule of law, (ii) regulatory quality, (iii) political stability, (iv) voice & accountability, (v) government effectiveness, and (vi) corruption control	World Bank	−1.176	1.355	−5.039	2.256	0.273***	0.128***	0.461***	(0.968)									
Internet	Binary variable: 1 for those who declare having internet access	Global Findex	0.618	0.486	0	1	0.395***	0.226***	0.355***	0.201***									
m-money	Binary variable: 1 for those who declare having a m-money account	Global Findex	0.242	0.428	0	1	0.251***	0.217***	−0.033***	0.055***	0.196***								
Epidemic	Own elaboration taking average value for m-money adoption by group of age, income, education, country, and gender.	Global Findex	0.214	0.250	0	1	0.078***	0.072***	−0.153***	0.021***	0.087***	0.504***							
m-banking	Binary variable: 1 for those who declare using mobile or internet to access bank account.	Global Findex	0.241	0.428	0	1	0.641***	0.418***	0.312***	0.176***	0.361***	0.405***	0.190***						
Transfers	Binary variable: 1 for those who declare receiving a government transfer or pension in an account	Global Findex	0.103	0.304	0	1	0.272***	0.118***	0.191***	0.118***	0.126***	0.190***	0.079***	0.230***					
Income	Scale 1–5 accounting for within-country household income quintile	Global Findex	3.234	1.425	1	5	0.205***	0.128***	−0.013***	0.011***	0.203***	0.165***	0.243***	0.192***	−0.012***				
Education	Scale 1–3 according to education level	Global Findex	1.816	0.682	1	3	0.431***	0.267***	0.333***	0.149***	0.456***	0.193***	0.233***	0.391***	0.106***	0.264***			
Age	Age of the individual.	Global Findex	37.849	16.028	15	99	0.086***	0.030***	0.179***	0.142***	−0.144***	−0.124***	−0.189***	−0.057***	0.049***	−0.009***	−0.078***		
Male	Binary variable: 1 if the individual is male.	Global Findex	0.458	0.498	0	1	0.098***	0.070***	0.018***	−0.000	0.087***	0.080***	0.113***	0.081***	−0.009***	0.092***	0.068***	0.001	
Rural	Binary variable: 1 if the individual lives in a rural area.	Global Findex	0.439	0.496	0	1	−0.132***	−0.034***	−0.171***	−0.038***	−0.216***	−0.026***	0.026***	−0.094***	−0.015***	−0.168***	−0.227***	−0.003	0.008**

Note:
** $p < 5\%$.,
*** $p < 1\%$.

Table 2
Results for m-money drivers.

Dependent variable:	Model 1 *m-money*	Model 2 *m-money*
Epidemic	2.801***	0.618***
	[0.027]	[0.048]
Internet	0.426***	0.642***
	[0.014]	[0.016]
Rural	−0.022*	−0.092***
	[0.013]	[0.014]
Age	−0.004***	−0.002***
	[0.000]	[0.000]
Income	0.010**	0.081***
	[0.005]	[0.005]
Education	−0.101***	0.245***
	[0.012]	[0.015]
Male	0.048***	0.119***
	[0.013]	[0.013]
Transfers	0.703***	0.923***
	[0.023]	[0.026]
Country Fixed Effects	NO	YES
Observations	65,562	60,953
R-squared	0.269	0.302
Estimation method	Probit	Probit

Note: Robust standard errors in brackets.
* $p < 10\%$.,
** $p < 5\%$.,
*** $p < 1\%$.

Table 3
Results for the transition from m-money to deposit-based financial inclusion.

Dependent variable:	Model 3 *Account*	Model 4 *Debit*	Model 5 *Debit use*	Model 6 *DFIN*
m-money	0.402***	0.437***	0.692***	0.212***
	[0.016]	[0.018]	[0.022]	[0.065]
m-money x DEV				0.274***
				[0.036]
m-money x GOV				0.053***
				[0.012]
m-money x Rural				−0.002
				[0.021]
m-money x Age				0.002**
				[0.001]
m-money x Income				0.055***
				[0.007]
m-money x Education				0.153***
				[0.018]
m-money x Male				0.046**
				[0.020]
Internet	0.440***	0.466***	0.414***	0.327***
	[0.014]	[0.016]	[0.021]	[0.009]
Rural	−0.108***	−0.135***	−0.141***	−0.076***
	[0.013]	[0.015]	[0.019]	[0.009]
Age	0.012***	0.011***	0.004***	0.007***
	[0.000]	[0.000]	[0.001]	[0.000]
Income	0.090***	0.113***	0.124***	0.066***
	[0.004]	[0.005]	[0.007]	[0.003]
Education	0.389***	0.433***	0.393***	0.277***
	[0.011]	[0.012]	[0.016]	[0.009]
Male	0.127***	0.156***	0.120***	0.085***
	[0.012]	[0.013]	[0.017]	[0.009]
Transfers	1.315***	0.442***	0.227***	0.591***
	[0.033]	[0.025]	[0.029]	[0.018]
Country Fixed Effects	YES	YES	YES	YES
Observations	62,485	62,015	61,985	63,734
R-squared	0.263	0.286	0.338	0.384
Estimation method	Probit	Probit	Probit	OLS

Note: Robust standard errors in brackets.
** $p < 5\%$.,
*** $p < 1\%$.

Table 4
Results for the transition from deposit-based financial inclusion to credit-based financial inclusion.

Dependent variable:	Model 7 *Credit*	Model 8 *Credit use*	Model 9 *Borrow*	Model 10 *CFIN*
DFIN	0.530***	0.517***	0.161***	0.089***
	[0.009]	[0.010]	[0.005]	[0.022]
DFIN x m-banking				0.122***
				[0.019]
DFIN x Rural				−0.004
				[0.009]
DFIN x Age				0.000
				[0.000]
DFIN x Income				0.013***
				[0.003]
DFIN x Education				0.016**
				[0.007]
DFIN x Male				0.025***
				[0.009]
m-banking				0.405***
				[0.023]
Internet	0.193***	0.265***	0.153***	0.049***
	[0.028]	[0.033]	[0.012]	[0.008]
Rural	0.035	0.032	0.068***	0.028*
	[0.023]	[0.026]	[0.011]	[0.015]
Age	−0.001*	−0.001	−0.004***	−0.001***
	[0.001]	[0.001]	[0.000]	[0.000]
Income	0.037***	0.055***	−0.003	0.021***
	[0.008]	[0.009]	[0.004]	[0.005]
Education	0.101***	0.109***	0.006	0.027**
	[0.019]	[0.021]	[0.009]	[0.012]
Male	0.110***	0.103***	0.045***	0.059***
	[0.021]	[0.023]	[0.010]	[0.014]
Transfers	0.116***	0.172***	0.232***	0.129***
	[0.035]	[0.037]	[0.021]	[0.026]
Country Fixed Effects	YES	YES	YES	YES
Observations	65,224	65,220	69,781	66,095
R-squared	0.320	0.326	0.061	0.175
Estimation method	Probit	Probit	Probit	OLS

Note: Robust standard errors in brackets.
* $p < 10\%$.,
** $p < 5\%$.,
*** $p < 1\%$.

Table 5
SEM results on m-money direct, indirect and total effects.

	Model 11						
	Direct Effects			Indirect Effects		Total Effects	
Dependent variable:	*m-money*	*DFIN*	*CFIN*	*DFIN*	*CFIN*	*DFIN*	*CFIN*
Epidemic	0.806***			0.053***	0.018***	0.053***	0.018***
	[0.007]			[0.002]	[0.001]	[0.002]	[0.001]
DFIN			0.335***				0.335***
			[0.011]				[0.011]
m-money		0.066***			0.022***	0.066***	0.022***
		[0.002]			[0.001]	[0.002]	[0.001]
Internet	0.105***	0.069***	0.008***	0.007***	0.025***	0.078***	0.034***
	[0.003]	[0.002]	[0.002]	[0.000]	[0.001]	[0.002]	[0.002]
Rural	−0.011***	−0.010***	0.009***	−0.001***	−0.003***	−0.011***	0.005***
	[0.003]	[0.002]	[0.002]	[0.000]	[0.001]	[0.002]	[0.002]
Age	−0.000***	0.002***	−0.000***	−0.000***	0.001***	0.001***	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Income	0.002**	0.012***	0.004***	0.000**	0.004***	0.013***	0.008***
	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]
Education	−0.021***	0.072***	0.002	−0.001***	0.024***	0.068***	0.026***
	[0.003]	[0.002]	[0.002]	[0.000]	[0.001]	[0.002]	[0.002]
Male	0.007**	0.018***	0.006***		0.006***	0.019***	0.012***
	[0.003]	[0.002]	[0.002]		[0.001]	[0.002]	[0.002]
Transfers	0.211***	0.219***	−0.010*		0.078***	0.234***	0.068***
	[0.008]	[0.004]	[0.006]		[0.003]	[0.004]	[0.006]
Fit statistics							
RMSEA	0.053						
SRMR	0.028						
CFI	0.964						
TLI	0.938						
CD	0.455						
Observations	61,904						

Note: Robust standard errors in brackets.
* $p < 10\%$.,
** $p < 5\%$.,
*** $p < 1\%$.

with an exogenous individual characteristic, age. The rationale is that these instruments affect *m-money* adoption, but their impact varies depending on individual age. Results in Model 13 indicate that the instruments are strong and exogenous. Moreover, in the first step estimation the relevance of the instruments is verified, as increased 3 G coverage and reduced market concentration in combination with younger individuals enhance *m-money* adoption. These results verify the positive effect of *m-money* on *DFIN*.

While the IV estimates should be accurate enough to address endogeneity concerns, our dataset lacks a panel structure. Therefore, we conduct a final robustness check by transforming the individual-level data into country-level averages to allow for a panel structure. We control for unobservable factors through country-level fixed or random effects and introduce lagged *m-money* as explanatory variable to current *DFIN* levels. Results for Models 14 – 18 (Table 7) support the causality direction from *m-money* and *DFIN*, taking as the primary reference the random effects models as supported by the Hausman test. Finally, we conduct a falsification test (Forman et al., 2012) in Models 19 and 20 (Table 7) which reinforces our previous findings.

5. Discussion and conclusions

We empirically analyze whether m-money facilitates a two-step transition to deposit and credit based financial inclusion. This implies understanding financial inclusion within a continuum where customers incorporate additional financial services into their portfolio (Arun and Kamath, 2015).

Our findings suggest that m-money can effectively act as a first step in transitioning towards broader financial inclusion levels, influencing deposit and credit based financial inclusion. These results are robust to different model specifications and consistent across different population clusters based on rural, age, income, education, and gender. We contribute to existing literature on m-money and financial inclusion (Ahmad et al., 2020; Donovan, 2012) by overcoming a major limitation in this field -"its narrow focus on certain financial products" (Demir et al., 2022: 90)-. Thus, we move beyond the binary (being financially included or not) and the unidimensional focus on a single financial product, typically bank accounts (Allen et al., 2016). Our approach captures the transition towards a more intense financial inclusion, encompassing a broader uptake of financial services.

We also contribute to the literature of non-bank financial institutions (Gomber et al., 2017; Hodula, 2021) by analyzing the transitional value of Fintech services in achieving a broader level of financial inclusion. Our findings suggest that buoyant m-money usage can result in widespread adoption of CFIN once DFIN has been achieved, confirming our theoretical arguments on the value of m-money in enhancing trust and familiarity towards formal finance among the unbanked. This perspective implies a synergistic effect

Table 6
Endogeneity control. Results for deposit-based financial inclusion with instrumental variables.

	Model 12		Model 13	
Dependent variable:	*M. Money*	*DFIN*	*M. Money*	*DFIN*
m-money		1.131***		1.435***
		[0.088]		[0.517]
Internet	0.140***	0.210***	0.144***	0.167**
	[0.003]	[0.016]	[0.003]	[0.076]
Rural	−0.026***	−0.056***	−0.029***	−0.047***
	[0.003]	[0.009]	[0.003]	[0.017]
Age	0.000	0.007***	0.000	0.007***
	[0.000]	[0.000]	[0.000]	[0.000]
Income	0.012***	0.060***	0.023***	0.054***
	[0.001]	[0.004]	[0.001]	[0.012]
Education	0.034***	0.262***	0.074***	0.237***
	[0.003]	[0.010]	[0.003]	[0.039]
Male	0.018***	0.069***	0.031***	0.061***
	[0.003]	[0.008]	[0.003]	[0.018]
Transfers	0.244***	0.412***	0.246***	0.340***
	[0.006]	[0.028]	[0.007]	[0.129]
Epidemic	0.360***			
	[0.011]			
3G Coverage x Age			−0.001**	
			[0.000]	
HHI x Age			0.000**	
			[0.000]	
Underidentification test	1007.685***		37.741***	
Weak identification test	1022.318		16.089	
Hansen J statistic	N/A		0.653	
Country Fixed Effects	YES		YES	
Observations	65,029		65,679	
Estimation method	IV-LIML		IV-LIML	

Note: Robust standard errors in brackets. Stock-Yogo weak ID test for critical value 10% maximal LIML size: 16.38.
** $p < 5\%$.,
*** $p < 1\%$.

Table 7
Robustness tests using panel data built from country averages.

Dependent variable:	Model 14 *DFIN*	Model 15 *DFIN*	Model 16 *DFIN*	Model 17 DFIN	Model 18 *DFIN*	Model 19 *DFIN - lag*	Model 20 *DFIN - lag*
Log(m-money penetration)	0.264***	0.251***	0.304***			−0.057	−0.166
	[0.050]	[0.064]	[0.062]			[0.104]	[0.137]
Log(m-money penetration-lag)				0.017	0.255***		
				[0.162]	[0.098]		
Log(Mobile internet penetration)	−0.043	−0.005	−0.040	−1.085	−0.173	−0.328	−0.421
	[0.060]	[0.065]	[0.054]	[0.757]	[0.230]	[0.374]	[0.571]
Population aged 15–64 (%)		−0.027	0.045*	0.010	0.050		0.183
		[0.052]	[0.025]	[0.156]	[0.034]		[0.116]
Population aged >64 (%)		0.020	0.073*	−0.047	0.107**		0.271
		[0.104]	[0.040]	[0.303]	[0.043]		[0.196]
Male population (%)		−0.060	0.059	0.714	0.083*		−0.065
		[0.122]	[0.041]	[0.894]	[0.047]		[0.558]
Log(GDP per capita)		−0.148	0.185	−0.149	0.092		−0.171
		[0.269]	[0.282]	[0.308]	[0.253]		[0.274]
Log(Human Capital)		0.312	0.345	0.291	0.462*		−0.191
		[0.275]	[0.212]	[0.334]	[0.260]		[0.226]
Hausman Test		6.26		4.30		29.54***	16.66**
R-squared	0.416 (within) 0.003 (overall)	0.431 (within) 0.030 (overall)	0.377 (within) 0.631 (overall)	0.284 (within) 0.059 (overall)	0.178 (within) 0.631 (overall)	0.292 (within) 0.209 (overall)	0.382 (within) 0.239 (overall)
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Years included	2014, 2017, 2021	2014, 2017, 2021	2014, 2017, 2021	2017, 2021	2017, 2021	2017, 2021	2017, 2021
Observations	114	114	114	75	75	74	74
Estimation method	OLS Fixed Effects	OLS Fixed Effects	OLS Random Effects	OLS Fixed Effects	OLS Random Effects	OLS Fixed Effects	OLS Fixed Effects

Notes: Robust standard errors in brackets.
* $p < 10\%$.,
** $p < 5\%$.,
*** $p < 1\%$.

of disruptive Fintechs' m-money on formal financial services, both deposit and credit based, which has not been explored yet. We extend the literature on technological diffusion of financial services (Lashitew et al., 2019) suggesting that Fintechs' m-money and its epidemic effects emerge as a financial innovation that can yield broader social outcomes. These findings complement extant research on Fintech influence in mitigating poverty and inequalities through financial inclusion (Demir et al., 2022). Moreover, our results also address the role of sustainable innovations in finance (Forcadell et al., 2020), which could be applied to the rise of recent financial innovations backed by blockchain, such as Non-Financial Tokens (NFTs) (Mavilia and Pisani, 2020).

Our results present important implications for different audiences: banks, since they imply that financial technologies can influence an extended adoption of financial services; newcomers such as Fintechs that can complement traditional incumbents; policymakers aiming to amplify financial inclusion and digital ecosystems to avoid cash reliance, since weak institutional conditions prevent the effect of m-money toward further financial uptake; and the society, that might benefit from increased social cohesion emanated from deeper financial inclusion levels.

CRediT authorship contribution statement

E. Aracil: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Conceptualization. **J. Jung:** Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation. **A. Melguizo:** Writing – review & editing, Validation.

Declaration of competing interest

The authors declare no conflict of interests.

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Data availability

Data will be made available on request.

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