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DIGITAL FINANCIAL INCLUSION: A SILVER BULLET FOR ENTREPRENEURSHIP IN SOUTH MEDITERRANEAN COUNTRIES

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CONTENTS

ABSTRACT

This paper aims to carry out an in-depth analysis of the extent to which digital financial inclusion contributes to boosting entrepreneurship in South Mediterranean countries, namely Algeria, Egypt, Jordan, Morocco, and Tunisia, where entrepreneurs are hallmarked by running into indubitable challenges and more intractable difficulties in accessing finance. The current undertaking has unearthed that digital financial inclusion plays a significantly important role in stimulating entrepreneurial activities in South Mediterranean countries. More specifically, the results provide irrefutable evidence that a mere 1% increase in the digital financial inclusion index has the potential to generate a 5.79% improvement in entrepreneurship in these countries. By the same token, the results gleaned disclosed that entrepreneurship can relentlessly thrive in an environment that guarantees sufficient economic freedom. More interestingly, such results could prove substantially important to policymakers and stakeholders as they clearly show where policy actions to instigate South Mediterranean countries' entrepreneurial activities are most likely to bear fruit.

Keywords: Digital financial inclusion; Entrepreneurship; South Mediterranean countries.

INCLUSION FINANCIÈRE NUMÉRIQUE : UNE SOLUTION MIRACLE POUR L'ENTREPRENEURIAT DANS LES PAYS DU SUD DE LA MÉDITERRANÉE

RÉSUMÉ

Cet article vise à réaliser une analyse approfondie de la mesure dans laquelle l'inclusion financière numérique contribue à stimuler l'entrepreneuriat dans les pays du sud de la Méditerranée, à savoir l'Algérie, l'Égypte, la Jordanie, le Maroc et la Tunisie, où les entrepreneurs sont confrontés à des défis indéniables et à des difficultés particulièrement complexes en matière d'accès au financement.

Cette étude a révélé que l'inclusion financière numérique joue un rôle particulièrement important dans la dynamisation des activités entrepreneuriales dans ces pays. Plus précisément, les résultats fournissent une preuve irréfutable qu'une simple augmentation de 1 % de l'indice d'inclusion financière numérique peut entraîner une amélioration de 5,79 % de l'entrepreneuriat dans ces pays.

Dans le même ordre d'idées, les résultats obtenus montrent que l'entrepreneuriat peut se développer de manière soutenue dans un environnement offrant une liberté économique suffisante. Fait encore plus intéressant, ces résultats pourraient s'avérer particulièrement utiles pour les décideurs politiques et les parties prenantes, car ils indiquent clairement où les actions politiques visant à stimuler l'entrepreneuriat dans les pays du sud de la Méditerranée ont le plus de chances de porter leurs fruits.

الشمول المالي الرقمي: الحل السحري لريادة الأعمال في دول جنوب البحر الأبيض المتوسط

الملخص

يهدف هذا البحث إلى إجراء تحليل معمق لمدى مساهمة الشمول المالي الرقمي في تعزيز ريادة الأعمال في دول جنوب البحر الأبيض المتوسط، وهي الجزائر، مصر، الأردن، المغرب وتونس، حيث يواجه رواد الأعمال تحديات لا يمكن إنكارها وصعوبات أكثر تعقيدًا في الوصول إلى التمويل.

وقد كشفت هذه الدراسة أن الشمول المالي الرقمي يلعب دورًا بالغ الأهمية في تحفيز الأنشطة الريادية في دول جنوب المتوسط. وتحديدًا، تقدم النتائج دليلًا قاطعًا على أن زيادة بنسبة 1% فقط في مؤشر الشمول المالي الرقمي يمكن أن تؤدي إلى تحسن بنسبة 5.79% في ريادة الأعمال في هذه الدول.

وبالمثل، أظهرت النتائج أن ريادة الأعمال يمكن أن تزدهر بشكل مستمر في بيئة تضمن قدرًا كافيًا من الحرية الاقتصادية. والأهم من ذلك، أن هذه النتائج قد تكون ذات أهمية كبيرة لصناع السياسات وأصحاب المصلحة، إذ توضح بجلاء أين يمكن أن تؤتي الإجراءات السياسية الهادفة إلى تنشيط ريادة الأعمال في دول جنوب المتوسط ثمارها المرجوة.

INTRODUCTION

Digital financial inclusion has recently emerged as a novel financial paradigm that is inexorably growing by leaps and bounds. It has been the epicenter of a great deal of attention within the academic community and policy arenas owing to its ability to overcome the antagonistic relationship holding between the traditional, mostly outdated financial systems and entrepreneurship, connect financially underserved and unserved people at the entrepreneurial level, and provide them with easy and affordable access to a plethora of financial services (Ahmad et al., 2021; Holzmann and Gregori, 2023; Yu et al., 2024). In fact, digital financial inclusion integrates the strengths of digital technology into financial services. Hence, it can, when used at a large scale, eradicate all manner of existing time and space stiffening constraints. It can also break down traditional boundaries, serve a broader group of people at a lower cost, and provide a favorable credit environment for entrepreneurship (Song et al., 2024).

On the one hand, thanks to its ability to combine digital payment technology and mobile technology, digital financial inclusion enables marginalized people living in poor, rural, remote, and economically backward areas to readily create bank accounts, access online financial services, and transfer money with utmost ease (Liu et al., 2021; Yang et al., 2022). On the other hand, digital financial inclusion has noticeably minimized the adverse effects of the issues inextricably associated with information asymmetry, which has been one of the main culprits preventing the financing of entrepreneurial projects for years. Individuals having a vested desire to get into entrepreneurial businesses often lack relevant information, such as historical financial data, rendering it incredibly arduous for traditional financial institutions to have a comprehensive understanding of entrepreneurial ventures. This state of affairs often triggers an information asymmetry between entrepreneurs and those institutions that, as an immediate outcome of that, depend virtually entirely on their judgment of the entrepreneur during the decision-making process about extending credit. Stated differently, digital financial inclusion depends on big data, cloud computing, the Internet of Things, artificial intelligence (AI), and digital platforms that use digital footprints, which, in turn, deploy information digestion algorithms to generate shared data and capture the traces and data of borrowers via the Internet, providing thereby more thorough information about them. This ultimately reduces the problem of information asymmetry between lending financial institutions and households and individual borrowers who do not have a credit reference record and who were previously excluded from traditional financing channels. It, by the same token, boosts the number of loans available to them and leads to a significant reduction of transaction costs. All these traits combined remarkably contribute to facilitating the ongoing development of entrepreneurship (Ozili, 2018; Wang et al., 2022; Sun and Xie, 2024).

One of the other widely known praiseworthy trappings of digital financial inclusion is that it has empowered many individuals and households up and down the globe to readily bypass conventional procedures such as mandating a large amount of collateral to mitigate most of the nerve-boggling losses

emanating from information asymmetry and uncertainty regarding the outcomes of entrepreneurial projects due to the high-risk nature of entrepreneurial activities and the comparatively high failure rates of new ventures (Lu et al., 2022; Mao et al., 2023).

The numerous, unique merits offered by digital financial inclusion and their massive role in enhancing entrepreneurship have underpinned the emergence of a wide range of very recent research; the overwhelming bulk thereof has focused primarily on China, such as Yang et al. (2022), Liu et al. (2022), Mao et al. (2023), Wu and Wu (2023), Shao et al. (2023), Tao et al. (2023), Ding et al. (2023), Hu et al. (2023), Song et al. (2024), Yang et al. (2024), Sun and Xie (2024), Li et al. (2024), Yu et al. (2024), and Hao and Zhang (2024). As far as we are aware, there is virtually a complete lack of literature that casts light on the role digital financial inclusion can play in promoting entrepreneurship in South Mediterranean countries. This has led to a major research gap, as these countries still lag behind in terms of both digital financial inclusion and entrepreneurship. According to the World Bank's 2021 Global Findex database, the share of adults who made or received digital payments accounted for 36% in Jordan, 34% in Algeria, 30% in Morocco, 28% in Tunisia, 20% in Egypt, and only 14% in Lebanon. It goes without saying that these percentages pale in comparison to the 97% recorded in the Euro area, as well as the 64% recorded in the world. This massive difference unambiguously reflects the limited use of digital financial services in the southern Mediterranean region (World Bank, 2021). In 2022, the new business density rate (the number of newly registered limited liability firms per 1,000 people in the age group 15-64) reached 2.57 in Morocco, 1.67 in Tunisia, 0.63 in Algeria, 0.4 in Jordan, and 0.27 in Egypt, while it accounted for 3.8 on the other side of the Mediterranean, specifically in the European Union, and 3.4 in the world. This patently reflects the small amount of entrepreneurial activity in the Southern Mediterranean region. By way of example, the number of newly established companies in Algeria, Jordan, and Egypt is fewer than one company per one thousand people (World Bank, 2024). These figures clearly reveal that there is significant scope for further efforts to attain more realistic improvements in both digital financial inclusion and entrepreneurship in these countries.

The current research paper attempts to contribute as tangibly as possible to filling the aforesaid research gap and enriching previous literature on the topic at hand. First, it aims to carry out an in-depth analysis of the extent to which digital financial inclusion contributes to boosting entrepreneurship in South Mediterranean countries, namely Algeria, Egypt, Jordan, Morocco, and Tunisia, where entrepreneurs are hampered by running into greater challenges and more intractable difficulties in accessing finance. This usually triggers unequal financing opportunities in entrepreneurial activities. The digital financial inclusion-entrepreneurship nexus has never received any scholarly interest as far as these countries are concerned. Second, this undertaking seeks to gauge the amount of improvement in entrepreneurship if the level of digital financial inclusion is enhanced in these countries using the fixed effects and random effects models during the period spanning from 2006 to 2021. The temporal and geographical scope of this study was principally limited due to the World Bank's groundbreaking inaugural and first-of-its-kind dataset on digital financial inclusion. Third, to procure irrefutable confirmations of the validity of the baseline regression results, our study conducts a number of robustness checks, viz., substituting the dependent and independent variables, applying a different estimation technique, namely the Arellano-

Bond difference GMM estimator, using instrumental variables, and incorporating additional control variables into our analysis. The present paper, therefore, could be reliably used as a starting point for future research on the intersection between digital financial inclusion and entrepreneurship in the Southern Mediterranean region. With regard to its practical value, our policy implications will be valuable and provide useful insights for international institutions and policymakers across the Southern Mediterranean and beyond.

In order to achieve the aforementioned aims, the rest of this paper is structured as follows: Section 2 reviews the relevant literature. Section 3 highlights stylized facts on entrepreneurship and digital financial inclusion in South Mediterranean countries. Section 4 introduces the data and presents the econometric methodology in detail. Section 5 reports and discusses the estimation results. Section 6 concludes with some recommendations.

LITERATURE REVIEW

Broadly speaking, entrepreneurial activity can be defined as the process whereby different resources to create value are put together. It is, therefore, virtually utterly impossible to engage in this activity unless and until adequate financial support is available. More often than not, however, entrepreneurs face a host of difficulties when attempting to secure requisite financing. This can be ascribed to a number of overlapping reasons, such as information asymmetry, lack of prior operational history and transparent information for entrepreneurial ventures, and the alarmingly high levels of uncertainty surrounding entrepreneurial outcomes. This is fundamentally why financial constraints are deemed the chief inhibitory factor affecting entrepreneurship. To obtain financing and loans needed to start entrepreneurial work, most individuals and households, who do not have sufficient funds, resort to traditional financial institutions, such as banks. They usually end up getting unavoidably exposed to exclusion due to their lack of sufficient guarantees or credit records during the early stages of entrepreneurship. This oft-repeated scenario is typically worse in rural, remote, and economically underdeveloped areas. This is primarily because these areas lack the presence of traditional financial institutions and the traditional financing service that is restricted to business outlets and limited by geographical location. This state of affairs triggers off a massive reduction in the chances of individuals and families living in these areas to gain equal access to financial services. It may even, under some circumstances, lead to lessening or putting off their enthusiasm for entrepreneurship (King and Levine, 1993; Aghion, 2017). Traditional financial institutions adopt overly cautious or even discriminatory eligibility criteria in gauging the creditworthiness of vulnerable groups, follow strict collateral and insurance standards, and require lengthy application processes that can be strenuous for households to meet or navigate, which may ultimately lead to financial exclusion (Kaiser et al., 2022; Ozili, 2018). Digital financial inclusion can, by implication, be rightly considered a veritable savior for vulnerable and financially excluded groups that were unfairly previously made ineligible for obtaining credit. It does so by activating, as it were, their entrepreneurial intention through providing comprehensive coverage and offering more convenient and diversified financing options at highly competitive, encouragingly low prices. It, likewise, has the added merits of minimizing transaction costs as well as reducing time delay (Ahmad et al., 2021; Senyo et al., 2022; Liu et al., 2022).

Digital financial inclusion gives vulnerable and unemployed people, whose requests to own accounts were turned down in traditional banks, a great opportunity to open an account, do business, and initiate their entrepreneurship activity (Sun and You, 2023). The remarkably increased coverage, which is guaranteed by digital financial inclusion, enables individuals with limited access to traditional financial services to virtually gain access to all necessary financial services from the comfort of their homes using merely the internet and their smartphones. The increasing use of digital financial services, such as digital payment, for example, helps accumulate users' digital footprints, thereby yielding large amounts of

transaction data. It thus leads to important reductions in information asymmetry and makes it easier for financial institutions to track the credit status of borrowers through leveraging big data analysis of household behavior (Berg et al., 2020; Liu et al., 2021; Wang and Guo, 2022). Prior to the adoption of the Internet and other digital technologies, commercial banks relied heavily on manual credit assessments, and those wishing to start entrepreneurial ventures were inevitably highly troubled by the complex, cumbersome, and lengthy credit approval process (Botsch and Vanasco, 2019). Owing to the enthralling array of benefits of digital technology, commercial banks and fintech companies have been better able to more readily leverage artificial intelligence models and big data for conducting credit assessments. This does not solely contribute to remarkably reducing information asymmetries between borrowers and lenders, but it also provides greater levels of convenience to entrepreneurs as it empowers them to gain faster and easier access to loans (Boot et al., 2021). Comprehensive digital finance has the added merit of helping to satisfactorily assess the risks and various aspects of entrepreneurial businesses at a lower cost. This meaningfully reduces the financing costs of entrepreneurship and removes some of the existing financing barriers that individuals usually encounter in the entrepreneurial process, which results in a promising enhancement of entrepreneurial activities as a whole (Xie and Wang, 2023). Inclusive digital finance, which is hallmarked by its potential to significantly reduce gender stereotypes and break time and space constraints, also provides more tangible financing opportunities for women who have traditionally been severely marginalized and deprived of access to finance in the traditional financial market (Balachandra et al., 2019; Ajide, 2020). Another positive fact of inclusive digital finance is that it can serve to lessen work-family conflicts by enabling women to achieve a better balance between entrepreneurial activities and family responsibilities. Stated more clearly, it empowers women to flexibly schedule their working time. After all, women in developing countries have a strong incentive to create their own work environments at home (Kamberidou, 2020).

The emergence of a brand-new generation of information technology tools has, over the last few years, brought about a number of important changes to the way financial services are delivered. It has, likewise, generated a wealth of opportunities that are capable of easing financing constraints for entrepreneurs. Many traditional financial institutions and Internet technology companies have started to provide different financial services, viz., third-party payment, peer-to-peer (P2P) lending that is characterized by not requiring collateral, and crowdfunding that is a financing mechanism for entrepreneurs through donations, loans, or investments from the general public through digital platforms (Liu et al., 2022; Halim, 2024). It is worth pointing out at this juncture that digital financial inclusion depends on the Internet, big data, cloud computing, and other information technology. Hence, it serves to significantly shorten the time of the financing process by reducing red tape and boosting the optimization of resource allocation. This leads to significant reductions in the cost and price of financial products and services and improves the availability of financial services in such a way that long-tail individuals, who have been unlawfully previously excluded from the financial services system, can readily draw on the myriad financial services at a fairly affordable price. In fact, digital financial inclusion has the potential to alleviate the “threshold effect” of financial services. Framed more patently, it paves the way for low-income individuals to cross the financial and information threshold and enhances their intrinsic motivation to generate income (Shen et al., 2021).

Digital finance includes digital financial services provided by commercial banks and BigTech firms (Xie and Wang, 2023). It encompasses not only online banking channels but also services furnished by digital technologies, such as digital payment and clearing systems, e-money, online lending, AI customer service, and robot advisory, to mention but a few. Through bringing about important reductions in costs and time and relinquishing transportation, the fusion of inclusive finance and digital technology will expand financial services and enable underserved communities, businesses, and regions to access financial services (Sun and You, 2023). Similarly, inclusive digital finance provides user-friendly communication platforms for clients to connect with other entrepreneurs or merchants, share the needed information bearing on entrepreneurship, and understand more fully the market conditions to accurately identify promising entrepreneurial opportunities (Yin et al., 2019b).

It is a widely known fact that digital financial inclusion is greatly influenced by financial literacy, which in turn affects the ability of individuals and households alike to make informed borrowing decisions and wisely pick the most appropriate financial instruments and services that are most clearly aligned with their varied needs and goals (Wang and Guo, 2022). What is more, households with higher financial literacy are far more likely to access economic and financial information when using digital tools and, as an immediate consequence of this, are far more able to identify and capitalize on promising entrepreneurial opportunities (Morgan, 2021). It is worth pointing out that digital literacy can have undeniably big impacts upon the quality of entrepreneurship. This is essentially because differences in digital skills and competences can create significant disparities in benefits (Möller et al., 2020). In fact, only entrepreneurs with strong digital skills can take full advantage of the digital economy and are more effective in gathering information, managing financial challenges, and understanding financial environments and risks (Goncalves et al., 2018; Li and Hu., 2022).

Most previously conducted studies that have looked at the relationship between digital financial inclusion and entrepreneurship have focused exclusively on China. Worth mentioning among them is the study carried out by Mao et al. (2023), which confirmed, amongst an array of other things, that digital financial inclusion plays a crucially important role in stimulating household entrepreneurship by removing most financing constraints. They also found out that a mere 1% increase in the digital financial inclusion index can lead to a 0.264% increase in the rate of household entrepreneurship in China. Another study of somewhat similar scope had been carried out by Wu and Wu (2023); the co-authors thereof concluded that digital financial inclusion is positively associated with household entrepreneurial decisions and performance owing to its effectiveness and efficiency in lessening the adverse impacts of financing constraints that obscure the vision of Chinese households aspiring to set up their entrepreneurial ventures. According to Song et al.'s (2024) primary gleaned results, inclusive digital finance can effectively improve the entrepreneurial decision-making process of Chinese residents. Their study included 29 provinces and municipalities across China during the period from 2015 to 2019. In the same vein, Yang et al. (2022) drew the conclusion that digital financial inclusion positively and significantly affects Chinese women's entrepreneurial decisions by removing financing constraints and improving work flexibility in a sample of 10,937 women living in 31 different provinces in China. Using the ordinary least squares (OLS) model, Shao et al. (2023) put forward that the

widespread use of inclusive digital finance, which is a combination of Internet technology and financial inclusion, can assist in significantly improving the entrepreneurial behavior of rural Chinese mothers by protecting them against the different hazards, as it were, which are routinely associated with exclusion from financial services. Framed differently, they found out that for every 1% increase in the digital financial inclusion index, there is an unquestionable 4.6% increase in the probability of entrepreneurship among rural women. They maintained that using the Internet as a primary source of information can serve to demolish barriers to accessing information, allowing rural mothers to easily seize entrepreneurial opportunities. Yang et al. (2024) delved into the impact of inclusive digital finance on social entrepreneurship in China during the period from 2011 to 2021. The results gleaned disclosed, amongst other things, that inclusive digital finance has a positive and significant impact on social entrepreneurship, as the former can indubitably reduce credit barriers, alleviate financing restrictions, lower the threshold for access to credit, play a remarkable role in solving the problem of information asymmetry between borrowers and lenders, and serve to significantly enhance the risk control capabilities of financial institutions.

Liu et al. (2022) investigated the precise nature of the relationship holding between the availability of digital finance and individuals' propensity to become entrepreneurs through using the IV-2SLS model. Amongst the inferences they were able to draw, it is worth mentioning that the availability of digital finance has the dual positive contribution of augmenting the likelihood of becoming an entrepreneur and boosting the quality of entrepreneurship. Sun and Xie (2024) surveyed 33,532 individuals from 2010 to 2020. Their study, which focused solely on China, disclosed that the development of both the digital finance provided by commercial banks and BigTech firms can significantly contribute to enhancing entrepreneurial activities by virtue of improving individuals' access to a range of financing opportunities. Li et al. (2024) analyzed the impact of the use of various digital services by Chinese households on their entrepreneurial decisions during the period between 2014 and 2018. To achieve the set of aims underpinning their undertaking, the researchers employed the two-stage least squares method. They found out that digital services encourage entrepreneurship among Chinese households by relieving financial and information constraints.

In an undertaking they conducted, Yu et al. (2024) concluded that the impact of digital financial inclusion on high-quality rural entrepreneurship in China demonstrates an inverted U-shaped pattern. The co-authors laid substantial emphasis on the fact that the enabling business environment and digital literacy have the potential to make digital financial inclusion harnessed in a more effective way for the sake of improving entrepreneurial quality. Tao et al. (2023) ascertained that promoting inclusive digital finance can enormously support the entrepreneurship of Chinese rural households and thus can remarkably reduce the risk of them falling into abject poverty. In a fairly similar-scoped study, Ding et al. (2023) unearthed that digital financial inclusion has a significant impact on mitigating poverty by virtue of its ability to promote entrepreneurship in China. Hu et al. (2023) argue that digital finance can provide quite a wide range of entrepreneurial opportunities that can increase household income in China. Hao and Zhang (2024) disclosed that the positive impact of digital finance on household entrepreneurship can never be overstated, as it contributes to making people have bigger incomes as well as reducing income inequality in China.

These insights give rise to the following two hypotheses:

Hypothesis 1. Digital financial inclusion exerts a positive impact on entrepreneurship in South Mediterranean countries.

Hypothesis 2. Digital financial inclusion, along with a business environment characterized by substantial economic freedom, can spawn entrepreneurship in South Mediterranean countries.

Other studies opted for completely different analytical directions, such as the one carried out by Yin et al. (2019). The researchers concluded that mobile payment significantly increases the likelihood of entrepreneurship success. It does so by making users more risk-seeking, enriching social networks, and providing easy and quick access to a range of supplementary lending channels. Andrianaivo and Kpodar (2011) put forward that affordable telecommunications services can result in improved financial inclusion through technology. The co-authors underscored the fact that insufficient digital infrastructure in many developing countries may restrict the role of digital technology in improving access to digital financial services. Elouaourti and Ibourk (2024a) cast light upon identifying the chief determinants of digital financial inclusion in MENA countries. They inferred that the most crucial factors that can greatly determine digital financial inclusion, which is already low in most of these countries, are educational attainment, labor market participation, and wide-ranging access to ICT and the Internet. In a study of similar scope, Elouaourti and Ibourk (2024b) pinpointed the massive progress made by African countries with regard to digital financial inclusion. The co-authors pointed out that African countries, such as Egypt, Sudan, and Tunisia, experienced notable declines in their rankings. Such a decline can be viewed as a genuine stress of the limited access to digital financial services in these countries. They went on to stress that those in the lowest income bracket tend to encounter multiple barriers with respect to leveraging digital financial inclusion. This can be put down to a clear lack of access to telecommunications services and their high cost compared to their inadequately low monthly income.

STYLIZED FACTS ON ENTREPRENEURSHIP AND DIGITAL FINANCIAL INCLUSION IN SOUTH MEDITERRANEAN COUNTRIES

The World Bank's new business density rate (the number of newly registered limited liability firms per 1,000 people in the age group 15-64) is a commonly used indicator of entrepreneurial activity. In 2022, it reached 2.57 in Morocco, 1.67 in Tunisia, 0.63 in Algeria, and 0.27 in Egypt. To conspicuously discern the massive difference between countries in the European Union and those South Mediterranean, it is worth knowing that the new business density rate reached 3.8 on the other side of the Mediterranean, specifically in the European Union, and 3.4 in the world. These figures plainly reflect the small amount of entrepreneurial activity in the Southern Mediterranean region. Having said that, we should not lose sight of the glaring fact that entrepreneurial activity has witnessed a slight improvement recently compared to 2020, when the new business density rate reached 2.27 in Morocco, 1.52 in Tunisia, 0.51 in Algeria, 0.4 in Jordan, and 0.21 in Egypt (World Bank, 2024). As a matter of fact, there exists a range of clear differences between these countries. New business density rates are said to be exceptionally low in Algeria, Jordan, and Egypt. Stated differently, the number of newly created companies is less than one company per thousand people in these three countries. This could be fundamentally attributed to weak formal sectors and their role in deterring entrepreneurial activities, the cumbersome business environment, and the woeful inability to obtain the necessary funds.

According to the 2022/2023 Global Entrepreneurship Monitor (GEM) Global Report, which includes only a few Southern Mediterranean countries, the percentage of adults who said that they have entrepreneurial intentions reached 50.7% in Tunisia, 47.3% in Egypt, and 37.3% in Morocco. The percentage of adults who dread the failure of their entrepreneurial projects, on the other hand, reached 50.6% in Egypt, 44.4% in Morocco, and 42.6% in Tunisia. Furthermore, the percentage of adults who clearly expressed a strong desire to launch entrepreneurial projects in order to earn a living because of the scarcity of jobs was 89.7% in Tunisia, 84.8% in Egypt, and 82.5% in Morocco. It is hardly surprising that "making a living because jobs are scarce" is, by and large, the single most dominant motivation among new entrepreneurs in these countries, hallmarked by extremely high youth unemployment rates and where GDP per capita is alarmingly low. In view of the impact of entrepreneurship on employment, the percentage of adults who expect to employ six or more people within five years was 3.7% in Tunisia, 1.7% in Egypt, and 1.2% in Morocco (Global Entrepreneurship Monitor, 2023). The Southern Mediterranean region displays the highest proportion of necessity-driven entrepreneurship worldwide. By contrast, in high-income countries, like the UAE, the overwhelming bulk of entrepreneurs start their businesses in pursuit of an opportunity. On account of the rather inadequate contribution that necessity-driven entrepreneurship makes to economic development and productivity, there is an urgent need to provide enabling conditions to strengthen

and solidify opportunity- and innovation-driven entrepreneurial activities (Mahmalat and Sumpf, 2018, 2020; Global Entrepreneurship Monitor, 2017).

It is worth mentioning that there exists significant variability with regard to the level of entrepreneurial activity in South Mediterranean countries. This can be ascribed to differences in the business environment and access to finance. First and foremost, the Ease of Doing Business Index, which the World Bank stopped releasing back in 2021, is widely used to assess the strength of the business environment in a country. This is fundamentally because it measures the relative strength of the regulatory environment conducive to the operation of businesses in the following 10 areas: starting a business, dealing with construction permits, receiving electricity, registering property, obtaining credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. According to the 2019 Ease of Doing Business Index, the global low rankings of South Mediterranean countries stand primarily for the unavoidably patent weakness of their business environments, such as Morocco (53), Jordan (75), Tunisia (78), Egypt (114), Lebanon (143), and Algeria (157) (World Bank, 2019).

Secondly, and no less crucially, the limited access to finance incessantly causes challenges and functions as a ubiquitous hindrance to entrepreneurs in South Mediterranean countries. Framed differently, many low-income individuals and households, particularly those inhabiting rural, remote, and economically backward areas, are persistently exposed to financial exclusion that renders it virtually impossible for them to start, continue, and develop entrepreneurial projects. By way of example, the Ease of Access to Entrepreneurial Finance score, which ranges from 0 (very inadequate, insufficient status) to 1 (very adequate, sufficient status), accounted for 4.3 in Egypt, 4.1 in Morocco, and 3.3 in Tunisia, which is low if compared to 7.2 in the UAE (Global Entrepreneurship Monitor, 2023).

If truth be told, the South Mediterranean region has the lowest proportion of adults with bank accounts in the world. In fact, the 2021 edition of the Global Findex reveals that the percentage of adults who possess a bank account reached 47% in Jordan, 44% in Algeria, 44% in Morocco, 37% in Tunisia, 27% in Egypt, and 21% in Lebanon. These figures stand in stark contrast to the remarkably higher rate of 99% observed on the other side of the Mediterranean, especially in the Eurozone, and even the 76% rate recorded in the world (World Bank, 2021). This patent discrepancy plainly proves the existence of a massive gap in financial access in the South Mediterranean region, resulting in the inevitable exclusion of a large portion of this region's population from formal financial services. This low level of bank account ownership denotes that a large section of this region's population continues to rely on informal financial systems or remains unbanked, which severely confines their access to basic financial tools and services. The wide disparities in access to bank accounts between countries in the region can be put down to a number of crucial factors, including, but not limited to, economic stability, unemployment, regulatory environments, and access to financial infrastructure (Elouaourti and Ibourk, 2024a).

When we attempt to address the most fundamental dimension of digital financial inclusion, the most noticeable fact that we observe is that the minimal use of digital channels for financial transactions and

services discloses the low level of digital financial inclusion in the South Mediterranean region. The incredibly puny performance meets the eye when looking at the percentage of adults who make or receive digital payments, which amounted to solely 36% in Jordan, 34% in Algeria, 30% in Morocco, 28% in Tunisia, 20% in Egypt, and only 14% in Lebanon. These percentages pale in comparison to the 97% recorded in the Euro area, as well as the 64% recorded in the world (World Bank, 2021). This major discrepancy sheds light upon a prodigious digital divide within the South Mediterranean region. It signals, amongst an array of things, that a large proportion of this region's population does not adequately benefit from the many and varied merits offered by digital financial services. Similarly, it demonstrates that the potential for digital financial inclusion in this area remains largely untapped, which has the inevitable consequence of leaving massive scope for significant improvement in enhancing the use of digital channels to promote digital financial inclusion. This can be accomplished, at least partly, through ameliorating technological infrastructure, improving digital literacy, removing excessive regulatory restrictions that persistently hinder FinTech innovations, developing new products, and deploying new digital financial solutions. Having said that, it is worth drawing attention to the fact that the aforesaid percentages recorded in 2021 remain substantially higher than those recorded in 2014. Stated more lucidly, the percentage of adults who make or receive digital payments reached 28% in Algeria, 17% in Morocco, 17% in Tunisia, 13% in Jordan, and 8% in Egypt in 2014. This unambiguously reflects the slight improvement in digital financial inclusion in South Mediterranean countries. Lebanon, however, remains an exception owing to the fact that the aforementioned percentage accounted for roughly 33% in 2014, which is much higher than the percentage recorded in 2021. This can be attributed to the debilitating financial and economic crisis Lebanon has been enduring since 2019, coupled with the grievous financial collapse that crippled most, if not all, of its institutions.

In the same vein, we can look closely at an integral part of digital financial inclusion and consider the percentage of adults who use mobile phones or the Internet to make payments, buy things, or send or receive money online. It is worth mentioning that this percentage reached 10% in Morocco, 7% in Jordan, 6% in Tunisia, 4% in Algeria, 2% in Egypt, and 1% in Lebanon, while it accounted for 62% in the Eurozone and 39% in the world. This patently reflects the very limited use of digital financial services in the Southern Mediterranean region. The 2021 Global Findex database reports that low levels of digital financial inclusion in this region could be ascribable to many factors, like utmost remoteness, high cost, lack of funds and documentation, distrust in financial institutions, as well as religious reasons (World Bank, 2021).

DATA AND METHODOLOGY

DATA DESCRIPTION

The empirical analysis is based on annual data covering the period from 2006 to 2021 for 5 South Mediterranean countries, namely, Algeria, Egypt, Jordan, Morocco, and Tunisia. Sample size and time period were determined primarily based on data availability. Our model includes the following variables:

- Entrepreneurship (ENTRP) as the dependent variable, which is directly represented by the new business density rate (new registrations per 1000 people in the age group 15-64). Data are taken from the World Bank's Entrepreneurship Database. Furthermore, we use the self-employment rate (the percentage of self-employed workers to total employment) as an alternative measure of entrepreneurship (ENTRPA) to test the robustness of the baseline regression results. Data are taken from the World Development Indicators database.

There is a set of explanatory variables, which includes:

- Digital Financial Inclusion (DFI), which is proxied by the percentage of people who made or received a digital payment (% age 15+). Data are taken from the World Bank's Global Findex Database.

- Heritage Foundation's Economic Freedom Index (EFH), which is measured based on 12 quantitative and qualitative factors (property rights, government integrity, judicial effectiveness, government spending, tax burden, fiscal health, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, and financial freedom). It is graded on a scale from 0 to 100, where 100 represents the maximum freedom. Data are taken from the Heritage Foundation. Moreover, we use the Fraser Institute's Economic Freedom Index as an alternative measure of economic freedom (EFF) to test the robustness of the baseline regression results. This index ranges from 0 (minimum freedom) to 10 (maximum freedom). Data are taken from the Fraser Institute's Economic Freedom of the World database.

- Investment Profile (INVP), which is evaluated based on the factors affecting the risk to investment that are not covered by other political, economic, and financial risk components. It is calculated based on the following three subcomponents: Contract Viability/Expropriation, Profits Repatriation, and Payment Delays. This index ranges from 0 to 12, where a higher score implies low risk to investment. Data are taken from the Political Risk Services (PRS) Group's International Country Risk Guide (ICRG).

- Financial Development Index (FD), which measures how developed financial institutions and financial markets are in terms of their depth (size and liquidity), access (ability of individuals and companies to access financial services), and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues and the level of activity of capital markets). Data have been obtained from the International Monetary Fund's Financial Development Index database.

- Frontier technology readiness index (TR), which measures the capacity to use, adopt, and adapt frontier technologies based on the following five building blocks: ICT deployment, skills, R&D activity, industry activity, and access to finance. It ranges from 0 (lowest) to 1 (highest). Data have been obtained from the UNCTAD statistical portal.

- Gross Domestic Product per capita growth (GDPP), which is the annual percentage growth rate of GDP per capita. Data are obtained from the World Development Indicators database.

- Human Development Index (HDI), which measures the performance of countries in promoting human capital accumulation. Data are taken from the UNDP database.

METHODOLOGY

This study applies static panel data models, namely the fixed effects (FE) and random effects (RE) models, to examine the impact of digital financial inclusion on entrepreneurship in South Mediterranean countries. Our empirical models build on earlier contributions of Liu et al. (2022), Shao et al. (2023), and Li et al. (2024). In fact, these models appropriately fit small sample sizes. Our modified panel data model is as follows:

$$ENTRP_{it} = \alpha_i + \beta' x_{it} + u_{it} \qquad (1)$$

where x_{it} is a 4x1 vector of observed individual-specific regressors (*DFI, EFH, DFIxEFH, and INVP*) on the 5th cross-sectional unit at time *t*, u_{it} is the error term, β is a 4-dimensional vector of unknown parameters, and α_i denotes an unobservable, unit-specific effect. In fact, α_i is time-invariant, and it accounts for any individual-specific effect that is not included in the regression (Pesaran, 2015).

1- The fixed-effects model (FE) assumes that the intercept differs across cross-section units (Brooks, 2008). The basic idea behind FE estimation is to estimate β after eliminating the individual effects α_i. β is now estimated as follows:

$$\hat{\beta}_{FE} = \left[\sum_{t=1}^{16}\sum_{i=1}^{5}(x_{it} - \bar{x}_i)'(x_{it} - \bar{x}_i)\right]^{-1} \sum_{t=1}^{16}\sum_{i=1}^{5}(x_{it} - \bar{x}_{i.})(ENTRP_{it} - \overline{ENTRP_i}) \qquad (2)$$

2- The random-effects model (RE) assumes that α_i are realizations from a probability distribution function with a fixed number of parameters, distributed independently of the regressors (Pesaran, 2015). Thus, an efficient estimator of β is given by

$$\hat{\beta}_{RE} = \left(\sum_{i=1}^{5} X_{i.}' \Sigma_v^{-1} X_{i.}\right)^{-1} \sum_{i=1}^{5} X_{i.}' \Sigma_v^{-1} ENTRP_{i.} \quad (3)$$

$$\text{with } v_{it} = \alpha_i + u_{it}$$

In order to determine the appropriate and reliable model between fixed- and random-effects models, we can use the Hausman test, whose hypotheses are as follows:

H_0: The random effects model is suitable and better than the fixed effects model.

H_1: The fixed effects model is suitable and better than the random effects model.

The significance of the Chi-Square statistics of the Hausman test enables us to choose between fixed- and random-effects models. If the p value reported in the Hausman Chi-Square test is less than 5%, we reject the null hypothesis, and hence the fixed effects model is the most appropriate one. If the p value is higher than 5%, we accept the null hypothesis, stating that the random effects specification is the suitable one (Wooldridge, 2010).

In order to check whether the baseline regression results gleaned are robust, we used an alternative measure of entrepreneurship and different alternative independent variables. We also applied the Arellano-Bond difference GMM estimator, which is a powerful econometric method that can address any potential endogeneity bias by instrumenting the first-differenced right-hand-side variables, which are not strictly exogenous, with suitable lags of their own levels (Arellano and Bond, 1991; Arellano and Bover, 1995; Hansen and West, 2002).

Our modified panel data model is as follows:

$$ENTRP_{it} = \alpha_i + \beta_1 ENTRP_{it-1} + \beta_2 FD_{it} + \beta_3 TR_{it} + \beta_4 FD_{it} \times TR_{it} + \beta_5 X_{it} + \varepsilon_{it} \quad (4)$$

Where the subscripts *i* and *t* represent country and time period, respectively. α_i represents unobserved country-specific effects. *X* represents the set of other explanatory variables that includes EFF, GDPP, and HDI. ε_{it} is the error term.

The Arellano-Bond estimation takes the first-difference form of Equation 4. (5)

$$ENTRP_{it} - ENTRP_{it-1} = \lambda_1 (ENTRP_{it-1} - ENTRP_{it-2}) + \lambda_2 (FD_{it} - FD_{it-1}) + \lambda_3 (TR_{it} - TR_{it-1}) + \lambda_4 (FD_{it} \times TR_{it} - FD_{it-1} \times TR_{it-1}) + \lambda_5 (X_{it} - X_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1})$$

When Equation 4 is first differenced, potential biases caused by omitted variables and fixed country–specific effects are removed. The Arellano-Bond difference GMM is also able to produce consistent results by solving autocorrelation problems since the first-differenced lagged dependent variable is also instrumented with its past levels. In fact, this method allows controlling for endogeneity of the lagged dependent variable, which occurs due to the correlation between the regressor ($ENTRP_{it-1} - ENTRP_{it-2}$) and the error term ($\varepsilon_{it} - \varepsilon_{it-1}$) (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998).

Instrumenting the regressors by their respective lagged values makes them pre-determined and therefore not correlated with the error term ($\varepsilon_{it} - \varepsilon_{it-1}$) under the assumption that there is no serial correlation in the error term and that the explanatory variables are weakly exogenous. We can check the validity of this assumption using two tests: first, the Sargan and Hansen test of over-identifying restrictions, whose null hypothesis is that instruments are overall exogenous and, thus, valid; a rejection of the null hypothesis implies that the instruments do not satisfy orthogonality conditions required for their employment, and second, the Arellano-Bond test for second-order serial correlation (AR(2)), whose null hypothesis is that there is no serial correlation for the second-order form. Thus, rejecting this null hypothesis implies that the model is misspecified (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998).

RESULTS AND DISCUSSION

DISCUSSION OF BASELINE REGRESSION RESULTS

Table 01 reports the results of two different estimation techniques: fixed effects and random effects models. All explanatory variables tend to have statistically significant coefficients with the expected signs in both regressions. Thus, the choice between fixed and random effects models will be made based on the Hausman test. In fact, the Hausman Chi-square test statistic is statistically significant at the 5% level of significance; thus, the null hypothesis is rejected in favor of the alternative hypothesis. In other words, the Hausman test shows that the fixed-effects model is the appropriate one, and hence we exclusively interpret its results.

According to the results shown in column (a) of Table 01, digital financial inclusion (DFI) exhibits a highly statistically significant positive effect on entrepreneurship (ENTRP) at the 1% level of significance in South Mediterranean countries, thus confirming hypothesis 1. This result is consistent with that of Wu and Wu (2023), Song et al. (2024), Yang et al. (2022), and Shao et al. (2023). An increase of 1% in digital financial inclusion (DFI) leads to an increase of 5.79% in entrepreneurship (ENTRP) in South Mediterranean countries. This can be explained by the fact that digital financial inclusion circumvents the antagonistic relationship between conventional financing and entrepreneurship, breaks through the bottlenecks of the traditional financial system, dissolves traditional boundaries, solves a triple-dimensional problem of remoteness, time, and cost, mitigates information asymmetry in financial transactions, alleviates credit constraints on entrepreneurial activities, and provides financial services to populations underserved and unserved by the conventional financial system. Stated differently, digital financial inclusion has made it easier for entrepreneurs to start and expand their businesses by undeniably providing a stable credit environment and opening up hitherto unheard-of prospects to promote individuals' incentive to become entrepreneurs.

As shown in column (a), economic freedom (EFH) positively and significantly affects entrepreneurship (ENTRP) in South Mediterranean countries at the 5% level of significance, confirming what has been reported by Nyström (2008) and Kuckertz et al. (2016). An increase of 1% in economic freedom (EFH) can generate a 2.09% increase in South Mediterranean countries' entrepreneurial activity. In fact, economic freedom, whose fundamental principles encompass the rule of law, limited government, regulatory efficiency, and the openness of markets, offers an excellent breeding ground for entrepreneurial activities, fosters the culture of entrepreneurship, and unleashes people's inner entrepreneurial spirit to start and grow their businesses. To put it differently, entrepreneurship can relentlessly thrive in an environment that guarantees sufficient economic freedom.

According to the regression results reported in column (a), the multiplicative interaction term between digital financial inclusion and economic freedom (DFIEFH) carries the expected positive sign and is

statistically significant, implying that the combined effect of digital financial inclusion and economic freedom appears to be of paramount importance to foster entrepreneurship in South Mediterranean countries. Therefore, hypothesis 2 is fully confirmed. In fact, digital financial inclusion and economic freedom are two sides of the same coin. They go hand in hand. And nowhere do they blend more perfectly and more powerfully than in an economy where entrepreneurs face literally zero barriers along the way. In economically free societies, entrepreneurs can reap maximum benefits the digital financial inclusion bestows upon them.

Column (a) indicates that entrepreneurship (ENTRP) is positively and significantly affected by investment profile (INVP) at the 5% level of significance in South Mediterranean countries. This is in line with the findings of Dutta et al. (2013). A 1% increase in investment profile (INVP) is found to increase entrepreneurship (ENTRP) in South Mediterranean countries by 1.23%. The investment profile, which captures three risks to investment (outright expropriation of assets, payment delays, and restrictions on profit repatriation), serves as a compass for entrepreneurs seeking to forge their entrepreneurial path fearlessly and confidently. The improvement of the investment profile can empower entrepreneurs to identify and seize entrepreneurial opportunities accurately, tap into useful resources, turn their ideas into thriving businesses, improve their business profitability, turnover, and efficiency, and navigate the dynamic world of business.

Table 1. Baseline regression results for 5 South-Mediterranean countries

	(a)	**(b)**
	Dependent Variable: ENTRP	
Regressors	**OLS**	**OLS**
	Fixed Effects	**Random Effects**
Constant	0.939730	0.829450
	(0.0133) **	(0.1693)
DFI	5.790910	3.161407
	(0.0005) ***	(0.0951) *
EFH	2.086499	0.378543
	(0.0367) **	(0.0048) ***
DFIxEFH	7.626714	4.699569
	(0.0000) ***	(0.0037) ***
INVP	1.225932	0.159857
	(0.0372) **	(0.0890) *
R-squared	0.818890	0.265617
Prob (*F-statistic*)	0.000000	0.315509
	Hausman test	
Chi-Sq. Statistic	10.097878	
(Prob)	(0.0178) **	

*p < 0.1; **p < 0.05; ***p < 0.01

ROBUSTNESS CHECKS

To ensure the robustness of our baseline regression results, we test them from multiple perspectives by employing the following different robustness-checking methods: substituting the dependent and independent variables, applying a different estimation technique, namely the Arellano-Bond difference GMM estimator, using instrumental variables, and incorporating additional control variables into our analysis.

First, we use the self-employment rate (ENTRPA) as an alternative measure of entrepreneurship, as well as different alternate independent variables, such as the financial development index (FD), the frontier technology readiness index (TR), the multiplicative interaction term between them (FDTR) as an alternative proxy for digital financial inclusion, and the Fraser Institute's economic freedom index (EFF). Second, we apply the Arellano-Bond difference GMM estimator, which is a powerful econometric method that can address any potential endogeneity bias by instrumenting the first-differenced right-hand-side variables. Third, we incorporate additional control variables into our analysis to revalidate our regression results.

Table 2 summarizes the results of robustness checks and clearly indicates that they are consistent with the baseline regression results. In fact, the impact of digital financial inclusion on entrepreneurship remains significant and positive. The coefficient size and significance level have not deteriorated and remain robust, even after employing the above-mentioned robustness-checking methods and addressing potential endogeneity issues, thereby reinforcing the robustness of our initial results.

Substituting the dependent and independent variables

As shown in column (a), the financial development index (FD) exhibits a statistically significant positive effect on entrepreneurship (ENTRPA) at the 1% level of significance in South Mediterranean countries. This result is consistent with that of Dutta and Meierrieks (2021) and Munemo (2018). An increase of 1% in the financial development index (FD) leads to an increase of 3.83% in entrepreneurship (ENTRPA) in the Southern Mediterranean countries. This can be explained by the fact that promoting financial development can bolster entrepreneurial endeavors by reducing the transaction costs incurred in the financial system, supplying adequate amounts of external credit at reasonable costs, making access to credit less dependable on social connections, broadening access to finance to the poor and vulnerable groups, relaxing liquidity constraints, mobilizing and pooling savings, optimizing the allocation of capital, and facilitating risk management. Countries with better-developed financial systems offer an environment conducive to entrepreneurship and amplify entrepreneurial activities. This is why improving financial development has become a prerequisite for entrepreneurial motivation in South Mediterranean countries, where entrepreneurs often grapple with financial constraints and struggle to access adequate capital to start or scale their ventures.

According to the regression results reported in column (a), the frontier technology readiness index (TR) is positively and significantly linked to entrepreneurship (ENTRPA) at the 1% level of significance in

South Mediterranean countries, confirming what has been reported by Alderete (2017) and Barnett et al. (2019). An increase of 1% in technology readiness (TR) can generate a 2.63% increase in the Southern Mediterranean countries' entrepreneurship. In fact, countries that exhibit higher technology readiness guarantee an empowering environment that enables entrepreneurs to easily and cheaply access information, resources, markets, and customers. By leveraging digital tools, platforms, networks, the arsenal of advanced tools, and the endless possibilities for innovation and optimization the technology provides, entrepreneurs can swiftly transform their ideas into tangible products, create new products and services, or improve existing ones. By the same token, they can tap into new markets, increase productivity and competitiveness, and confidently navigate the ever-changing business landscape. Advanced technology has revolutionized entrepreneurship in all niches and sectors. It can patronize entrepreneurs in all stages of the entrepreneurial cycle.

Column (a) reveals that the multiplicative interaction term between financial development and technology readiness (FDTR) carries the expected positive sign and is statistically significant, implying that the combined effect of financial development and technology readiness appears to be of paramount importance to instigate entrepreneurial activities in the Southern Mediterranean countries. This is consistent with the baseline regression results. The fusion between financial development and technology readiness unleashes crowdfunding platforms and specialized accelerators that connect entrepreneurs to financial resources and help them secure necessary start-up funds and gain valuable mentorship, both of which are paramount for entrepreneurs seeking to position themselves ahead of the curve, stay competitive in today's rapidly evolving market, and tackle future challenges. In fact, financial development and digital technology have been bound together by a continuous relationship that goes beyond just having financial intermediaries and infrastructures in place. It's not just about satisfying entrepreneurs' demand for accessible financial services; it's about dissolving traditional boundaries, solving a triple-dimensional problem of remoteness, time, and cost, mitigating information asymmetry, providing credit and a wide range of financial services to populations excluded from the conventional financial system, and enabling vulnerable groups to embrace the entrepreneurial mindset.

Column (a) demonstrates that entrepreneurship (ENTRPA) appears to be positively and significantly affected by the Fraser Institute's economic freedom index (EFF) at the 5% level of significance in South Mediterranean countries, which is in line with the findings of Nyström (2008) and Kuckertz et al. (2016). A 1% increase in economic freedom (EFF) is found to increase entrepreneurship (ENTRPA) by 1.41% in the Southern Mediterranean countries. Thus, the reliability of the baseline regression results has been further validated. In fact, high economic freedom sweeps away obstacles standing in the way of entrepreneurship and has the potential to drive radical change in the capabilities of entrepreneurs. Economic freedom allows entrepreneurs to make their own entrepreneurial decisions without interference or limitations by the government or the government's protection of anti-market behavior. Stated differently, securing economic freedom enables entrepreneurs to get rid of as many unnecessary, cumbersome regulations as they can and perceive lucrative entrepreneurial opportunities.

Applying the Arellano-Bond difference GMM

We estimate the same model shown in column (a) using a different estimation technique, namely the Arellano-Bond difference GMM estimator. The results shown in column (b) clearly indicate that all explanatory variables (financial development index (FD), frontier technology readiness index (TR), the multiplicative interaction term between them (FD×TR), and the Fraser Institute's economic freedom index (EFF)) maintain their significant positive impact on entrepreneurship (ENTRP), thereby confirming the robustness of our baseline regression results. Additionally, the Sargan-Hansen test of over-identifying restrictions and the Arellano-Bond test for second-order serial correlation AR(2) were conducted in order to assess the validity of our instruments. The results show that null hypotheses cannot be rejected for the model displayed in column (b). This indicates that the instruments are valid, and the results of our estimates are consistent and credible.

Incorporating additional control variables

We incorporate additional control variables into our analysis to revalidate our baseline regression results. More specifically, we include the gross domestic product per capita growth (GDPP) and the human development index (HDI) in the model, as is shown in column (c). In fact, the inclusion of these two control variables in the model plainly shows that the signs and significance of core explanatory variables remain robust and simultaneously proves that the regression results in column (c) are still consistent with the baseline regression results. Furthermore, the Hansen J-statistics are insignificant, and therefore the instruments are valid. This model also passes the Arellano-Bond test for second-order serial correlation. This asserts that our instruments are indeed valid, and hence the results gleaned are highly reliable and difficult to dispute. Ultimately, these robustness checks further validate our baseline regression results and evidently confirm that they are robust.

Table 2. Regression Results for 5 South-Mediterranean countries

	(a)	(b)	(c)
Dependent Variable	**ENTRPA**	**ENTRP**	**ENTRP**
Regressors	**OLS**	**Difference**	**Difference**
	Fixed Effects	**GMM**	**GMM**
Constant	1.405038		
	(0.0081) ***		
$ENTRP_{t-1}$		5.300475	6.908821
		(0.0160) **	(0.0276) **
FD	3.833752	4.134565	5.726058
	(0.0073) ***	(0.0095) ***	(0.0000) ***
TR	2.629943	3.849065	4.564646
	(0.0024) ***	(0.0294) **	(0.0179) **
FDTR	6.071133	8.513420	9.035580
	(0.0001) ***	(0.0201) **	(0.0000) ***
EFF	1.414933	2.461339	
	(0.0230) **	(0.0116) **	

GDPP			6.498143
			(0.0000) ***
HDI			2.78876
			(0.0000) ***
AR (2) (p-value)		0.3900	0.6186
Hansen's J statistic		0.136688	0.302805
[p-value]		[0.711596]	[0.582129]
No of instruments		4	4
No of countries	5	5	5
No of observations	70	60	60

*p < 0.1; **p < 0.05; ***p < 0.01

CONCLUSION AND POLICY IMPLICATIONS

The current undertaking has unearthed that digital financial inclusion plays a significantly important role in stimulating entrepreneurial activities in South Mediterranean countries, where entrepreneurs often grapple with financial constraints and struggle to access adequate capital to start or scale their ventures. Stated differently, digital financial inclusion opens up hitherto unheard-of prospects to bolster individuals' incentive to become entrepreneurs. This is in line with the findings of Wu and Wu (2023), Song et al. (2024), Yang et al. (2022), and Shao et al. (2023). More specifically, the results provide irrefutable evidence that a mere 1% increase in the digital financial inclusion index has the potential to generate a 5.79% improvement in entrepreneurship in South Mediterranean countries. More interestingly, such estimates could prove substantially important to policymakers and stakeholders, as they clearly show where policy actions to instigate South Mediterranean countries' entrepreneurial activities are most likely to bear fruit.

By the same token, the results gleaned disclosed that entrepreneurship can relentlessly thrive in an environment that guarantees sufficient economic freedom, confirming what has been reported by Nyström (2008) and Kuckertz et al. (2016). Stated more lucidly, entrepreneurs can reap maximum benefits the digital financial inclusion bestows upon them under the banner of economic freedom. Therefore, governments in the Southern Mediterranean should not slack off on their endeavors to embrace digital financial inclusion. It is worth mentioning at this juncture that the robustness checks further validate our baseline regression results and evidently confirm that they are robust. We have, accordingly, come up with a range of practical recommendations, which will be delineated below.

Decision-makers in the Southern Mediterranean region, which is plainly hallmarked by being full of highly rewarding entrepreneurial opportunities, ought to pour far more effort into their attempts to promote inclusive digital finance in a way that caters to the various needs of those wishing to engage in entrepreneurial projects. One way of accomplishing this is through improving the digital financial infrastructure via greater investment in areas such as fiber optics and base stations, in addition to enhancing both Internet coverage and access and improving the quality and availability of Internet services in various regions, especially rural and remote ones. It is also incumbent upon them to ensure that low-income people have uninterrupted access to mobile phone services and Internet services at affordable prices.

If they truly aspire to attain a more fulfilling exploitation of digital financial inclusion in the field of entrepreneurship, governments and financial institutions alike are called upon to pay far more attention to eradicating digital illiteracy and spreading digital financial literacy among low-income groups, especially in rural, remote, and economically backward areas. They should, likewise, work strenuously to lower the

education and skill thresholds required to use new technologies, empowering those vulnerable groups to learn more about digital finance and take full advantage of the various benefits provided by digital financial inclusion. For the sake of more effective upshots, governments can rely upon issuing brochures, launching digital skills and entrepreneurship training programs, inviting highly qualified financial practitioners to give lectures, as well as drawing on the countless merits of social media platforms.

People's trust in digital financial technologies can be significantly boosted through continuous collaboration with stakeholders, such as financial institutions, FinTech companies, telecommunications companies, and regulatory bodies. This can ensure full protection of their personal data and privacy, paving the way for greater digital financial inclusion.

Governments should also put great efforts into stimulating research and development in financial institutions and invigorating the latter to stir up innovations in digital financial inclusion services, especially innovations targeting rural markets. These institutions should be encouraged to design digital finance solutions that are well aligned with the various entrepreneurship development phases.

It is incalculably important to lay sufficient emphasis upon the need to adopt policies that encourage start-ups, such as facilitating company registration procedures, reducing the associated costs, cutting down bureaucracy, battling corruption, developing the legislative environment, unleashing economic freedom, and improving the business climate in general. Similarly, government officials should develop properly updated schemes targeting the development of the digital economy.

Given the novelty of the subject matter per se, our study has some limitations that are worth pointing out. First, since research on the quantification of digital financial inclusion is still in its infancy, we have not been able to obtain a longer time period. Secondly, owing fundamentally to the complete dearth of data on the different types of entrepreneurial projects and the motivations for their creation in different sectors in the Southern Mediterranean countries, we have fallen short of carrying out a more all-encompassing study on the impact of digital financial inclusion on different types of entrepreneurships. Notwithstanding the significance of the results, our study has empowered us to procure, some intriguing questions remain unanswered. Accordingly, an important set of research avenues can be suggested for future undertakings interested in adopting a holistic perspective in scrutinizing the relationship between digital financial inclusion and entrepreneurship. First and foremost, future studies could focus on casting light on the potential impact of inclusive digital finance on the success rates and profitability of entrepreneurial projects in various sectors in the Southern Mediterranean countries. Secondly, and no less crucially, future research may benefit from the future deployment of more data on digital financial inclusion. This will empower them to delve more profoundly into more complex econometric models. Last but by no means least, future undertakings could also shed light on the potential role of artificial intelligence in amplifying digital financial inclusion, revamping entrepreneurial quality, and pinpointing auspicious entrepreneurial opportunities.

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