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Abstract

E-commerce is a global trend that is having an impact on consumers and businesses. While this trend is increasing, its adoption by Moroccan firms is low and research on this context and topic is limited. This paper tries to redress this by analyzing the determinants of adoption of e-commerce by firms in Morocco. We employ a probit model to identify the main factors affecting adoption of e-commerce by Moroccan firms. The results provide five main findings. First, due to their greater openness to innovation and the change, newer firms are more likely to adopt e-commerce. Second, firms with larger numbers of higher educated workers are more likely to adopt e-commerce. Third, the level of new employees' digital skills has no effect on the probability of adopting e-commerce. Fourth, listing on digital platforms increases the probability of e-commerce adoption. Fifth, innovation activity has a positive effect on adoption of e-commerce by Moroccan firms. These findings suggest the need for more investment to enable adoption of new organizational practices, reskilling of workforces, and use of new technologies to facilitate effective adoption of e-commerce by firms.

JEL Classification: O3, L2

Keywords: Technology, Digitalization, E-commerce, Morocco

ملخص

التجارة الإلكترونية هي اتجاه عالمي له تأثير على المستهلكين والشركات. وبينما يتزايد هذا الاتجاه، فإن اعتماده من قبل الشركات المغربية منخفض والبحوث حول هذا السياق والموضوع محدودة. وتحاول هذه الورقة تصحيح ذلك بتحليل محددات اعتماد الشركات في المغرب للتجارة الإلكترونية. نستخدم نموذجًا محتملًا لتحديد العوامل الرئيسية التي تؤثر على تبني الشركات المغربية للتجارة الإلكترونية. وتقدم الورقة خمس نتائج رئيسية. أولاً، نظرًا لانفتاحها الأكبر على الابتكار والتغيير، فمن المرجح أن تتبنى الشركات الجديدة التجارة الإلكترونية. ثانيًا، من المرجح أن تتبنى الشركات التي لديها أعداد أكبر من العمال ذوي التعليم العالي التجارة الإلكترونية. ثالثًا، ليس لمستوى المهارات الرقمية للموظفين الجدد أي تأثير على احتمال تبني التجارة الإلكترونية. رابعًا، يزيد الإدراج على المنصات الرقمية من احتمالية اعتماد التجارة الإلكترونية. خامساً، لنشاط الابتكار أثر إيجابي على اعتماد الشركات المغربية للتجارة الإلكترونية. تشير هذه النتائج إلى الحاجة إلى مزيد من الاستثمار للتمكين من اعتماد ممارسات تنظيمية جديدة، وإعادة تشكيل القوى العاملة، واستخدام التكنولوجيات الجديدة لتسهيل الاعتماد الفعال للتجارة الإلكترونية من قبل الشركات.

Introduction

This paper analyzes the adoption of e-commerce applications by firms in Morocco. While the potential of e-commerce is high, its takeup by firms in in Morocco is low. The e-commerce literature includes only a small strand of work on the MENA region and more especially on Morocco due mainly to the absence of surveys asking about the determinants of e-commerce activity adoption. The recent Economic Resilience Fund (ERF) survey is an important source of information on this aspect and adds to our understanding of the determinants of adoption of e-commerce in Morocco.

The rapid spread of digital technologies since the early 1990s has disrupted world societies. Digital technologies are considered to be general purpose technologies (GPTs)[2] which have the potential to have significant impact worldwide on entire economies and communities given appropriate application and management. They have the potential to address and resolve numerous economic, social, and environmental issues (Ben Youssef, 2020). GPTs are not meant to serve individual users or serve a single purpose and the economic and societal effects of the digital revolution are hotly debated by politicians, economists, and business executives. The digital transformation is a process that seeks to allow enhancements through major changes enabled by a combination of information, computation, communication, and networking technologies (Vial, 2019).

Since the 1990s, we have experienced successive waves of complementary digital technologies each with higher transformative potential than the preceding technologies. These new technologies include artificial intelligence (AI), the Internet of Things (IoT, robots, 3D printing, and virtual and augmented reality and are expected to have major impacts in all economic sectors. Many previously manual tasks have been automated and this reshaping future service and production sector employment. These digital technologies have the ability to increase productivity and market competitiveness but require a highly skilled workforce and changes to firms' business models.

In theory, the digital transformation could allow developing countries to achieve technological and development leapfrogging. However, in practice, digital dividends dependent on several conditions. It is likely that due to their different economic outlook and different access to technology developing countries will experience a different 4th industrial revolution to that experienced in the developed countries. These differences are related to the maturity of the industry sector, the adoption of technologies, skills, availability of human resources, and political governance. That the digital transformation will have a positive consolidated effect tends to be the dominant believe and in the case of African countries, the World Bank (2022) has referred to an acceleration potential of 2% additional growth.

[2] GPTs are defined as "a single generic technology, recognizable as such over its whole lifetime, that initially has much scope for improvement and eventually comes to be widely used, to have many uses, and to have many spillover effects" Lipsey et al. (2005, p. 98).

While digitalization is diffusing through society, its use for productive purposes and economic transactions is low in Africa which might explain why digitalization has not translated into creation of economic value creation and economic growth. It is important to study the diffusion of e-commerce among firms and what determines its use in order to obtain a better understanding of how digitalization can affect economic performance.

Digital technologies are enabling online sales and purchase or e-commerce/electronic commerce. One of the first studies of e-commerce by Vladimir Zwass (1996) defines it as " the sharing of business information, maintaining business relationships, and conducting business transactions by means of telecommunication networks". This early and broad definition has been replaced by an understanding of e-commerce as utilization of the internet to buy and sell products and services (Gibbs and Dedrick, 2003; Grandon and Pearson, 2004). Goyal et al. (2022) suggest that e-commerce is ushering usher in a new marketing era through convergence with conventional commerce and is providing opportunities to identify and understand customers and their needs within a wider perspective. It includes both domestic and foreign markets and is revolutionizing business and marketing practices.

E-commerce can be an important driver of economic growth in developing countries through support for international value chains, improved access to markets, increased market efficiency, and reduced operating costs (Humphrey et al., 2003; Lawrence and Tar, 2010; UNCTAD, 2015). Developing countries can be expected to benefit from adoption of e-commerce based on exploitation of competitive advantages not available in the "traditional economy" which includes inefficient marketing and export channels dominated by multiple offline intermediaries. In particular, e-commerce can stimulate growth in developing countries by enhancing the transparency and efficiency of market operations and public institutions.

However, e-commerce in the African countries started later than in China and India for instance, and has shown much less consistent growth, higher transaction costs, and apparently more limited demand. One of the leading e-commerce firms in Africa is Jumia. In Morocco, as in Africa overall, e-commerce remains at low levels and below potential; UNCTAD's (2020) index highlights the relative strengths and weaknesses of the different elements of the e-commerce process and ranks Morocco 81st among a sample of 151 countries. ANRT (2020), the Moroccan National Telecoms Regulatory Agency states that Moroccan companies' online purchases account for about 8.4 percent of total purchases and in 95 percent of cases amount to 4 percent of total purchases. This poor performance could be explained by lack of trust in legal guarantees and low use of online payment solutions.

The remaining paper is structured as follows. Section 1 discusses digitalization trends in Morocco, section 2 reviews the relevant literature, section 3 discusses digitalization and e-commerce in Morocco, section 4 presents the methodology and estimation strategy, and section 5 presents the results and discusses the findings. Section 6 offers some conclusions and implications for policy.

2. Literature review

Research on e-commerce research has grown over the last 20 years. Most e-commerce research draws on the technology acceptance model (TAM), the theory of planned behavior (TPB) or the unified theory of acceptance of use of technology (UTAUT) (Yenyuen and Yeow, 2009; Yahya et al., 2012; Pistilli and Pennarol, 2016; Liu and Yi, 2017). UTAUT theory is used less than other theories due to the more recent definition of UTAUT 2003 and UTAUT 2 in 2012.

Although there is a large literature on e-commerce adoption it is focused mostly on developed countries (Kurnia et al., 2015; Williams et al., 2009; Parker and Castleman, 2007) and large firms. E-commerce has the potential to improve efficiency and productivity in many sectors but some doubt whether this applies also to developing countries. Using data for 107 countries, Muftawu and Ibrahim (2022) employ partial least squares (PLS) structural equation modeling and show that mobile infrastructure and affordable mobile devices do not positively impact e-commerce usage.

Goyal et al. (2022) show that slow adoption of e-commerce in developing countries is due to lack of infrastructure, poor socioeconomic conditions, and absence of a national strategy which is resulting in developing countries being deprived of the benefits and contributions of e-commerce. Goya and colleagues show that to understand the introduction and spread of e-commerce in developing countries requires consideration of cultural factors.

In developing countries e-commerce is considered an innovation. Jahanshahi and Zhang (2013) show that security and privacy issues, lack of knowledge and understanding of e-commerce, and high maintenance costs are the main barriers to adoption of e-commerce by small and medium sized enterprises (SMEs) in three developing countries (Iran, Malaysia, India). Zareef and Gurvirender (2017) studied Trinidad and Tobago to examine the impact of national culture on the relationship between privacy and e-commerce adoption. They argue that individual privacy concerns and societal acceptance of e-commerce depend on cultural values regardless of the technological and economic infrastructure. They show also that the level of internet security awareness, acceptance of e-commerce, privacy, and personal interests are important to the intention to use online transactions.

Technology is the main driver of e-commerce use and access to products (Robert et al., 2011). Poor technological infrastructure in developing countries is hampering the spread of technology (Dalberg, 2011). Jovanovic (2009) explains the lack of technological innovation in developing countries as due to licensing costs.

The move to online shopping depends on technology awareness (Babar and Rasheed, 2014). Muneer Abbad et al. (2011) conclude that technological issues are constraining e-commerce in less developed countries. Jaft Lawrence et al.'s (2010) study confirms this and concludes that infrastructure is a barrier to adoption of e-commerce by developing countries and that access to technology is the main infrastructural constraint.

E-commerce offers numerous benefits to consumers and organizations. It extends consumer choice in terms of number of products available and allows user to shop at any time from any place, and to self-customize products (Turban et al., 2015). Organizations benefit through increased sales, operational efficiency, and employee productivity, reduced costs, better customer/supplier relationships, greater competitive advantage, and higher financial returns (Turban et al., 2015; Rahayu and Day, 2016).

Goyal et al. (2022) show that adoption of e-commerce in underdeveloped nations has been identified as a an infrastructural impediment in relation to access to technology including computers, lack of connectivity, access to the internet, safe on-line transactions, availability of medium and large firms, absence of a good legal system, and poor telecommunication infrastructure. Adoption by developed countries is affected by the quality of web connections and communication services available at affordable costs and choice among services, and a reliable electricity supply (Rahayu and Day, 2013).

Some studies highlight type of employment as a variable explaining e-commerce adoption. Allred et al. (2006) in their study of e-shopping found that online shoppers are wealthier than those that use physical stores. E-commerce to increase welfare depends on many factors. Among African countries, trust and means of payment have proved essential for e-commerce adoption. Amofah and Chai (2022) show that the mediation was highest between social influence and trust, and lowest between effort expectancy and trust. This challenges practitioners and managers of e-commerce platforms to contemplate the mediating role of trust to boost adoption and also the property usage of e-commerce.

Hajli et al. (2014) showed that in Iran the barriers to e-commerce are lack of awareness of the benefits of its adoption and organizational problems regarding its application. The study by Houache et al. (2020) uses a qualitative methodology based on in-depth, structured interviews to identify the factors affecting SMEs' adoption of e-commerce in Algeria. The results of the analysis show that the biggest barriers to adoption of e-commerce by SMEs in Algeria are e-payment methods, non-readiness of banks, lack of legal protection, lack in awareness of the advantages of e-commerce, and anxiety about the risks involved.

Research on the MENA countries is scarce. Ziadi and Ben Salah (2009) suggest that diffusion of use of bank cards and other forms of electronic payments would familiarize citizens with e-transactions and boost use of e-commerce activity. Doctoral research conducted by Sbei (2018) involves an empirical and exploratory analysis conducted on a sample of about 400 Tunisian students. It asks about adoption of e-commerce and shows that while internet use is relatively well diffused among young Tunisians, adoption of e-commerce needs to be encouraged.

In the specific case of Morocco, research on adoption of e-commerce remains limited. In the Moroccan case, d Bighrissen (2022) examines the main factors hindering cooperatives from adopting e-commerce solutions in the Agadir region. Their conceptual model draws on previous research and uses structural equation modeling applied to a sample of 102 cooperatives. The

study shows that technical, economic, and external factors inhibit e-commerce adoption among cooperatives.

Gallab et al. (2020) studied the challenges and opportunities posed by industry 4.0 in the case of Moroccan firms and according to sectors. They found that adoption of most technologies such as computer aided design, big data, additive manufacturing, simulation, and the IoT improved product quality, productivity, and decision-making, and reduced operational costs. They found also that the obstacles to adoption of digital technologies by Moroccan firms included internal barriers such as high implementation costs, lack of clarity in defining return on investment, poor corporate structure, and culture and the external barrier of difficulty involved in identifying technologies and partners which influences the choice of technologies especially by large companies. Dahbi and Benmoussa (2019) conducted an exploratory investigation on e-commerce adoption by SMEs in Morocco and found that it is affected by technological, financial, cultural, and organizational factors – the first two being the most critical ones.

3. Digitalization in Morocco: main trends

Morocco's telecommunication infrastructure was privatized in the early 1990s – a move that provided successful and has resulted in reduces cost of access to telecommunications. Morocco's pioneering regulatory reforms in the mobile sector in the late 1990s has resulted in it having the highest teledensity in the region. It also embarked on the construction of a number of technology parks and technology industrial zones which attracted foreign direct investment (FDI) and enabled advanced manufacturing. It has implemented national plans in several fields such as industry, agriculture, fisheries, ICT, and tourism in line with a knowledge-based development path.

In January 2022, there were 31.59 million internet users in Morocco and its internet penetration rate was 84.1 percent of the total population. Kepios analysis indicates that between 2021 and 2022 the number of internet users in Morocco increased by 363,000 (+1.2%). This means that 5.96 million people in Morocco were not internet users at the start of 2022, and that 15.9 percent of the population were not online . The COVID-19 pandemic had a negative effect on research on internet adoption and actual internet user figures may be higher (Data Reportal, 2022). According to ANRT(2020), the rate of penetration of smartphone equipment was 137.5 percent at the end of 2020. Based on this indicator, the International Telecommunication Union (ITU) (2021) ranked Morocco 5th among the 22 Arab countries. However, these statistics give no indication of the quality of access to networks which in rural compared to urban areas is very limited. Total revenue from e-commerce in Morocco was $300 million in 2021 with growth of 40% . This high growth is due to the current 69 percent internet penetration rate and increased usage of online shopping and payment methods.

Morocco has a fast-growing innovation ecosystem and is the 2nd most competitive country for new technologies in North Africa, and is 77th in the world according to the Global Innovation Index 2021 (GII, 2021). Since 2012, Morocco has pursued a cluster development strategy to

increase productivity and innovation, in line with the 2009 Morocco Innovation Initiative. Currently, most incubators and accelerators are located in the Casablanca and Rabat areas, but the Cities of Professions and Skills (CMC) project is aimed at diffusing the innovation ecosystem structure. In addition, growth of Morocco's innovation ecosystem is supported by comprehensive funding and support programs including the Innov-Investment Fund and the Mohammed VI Investment Fund.

The Government of Morocco's (GoM) innovation agenda is managed by the Digital Transition and Administration Reform, Economic Inclusion, Small Business, Employment and Skills, Industry and Trade, and Higher Education, Scientific Research and Innovation ministries. These institutions in collaboration with an extensive network of agencies and organizations in Morocco are actively shaping the Moroccan innovation ecosystem through a number of programs, public works, projects, and regulations.

4. Methodology

In the case of a qualitative (dichotomous or multiple choice) dependent variable, a simple or multiple linear regression model is not appropriate. . Based on the characteristics of the dependent variable (nature: qualitative, modalities: two), a binary (dichotomous) model is more appropriate to allow the binary qualitative dependent variables to indicate the presence or absence of a probabilistic event.

From a theoretical perspective, three main models are possible: probit model, logit model, and linear probability model. However, in practice, probit and logit models tend to be used. The distribution function of the probit model error follows a reduced centered normal distribution and in the logit model follows a logistic distribution (Greene, 2018). This means that these models are distinguished by their distribution functions and their random deviation variances. The variance of the random deviations of the normalized probit model is unity (1) and in the logit is $\pi^2/3$ (Amemiya, 1985).

We start by employing logistic regression model (supported by a probit model). This choice is justified by the fact that the logit model offers the advantage of alternative interpretations (including the signs of the coefficients, marginal effects, and odds ratios) of the results (Freedman, 2008). It also allows "extreme" events to be assigned a higher probability than the normal distribution (Greene, 2018). The model can be expressed as a basic logit regression model as follows:

$$EA_i = \beta_0 + \beta_1 FC_i + \beta_i X_i + \varepsilon_i$$

where EA_i is a binary variable which takes the value 1 if the firm has adopted an e-commerce system and 0 otherwise. FC_i is a dummy variable for the firm's technological support to encourage adoption of e-commerce, and X_i is a vector of the observed characteristics believed to influence the firm's e-commerce adoption decision and include firm size, firm age, firm location, economic sector, workforce digital skills, product innovation, etc.

Existing studies point to the importance of the selection issue for analyzing the determinants of adoption of digital technologies including e-commerce. Adoption of e-commerce is not a random firm decision; firms with favorable facilitating conditions are more likely to adopt e-commerce. This endogeneity of the facilitating condition variables could bias our estimates, and especially if the factors associated to the availability of an organizational and technical infrastructure and specific support to use that infrastructure also affect the decision to adopt e-commerce.

To address these issues, we also applied the conditional mixed process with a heteroskedasticity-robust standard errors (CMP) framework proposed by Roodman (2011). This method is frequently employed to analyze the determinants of digital technology adoption. Through use of a seemingly unrelated regression (SUR) technique, the CMP method allows simultaneous estimation of the determinants of e-commerce adoption and facilitating conditions. The CMP model consists of two equations with correlated errors. The first equation (eq. 2) takes the probability of e-commerce adoption as the dependent variable and considers a set of factors that could affect the decision to adopt this strategy. The second equation (eq. 3) analyzes the effects of the availability of basic equipment and uses and its interaction with the existence of facilitating conditions for e-commerce adoption, along with the control variables described above.

To enable more consistent estimates of the determinants of e-commerce adoption by Moroccan firms, we estimate the following equations :

$$EA_i = \beta_0 + \beta_1 FC_i + \beta_i X_i + \omega_i$$

$$FC_i = \gamma_0 + \gamma_1 Z_i + \gamma_2 X_i + \mu_i$$

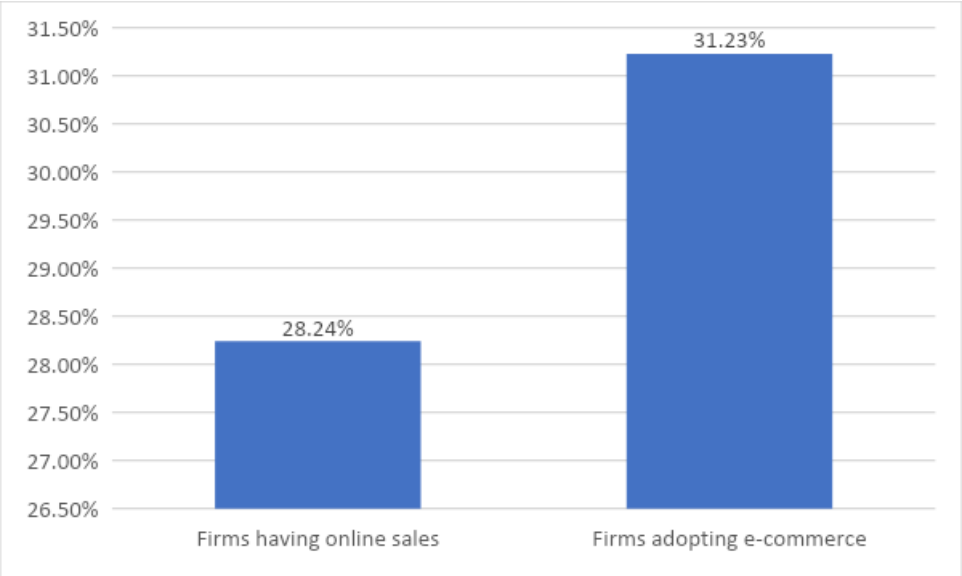
where Z represents the instrument (i.e. availability of computers, website, and information technology staff), X_i is a vector of the explanatory variables excluding the instrumental variables, and μ_i and ω_i are the error terms.

5. Results

5.1. Descriptive statistics

Primary data were collected in July 2022 from 807 firms in Morocco. Tables 1 and 2 provide descriptive statistics for the qualitative variables. They show that fewer than a third of the firms surveyed have adopted e-commerce (31.23%), measured by the proportion of firms engaging in online buying and/or selling. Also, 79.80% of firms have fewer than 15 employees. In terms of firm age, 25.99% of the sample are young firms (less than 5 years old) and 36.58 have been in the market for between 6 and 10 years. Tables 1 and 2 indicate also that 20.06% of firms are aged between 11 and 15 years with only 17.37% of firms older than 15 years .

Figure 1. Adoption of e-commerce



The descriptive analysis shows that 44.24 percent of the companies surveyed are located in the Casablanca-Settat region, 14.75 percent in the Rabat-Salé-Kénitra region, 10.66 percent in the Marrakech-Safi region, 9.67 percent in the Fez-Meknes region, and 8.05 percent in the Tangier-Tetouan-Al Hoceima region percent. These five regions account for 87.37 percent of the sample companies. Accommodation and food services is the largest industry sector (21.81%) followed by motor vehicle retail or wholesale or services (19.58%). The industry sectors with the smallest representation are chemicals and chemical products and petroleum products, plastics and rubber with 0.99 percent and 0.5 percent respectively. In terms of higher education (university degree) around 32.71 percent of the firms in the sample include less than 25% of their workforce with a university degree, and only 17.35 percent of firms include more than 75 percent of the workforce with higher education . Most of the enterprises (80.79%) are managed or owned by a man. 48.94 percent of the sample have an information technology infrastructure to support sales and customer service activities, 55.90 percent and 48.74 percent use social media and smartphones respectively for business purposes, 68.65 percent indicated having a website, 46.70 percent have internet access, 5.57 percent do not use computers for business purposes, 40.52 percent are engaged in product innovation activities, and 7.81 percent are listed on digital platforms. Finally, 60.15 percent of the sample did not consider digital skills to be required for employment in the organization.

Table 1. Descriptive statistics

Variables	Observations	Mean	Standard Deviation	Min	Max
E-commerce adoption	807	0.3123	0.4637	0	1
Firm size	807	2.1239	1.1357	1	4
Firm age	710	2.2901	1.0369	1	4
Firm location	807	5.2577	2.0881	1	12
Economic sector	807	11.4027	4.3189	1	18
Highly educated workers	807	2.1958	1.0771	1	4
Managerial staff digital skills	517	0.7215	0.4487	0	1
Workers digital skills	517	0.3985	0.4901	0	1
Facilitating conditions	517	0.4894	0.5004	0	1
Social media use	517	0.5590	0.4970	0	1
Women in the workforce	807	1.9455	0.8582	1	4
Gender of the firm's owner	807	0.8079	0.3942	0	1
Digital platform use	807	0.0781	0.2684	0	1
Product innovation	807	0.4052	0.4912	0	1
Smartphone use	517	0.4874	0.5003	0	1
Having own website	807	0.3135	0.4642	0	1
Using computers for business	503	3.0219	1.2310	1	5
Having Internet access	621	0.5330	0.4993	0	1

Table 2. Descriptive analysis of qualitative data

Variable	Frequency	Percentage	Cumulative percentage
E-commerce adoption			
Non adopters	555	68.77	68.77
Adopters	252	31.23	100.00
Firm size			
5 employees or less	313	38.79	38.79
6 to 10 employees	244	30.24	69.02
11 to 15 employees	87	10.78	79.80
More than 15 employees	163	20.20	100.00
Firm age			
5 years or less	184	25.99	25.99
6 to 10 years	259	36.58	62.57
11 to 15 years	142	20.06	82.63
More than 15 years	123	17.37	100.00
Firm location			
Tanger-Tetouan-Al Hoceima	65	8.05	8.05
Oriental	21	2.60	10.66
Fès-Meknès	78	9.67	20.32
Rabat-Salé-Kénitra	119	14.75	35.07

Table 2. Descriptive analysis of qualitative data (contd.)

Béni Mellal-Khénifra	15	1.86	36.93
Casablanca-Settat	357	44.24	81.16
Marrakech-Safi	86	10.66	91.82
Drâa-Tafilalet	7	0.87	92.69
Souss-Massa	47	5.82	98.51
Guelmim-Oued Noun	6	0.74	99.26
Laayoune-Sakia El Hamra	4	0.50	99.75
Eddakhla-Oued Eddahab	2	0.25	100.00
Economic sector			
Agriculture, fishing or mining	12	1.49	1.49
Textile & Garments	27	3.35	4.83
Industry of Food	39	4.83	9.67
Industry of mechanics or electronics or Vehicles	25	3.10	12.76
Leather Products	15	1.86	14.62
Chemicals & Chemical Products	8	0.99	15.61
Petroleum products, Plastics & Rubber	4	0.50	16.11
Non-Metallic Mineral Products	15	1.86	17.97
Basic Metals, Metal Products, Wood Products, Furniture, Paper & Publishing	53	6.57	24.54
Construction or utilities	26	3.22	27.76
Retail or Wholesale or Services of Motor Vehicles	158	19.58	47.34
Transportation and storage	30	3.72	51.05
Accommodation and food services	176	21.81	72.86
Information and communication or IT	48	5.95	78.81
Financial activities or real estate	30	3.72	82.53
Education	40	4.96	87.48
Health	55	6.82	94.30
Other Manufacturing or services	46	5.70	100.00
Highly educated workers			
25% or less	264	32.71	32.71
26% to 50%	261	32.34	65.06
51% to 75%	142	17.60	82.65
More than 75%	140	17.35	100.00
Women in the workforce			
25% or less	281	34.82	34.82
26% to 50%	328	40.64	75.46
51% to 75%	159	19.70	95.17
More than 75%	39	4.83	100.00

Table 2. Descriptive analysis of qualitative data (contd.)

Gender of the firm's owner			
Female	155	19.21	19.21
Male	652	80.79	100.00
Managerial staff digital skills			
Digital skills not important	144	27.85	27.85
Digital skills important	373	72.15	100.00
Workers digital skills			
Digital skills not important	311	60.15	60.15
Digital skills important	206	39.85	100.00
Facilitating conditions			
Not having information technology support	264	51.06	51.06
Having information technology support	253	48.94	100.00
Social media use			
Don't use social media for business purposes	228	44.10	44.10
Use social media for business purposes	289	55.90	100.00
Digital platform use			
Firm not listed on app or website	744	92.19	92.19
Firm listed on app or website	63	7.81	100.00
Product innovation			
Do not have product innovation activities	480	59.48	59.48
Having product innovation activities	327	40.52	100.00
Smartphone use			
Not using smartphones for business	265	51.26	51.26
Using smartphones for business	252	48.74	100.00
Firm's website			
Do not have a website	554	68.65	68.65
Having own website	253	31.35	100.00
Having Internet access			
Firm don't have access to the Internet	290	46.70	46.70
Firm have access to the Internet	331	53.30	100.00
Using computers for business purposes			
Do not use computers for business purposes	28	5.57	5.57
1-25% of employees	185	36.78	42.35
26 to 50% of employees	144	28.63	70.97
51 to 75% of employees	40	7.95	78.93
76 to 100% of employees	106	21.07	100.00

5.2. Estimation results

Table 3 presents the estimations of determinants of e-commerce adoption using logit, probit, and conditional mixed-process probit models. Since these are binary models, the coefficients

are not interpretable directly. Indeed, the signs of these coefficients indicate downward or upward influence of the associated variables on the probability of adopting e-commerce. To get an idea of the sensitivity of the probability of adopting e-commerce, in the logit model we use the odds ratio.

Roodman's (2011) CMP estimation approach accounts also for endogeneity due to self-selection bias. The atanhrho_12 statistic reported at the bottom of the table, measures the covariance of the error terms in the two equations used and is negatively significant, indicating that some unobserved factors are negatively affecting both the outcome variable (e-commerce adoption) and the endogenous variables (facilitating conditions); however, these are accounted for in the estimation.

Observing the values of the coefficients and odds ratios and their probabilities, and the values of the Pseudo R^2, we see that most of the variables explain the probability of adopting e-commerce. In Morocco, firm age, firm location in the Oriental, Casablanca-Settat, or Souss-Massa regions have between 51 percent and 75 percent of employees with higher education. We see that the level of digital skills of management, facilitating conditions, use of social media for business purposes, use of digital platforms, product innovation, and the use of smartphones for business purposes have a significant effect on the likelihood of the firm adopting e-commerce. However, firm size, women employees, women managers or owners, and level of employees' digital skills have no effect on the probability of adoption of e-commerce in Morocco.

Table 3. Regression results of the Logit, Probit and Mixed-process models

Variable	Logit		Probit	CMP
	Coefficient	Odds ratio		
Firm size				
5 employees or less	(Ref.)	(Ref.)	(Ref.)	(Ref.)
6 to 10 employees	-0.3131 (0.2763)	0.7311 (0.2020)	-0.1758 (0.1592)	-0.2244 (0.1369)
11 to 15 employees	-0.2639 (0.6131)	0.7681 (0.4709)	-0.1368 (0.3448)	-0.3601 (0.3212)
More than 15 employees	0.6493 (1.3377)	1.9143 (2.5608)	0.4434 (0.7478)	0.3265 (0.5790)
Firm age				
5 years or less	(Ref.)	(Ref.)	(Ref.)	(Ref.)
6 to 10 years	-0.5392* (0.3193)	0.583* (0.186)	-0.310* (0.185)	-0.3046* (0.1648)
11 to 15 years	-0.7578** (0.3923)	0.469** (0.184)	-0.465** (0.223)	-0.4077** (0.1927)
More than 15 years	-1.3204*** (0.3712)	0.267*** (0.099)	-0.792*** (0.217)	-0.6907*** (0.1991)

Table 3. Regression results of the Logit, Probit and Mixed-process models (contd.)

Firm location				
Tanger-Tetouan-Al Hoceima	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Oriental	-1.0947 (0.7236)	0.3347 (0.2422)	-0.6588 (0.4253)	-0.5909 (0.4015)
Fès-Meknès	-0.7791 (0.5697)	0.4588 (0.2614)	-0.4230 (0.3149)	-0.4135 (0.2617)
Rabat-Salé-Kénitra	-0.3110 (0.5284)	0.7327 (0.3872)	-0.1709 (0.2993)	-0.1571 (0.2549)
Béni Mellal-Khénifra	-0.0025 (0.7424)	0.9975 (0.7406)	0.0480 (0.4569)	0.0628 (0.4352)
Casablanca-Settat	-0.8414* (0.4591)	0.4311* (0.1979)	-0.4874* (0.2574)	-0.4126* (0.2176)
Marrakech-Safi	-0.7576 (0.6104)	0.4688 (0.2862)	-0.4221 (0.3341)	-0.3677 (0.2683)
Drâa-Tafilalet	-1.0348 (0.9261)	0.3553 (0.3291)	-0.5903 (0.5866)	-0.4661 (0.6078)
Souss-Massa	-2.0786*** (0.6422)	0.1251*** (0.0803)	-1.2346*** (0.3707)	-1.1137*** (0.3763)
Guelmim-Oued Noun & Laayoune-Sakia El Hamra & Eddakhla-Oued Eddahab	-0.9960 (1.1737)	0.3694 (0.4335)	-0.5661 (0.6855)	-0.6899 (0.5708)
Economic sector				
Agriculture, fishing or mining	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Textile & Garments	1.9003 (1.3454)	6.6877 (8.9976)	1.1098 (0.7593)	0.5424 (0.6288)
Industry of Food	0.2435 (1.3505)	1.2757 (1.7228)	0.0962 (0.7612)	-0.2422 (0.6273)
Industry of mechanics or electronics or Vehicles	1.4374 (1.3278)	4.2095 (5.5894)	0.8003 (0.7563)	0.3184 (0.5801)
Leather Products	3.2087** (1.4139)	24.7472** (34.9893)	1.8567** (0.7945)	1.3308 (0.6417)
Chemicals & Chemical Products	3.8332** (1.7081)	46.2104** (78.9341)	2.2360** (0.9540)	1.2595 (0.8013)
Petroleum products, Plastics & Rubber	0.9891 (1.7900)	2.6887 (4.8130)	0.5428 (1.0922)	0.2460 (0.9960)
Non-Metallic Mineral Products	2.7625* (1.5892)	15.8398* (25.1726)	1.6075* (0.8782)	0.8570 (0.7077)
Basic Metals, Metal Products, Wood Products, Furniture, Paper & Publishing	3.0818*** (1.3048)	21.7982*** (28.4412)	1.8289*** (0.7342)	1.2329** (0.5878)
Construction or utilities	1.3719 (1.4061)	3.9427 (5.5438)	0.8036 (0.7831)	0.3898 (0.5943)
Retail or Wholesale or Services of Motor Vehicles	2.2189* (1.2376)	9.1975* (11.3828)	1.2901* (0.6918)	0.7551 (0.5235)
Transportation and storage	2.3003* (1.2926)	9.9774* (12.8963)	1.3604* (0.7288)	0.7261 (0.5891)
Accommodation and food services	2.0337* (1.2305)	7.6421* (9.4036)	1.1398* (0.6877)	0.6838 (0.5149)

Table 3. Regression results of the Logit, Probit and Mixed-process models (contd.)

Information and communication or IT	2.1938* (1.2643)	8.9693* (11.3396)	1.3033* (0.7082)	0.7159 (0.5532)
Financial activities or real estate	1.0778 (1.3484)	2.9383 (3.9619)	0.6448 (0.7510)	0.1513 (0.5564)
Education	3.5088*** (1.3918)	33.4069*** (46.4970)	2.0336*** (0.7679)	1.4422*** (0.5998)
Health	2.7243** (1.3218)	15.2450** (20.1501)	1.5953** (0.7341)	0.9677* (0.5736)
Other Manufacturing or services	2.3431* (1.2736)	10.4133* (13.2623)	1.3519* (0.7154)	0.8359 (0.5611)
Highly educated workers				
25% or less	(Ref.)	(Ref.)	(Ref.)	(Ref.)
26% to 50%	0.2957 (0.3172)	1.3441 (0.4264)	0.1568 (0.1831)	0.0640 (0.1591)
51% to 75%	1.0877*** (0.4083)	2.9675*** (1.2116)	0.6039*** (0.2310)	0.3972** (0.1946)
more than 75%	0.1100 (0.4089)	1.1163 (0.4565)	0.0481 (0.2302)	-0.1042 (0.1908)
Women in the workforce				
25% or less	(Ref.)	(Ref.)	(Ref.)	(Ref.)
26% to 50%	-0.0872 (0.2972)	0.9165 (0.2724)	-0.0563 (0.1684)	-0.0419 (0.1394)
51% to 75%	-0.3690 (0.3712)	0.6914 (0.2566)	-0.1951 (0.2123)	-0.1647 (0.1777)
more than 75%	0.0265 (0.6374)	1.0269 (0.6545)	-0.0477 (0.3834)	-0.0385 (0.3227)
Gender of the firm's owner				
Female	(Ref.)		(Ref.)	(Ref.)
Male	0.4595 (0.3180)	1.583 (0.504)	0.2596 (0.1851)	0.2650 (0.1731)
Managerial staff digital skills				
Digital skills not important	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Digital skills important	0.4967* (0.3082)	0.6085* (0.1875)	0.2897* (0.1755)	-0.3373** (0.1473)
Workers digital skills				
Digital skills not important	(Ref.)		(Ref.)	(Ref.)
Digital skills important	0.2131 (0.2762)	1.2375 (0.3418)	0.1358 (0.1573)	0.0904 (0.1338)
Facilitating conditions				
Not having IT support	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Having IT support	0.5235* (0.2975)	1.6879* (0.5022)	0.3017* (0.1673)	1.3709*** (0.2340)
Social media use				
Do not use social media for business purposes	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Use social media for business purposes	1.1709*** (0.2600)	3.2248*** (0.8383)	0.6928*** (0.1500)	0.5234*** (0.1438)

Table 3. Regression results of the Logit, Probit and Mixed-process models (contd.)

Digital platform use				
Firm not listed on app or website	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Firm listed on app or website	0.9447** (0.4161)	2.5720** (1.0702)	0.5804*** (0.2298)	0.4421** (0.2048)
Product innovation				
Do not have product innovation activities	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Having product innovation activities	0.6055*** (0.2418)	1.8321*** (0.4429)	0.3539*** (0.1392)	0.3272*** (0.1219)
Smartphone use				
Not using smartphones for business	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Using smartphones for business	1.2270*** (0.2742)	3.4111*** (0.9351)	0.7283*** (0.1561)	0.5700*** (0.1441)
Constant	-2.8391** (1.3026)	0.0585** (0.0762)	-1.6544** (0.7326)	-1.3615** (0.5716)
Facilitating conditions				
Computers use				
Not using computers for business				(Ref.)
Using computers for business				0.1610*** (0.0492)
Firm's website				
Do not have own website				(Ref.)
Having own website				0.6731*** (0.1082)
Internet access				
Firm do not have access to the Internet				(Ref.)
Firm have access to the Internet				0.0816*** (0.1200)
Constant				-1.2083*** (0.1897)
Observations	462	462	462	512
Log pseudolikelihood	-234.7048	-234.7048	-234.4637	-539.3411
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.2661	0.2661	0.2668	
atanhrho_12				-0.9456*** (0.2995)
rho_12				-0.7378 (0.1365)

Notes: ***, **, * denote significance at the 1%, 5%, 10% levels; ref denotes modality thresholds. Values in parentheses are robust standard errors.

In relation to the sample firms' sectors of activity, the results show that firms in the basic metals, metal products, wood products, furniture, paper and publishing, education, and health sectors are respectively 21.79, 33.40, and 15.24 times more likely to adopt e-commerce.

Firm age seems to be important for adoption of e-commerce with a negative and significant coefficient in all the models. The odds ratio values in the logit model imply that in Morocco,

the newer the firm, the higher the adoption of e-commerce. Firms aged 11-15 years and more than 15 years are 0.46 and 0.26 times less likely to adopt e-commerce than those aged less than 5 years. This is explained as that younger firms are more likely to adopt technological innovations than older firms with more traditional attitudes and reluctance to change. Older firms are likely to find it more difficult to adopt e-commerce than younger firms, due to their limitations in adopting new technologies. This result is consistent with Amornkitvikai et al. (2022), Nair et al. (2019), and Walker et al. (2016).

In terms of firm location, we found that firms located in the Oriental, Casablanca-Settat, and Souss-Massa regions are less likely to adopt e-commerce than those located in the Tangier-Tetouan-Al Hoceima region. No other firm location modality contributes to explaining the adoption of e-commerce in Morocco. Our findings are in line with Jabbouri et al. (2022), and suggest that access to the Internet, lack of information, and the cost of technology are the most important barriers to adoption of e-commerce in the Rabat-Salé-Kenitra, Fes-Meknes, Rabat-Salé-Kenitra, and Beni Mellal-Khenifra regions.

In relation to owner, manager, and employee gender, these variables have no influence on adoption of e-commerce in Morocco. Similarly, firm size also has no effect on the probability of adoption of e-commerce . The coefficients of these variables are statistically insignificant.

The variable employee level of education shows that having a significant proportion of employees who are university graduates has a positive effect on the probability of e-commerce adoption in Morocco. Firms with between 51 percent and 75 percent of workforce with higher education are 2.96 times more likely to adopt e-commerce. This is because use of the technologies related to e-commerce requires minimum cognitive and technological abilities. This finding confirms the results in the studies by Abualrob and Kang (2016), Bou-Shouk and Eraqi (2015), and Liu et al. (2021).

The results show also that the level of digital skills required to recruit new employees has an insignificant statistical effect on the probability of e-commerce adoption by Moroccan firms. It seems that use of e-commerce depends on workers' digital literacy levels. Lack of digital cognitive skills limits use of ICTs required to develop e-commerce activities to rudimentary uses with no added value. This shows the low importance given to e-commerce among all digital technologies.

The importance of digital skills to executive appointment decisions is statistically significant at the 10 percent level and is significant for willingness to adopt e-commerce, with an odds ratio value of 0.60. The suggests that firms do not recognize the effect of digital skills on the decision to adopt e-commerce and is consistent with the findings in Ghobakhloo et al. (2011), Muathe et al. (2020), and Walker et al. (2016).

The positive coefficient of facilitating conditions in all the models indicates that the facilitating conditions for using a technology or system are extremely important for increasing the

probability of e-commerce adoption by firms. Based on the result of the logit estimation, calculation of the odds ratio shows that the availability of organizational and technical infrastructure to support use of the system increases the chances of e-commerce adoption by 1.68 times.

The fact that the firm is listed on an app, website, or digital platform such as Amazon or Jumia, increases the probability of e-commerce adoption. This highlights the importance of being part of an online commerce network for the probability of e-commerce adoption which increases by 2.57 times. This is as expected since these digital platforms provide a wealth of resources to enable users get the best out of their experience and offer detailed guides and tutorials. The large user bases of these platforms make them an ideal choice for firms looking to conduct e-commerce.

The logit model shows that the probability of e-commerce adoption increases significantly (at the 1% level) with employees' use of social media and smartphones for business purposes. The odds ratios of these two variables show that the likelihood of adoption increases by 3.22 and 3.41 times respectively. This result is in line with the literature (Apergis, 2019; Mahliza, 2019; Rahayu and Day, 2016; Vyas et al., 2016).

Engaging in product innovation activities has a positive influence on the probability of adoption, statistically significant at the 1% level in all the models. Firms that introduce new products/services, or a production process innovation experienced a 1.83-fold increase in the probability of e-commerce adoption.

6. Conclusions and recommendations

This paper set out to analyze adoption of e-commerce by firms in Morocco. Using a probit model, we identified the main factors affecting the adoption of e-commerce by Moroccan firms. While digitalization in Morocco is advancing, adoption of e-commerce remains low. Most firms do not consider development of e-commerce to be a priority and there is a lack of the skills required for e-commerce adoption in Moroccan firms.

This paper provides five main findings. First, firm age is an important indicator of adoption of e-commerce. Younger firms are more likely to adopt e-commerce since they are more open to innovation and change. Second, adoption of e-commerce depends on education level and firms more workers with higher education workers are more likely to adopt e-commerce. Third, the level of digital skills required by new recruits has no effect on the probability of adopting e-commerce. This indicates the low importance given by Moroccan firms to e-commerce adoption, and the fact that they do not consider digital literacy to be a prerequisite for recruitment. Fourth, listing on a digital platform increases the probability of adoption of e-commerce. Fifth, innovation activities and introduction of new products and services influences adoption of e-commerce in Moroccan firms.

Based on these findings we propose the following recommendations for firms in Morocco.

1. Moroccan firms should change their business strategy and leverage the potential of new technologies and a shift to online. E-commerce requires firms to have some degree of digitization, and therefore the internet and digital technologies are crucial for effective e-commerce adoption.
2. Firms should have a consumer retention online strategy. Since e-commerce saves time and has several benefits, many consumers would prefer to buy online to save time. Adoption of e-commerce could increase consumer numbers consequently sales.
3. There is a need to train employees and provide them with the skills required for adoption of e-commerce. Firms should offer programs to help workers achieve the necessary digital skills. Equipping employees with digital skills is important to improve the functioning of e-commerce.
4. Firms should seek a digital platform listing and explore new ways to leverage the online market. Digital platforms are affecting daily life, and listing on an e-commerce digital platform could provide many benefits including reaching more consumers and increasing visibility.
5. There is a need to introduce more innovative products and services online. This would increase the market and improve e-commerce.

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