Mobile Data Internet Costs and E-shopping Frequency: Evidence from Seven Regions

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Abstract: Understanding the relationship between data costs and e-shopping adoption is crucial in today's digital age. Given the numerous benefits of e-shopping such as increased market access, convenience, and cost savings for both businesses and consumers, e-shopping has become an essential component of worldwide commerce and the expansion of the economy. However, access to affordable and reliable internet connectivity is essential for e-shopping to thrive. To conduct this investigation, panel data from a diverse set of countries spanning different regions is utilized. The objective of this study is to investigate the potential relationship between the cost of data over the internet and e-commerce by utilizing panel data from 100 nations across seven distinct regions. The data used in this study is sourced from the 3i-index database, which covers a period of 3, 4, or 5 consecutive years ranging from 2018 to 2022. The primary focus of this research is to examine how the price of a 1 GB prepaid mobile broadband data package influences countries level of e-shopping. By analyzing the correlation between these two variables, the study aims to shed light on the impact of data costs on e-shopping usage patterns. The study incorporates countries' nominal GDP, aggregate population, and e-shopping safety as control variables to examine their relationship with the cost of mobile data internet and its impact on e-commerce in different regions. The results indicate a general positive association between mobile costs and e-shopping; however, results indicate a negative correlation between the cost of mobile data internet and e-shopping in the Middle East and North Africa region within a specific threshold. In contrast, results indicate a positive correlation between the two variables in North America, while no significant correlation is observed in all other regions. The study provides insightful explanations and policy implications to promote e-shopping.

JEL Classification: L81, L86, O1.

Keywords: E-Commerce, E-Shopping, M-Shopping, Mobile Data Cost.

1. INTRODUCTION

The way people engage in various activities, including online shopping, has been revolutionized by the rapid growth of mobile internet usage. With smartphones becoming increasingly available and affordable, consumers now have the convenience of accessing e-shopping platforms anytime and anywhere. However, an important factor that significantly impacts e-shopping behavior is the cost of mobile data internet. In recent years, there has been a tremendous increase in global smartphone penetration, with the United States leading with a penetration rate of 81.6%, followed by Japan at 78.6%, Russia at 73.6%, and China at 68.4% (Newzoo, 2022).

The widespread adoption of smartphones has resulted in a significant increase in the usage of mobile internet, as individuals now heavily rely on their devices for various online activities, including shopping. In 2022, around 66% of the global population, equivalent to approximately 5.3 billion individuals, were utilizing the internet, as reported by the International Telecommunication Union (ITU). Furthermore, statistics from Cisco in 2020 indicate that 71% of the global population had mobile connectivity by 2023. Additionally, GSMA Intelligence reported that by the end of 2022, over 5.4 billion people worldwide subscribed to a mobile service, with 4.4 billion individuals also utilizing the mobile internet.

The future is expected to witness a substantial increase in the quantity of mobile devices and connections. According to Cisco (2020), smartphones are expected to continue dominating the market, accounting for over 90% of all mobile devices by 2024. This indicates that smartphones will remain the most popular choice among consumers. Furthermore, according to GSMA Intelligence (2023), over 67% of the world's population presently utilizes a mobile phone, with the number of distinct mobile users reaching 5.48 billion in April 2023 and expected to increase to 6.3 billion by 2030. This highlights the widespread adoption and increasing reli-

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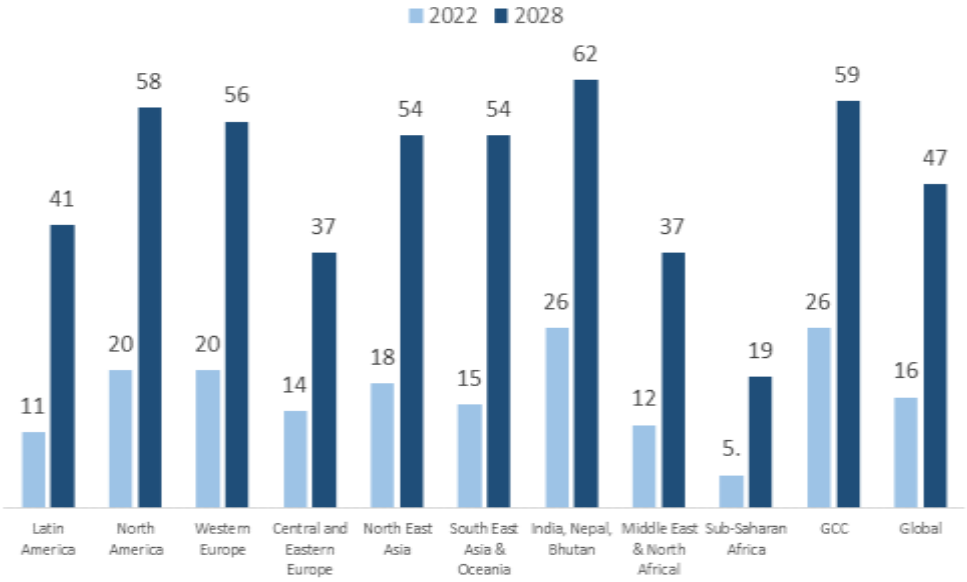


Source: Author's visualization of data from Ericsson mobile data outlook (2020).

Fig. (1). World and regional mobile internet GB data usage 2022 and 2028.

ance on mobile devices worldwide. In terms of mobile data usage, Ericsson reports that the monthly global average usage per smartphone is anticipated to exceed 20GB by the end of 2023. However, it is important to note that this figure can vary significantly across different regions (see Fig. **1**).

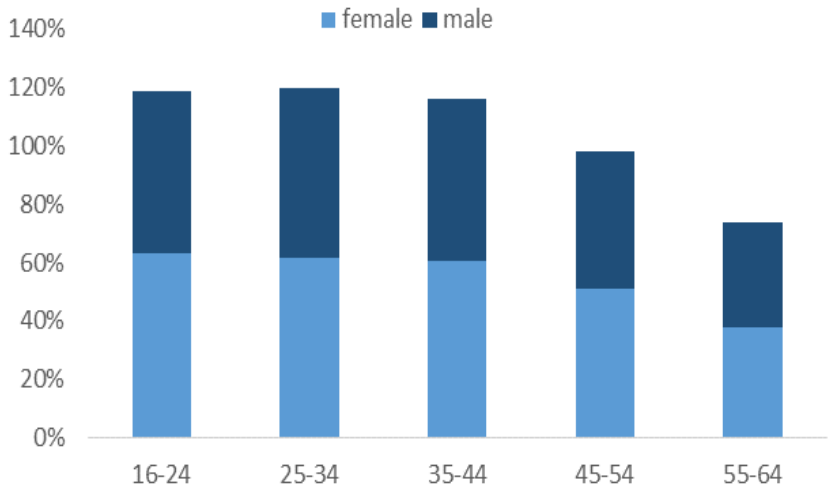
In 2021, mobile phones accounted for approximately 53 percent of the world's online time, according to We Are Social & Hootsuite (2021). Online shopping and reviewing products and services are among the main activities carried out on the internet. Global Web Index's data from 2020 revealed that younger generations are significantly more inclined to use mobile phones for online purchases, but this trend diminishes among their parents' generation (see figure 2). According to the 2021 report by UNCTAD, the global e-commerce sector has witnessed substantial expansion. In 2019, e-commerce sales reached an astonishing $26.7 trillion, underscoring its increasing significance as a catalyst for economic growth and development on a global scale. The report emphasizes the steady growth of e-commerce's impact on Gross Domestic Product (GDP), showing an average global increase of 3.5% from 2017 to 2019. Moreover, it emphasizes the potential of e-commerce to contribute to sustainable development goals by facilitating inclusive growth, job creation, and poverty reduction.

The affordability of mobile data internet can hinder consumers from fully embracing the convenience and accessibility of mobile e-commerce. While the benefits of shopping on mobile devices are undeniable, the varying costs of mobile data plans across different regions can create barriers for some individuals. These discrepancies in mobile data internet costs have the potential to influence consumers' online shopping behavior, as higher costs may discourage them from engaging in e-commerce activities on their mobile devices. Understanding the correlation between mobile data internet expenses and the frequency of online shopping is of utmost importance for businesses and policymakers alike. E-commerce companies must grasp the impact of pricing structures on consumer behavior in order to optimize their marketing strategies and customize their offerings accordingly. Policymakers can leverage this understanding to introduce regulations or initiatives that encourage affordable mobile data plans, thereby fostering a more inclusive digital economy.

The aim of this research is to examine the relationship of mobile data internet cost and e-shopping among different regional groups. By examining diverse regions, insights can be gained into how varying levels of mobile data internet costs impact e-shopping frequency across different socio-economic contexts. The subsequent section of this paper presents a review of existing literature, which is followed by a section outlining the methodology employed in the study. This is then followed by a discussion section where the findings and results are analyzed and interpreted. Finally, there is a concluding section that summarizes the key points discussed and provides policy recommendations based on the study's outcomes.

2. LITERATURE REVIEW

As the popularity and usage of smartphones continue to rise, there is a significant increase in the demand for internet bandwidth on cellular networks. This surge can be attributed to the extensive data traffic generated by mobile browsers and applications. Consequently, cellular networks are encountering resource limitations and higher costs in order to cater to the escalating bandwidth requirements. To alleviate the strain on the cellular infrastructure, users may have to bear the burden of paying more for each byte of data consumed (Qian et al., 2012; Mendoza et al., 2015). However, it



Source: Author's visualization of data from the Global Web Index (GWI) (2020).

Fig. (2). Adoption of e-shopping using mobile data internet around the world.

is important to note that mobile devices offer customers unparalleled flexibility, making mobile shopping a superior option compared to other devices for its convenience and accessibility. The customer's purchasing experience becomes more intuitive when the limitations of physical space and time are removed, allowing for a more flexible and convenient shopping process (Schoppmann, 2017).

The field of retailing is multifaceted, encompassing various interconnected aspects such as distribution, location, pricing and promotions, merchandising, customer loyalty, e-tailing, and retail branding (Lehmann, 2014). With the advent of online marketing channels, retailers now have access to a wealth of information due to the increased number of touchpoints throughout the customer journey (Anderl et al., 2016). This had massive impressions on economies as the introduction and growth of both e-commerce and mobile commerce have positive impact on the GDP of many countries (Pantelimon et al., 2020). Zatonatska and Novosolova (2017) conducted a study to explore the connection between e-commerce and economic growth. Their findings revealed that e-commerce plays a crucial role in driving economic growth by contributing to productivity, innovation, and market expansion. By leveraging e-commerce platforms, businesses can enhance their productivity through streamlined processes and increased efficiency. Additionally, e-commerce fosters innovation by providing a platform for new ideas, products, and services to emerge. E-commerce plays a crucial role in expanding markets as it allows businesses to access a larger pool of customers within their own country and across borders. Anvari (2016) conducted a study that specifically examined the connection between e-commerce, research and development (R&D), and economic growth, with a focus on developing nations. The study found that both e-commerce and R&D have a positive impact on economic growth in these nations. E-commerce allows developing countries to tap into global markets, boosting their export potential and attracting foreign investment. Furthermore, R&D activities stimulated by e-commerce contribute to technological advancements, which in turn drive economic growth. Liu (2013) examined the positive relationship between e-commerce development and economic growth in China. The study emphasized the significant contribution of e-commerce to employment, productivity, and innovation in the country. E-commerce has generated a multitude of employment prospects across different industries including logistics, customer support, and digital advertising. Additionally, it has enhanced efficiency by optimizing supply chains and minimizing expenses associated with transactions. This is in addition to fostering innovation by providing a platform for entrepreneurs and small businesses to showcase their products and services.

From the perspective of the consumer, e-shopping involves a complex decision-making process, encompassing various stages and considerations. The model developed by Howard and Sheth (1969) provides a framework for understanding the various stages that customers go through when making a purchase. According to their theory of buyer behavior, the decision-making process is influenced by the amount of information consumers require. This means that depending on the type of decision being made, consumers may utilize different channels to gather information. Additionally, external factors such as the availability of information, the significance of the purchase, and perceived time constraints also play a role in shaping the decision-making process (Pellémans, 1971).

Researchers identified multiple barriers to e-shopping have been identified by, including psychological, financial, social, security, and performance risks associated with online shopping (Groß, 2016; Hubert et al., 2017). The purchase decision of online consumers is influenced by their optimistic attitude towards online shopping, the perceived risk involved, and their trust in the online shopping experience (Abarna et al., 2023). Additionally, Hoffman (2017) discovered that the perceived risk of online shopping plays a mod-

Table 1. Countries Included and their Surveyed Spans.

Countries	Time span	Number of years
Algeria, Angola, Argentina, Australia, Austria, Bangladesh, Belgium, Botswana, Brazil, Bulgaria, Burkina Faso ,Cambodia, Cameroon, Canada, Chile , China ,Colombia, Congo (DRC), Côte d'Ivoire, Denmark, Egypt, El Salvador, Estonia, Ethiopia, France, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, India, Indonesia, Iran, Ireland, Italy, Jamaica, Japan, Kazakhstan, Kenya, Kuwait, Liberia, Madagascar, Malawi, Malaysia, Mali, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Netherlands, Nigeria, Oman, Pakistan, Turkey, UAE, Uganda, United Kingdom, United States, Uzbekistan, Venezuela, Vietnam, Zambia, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Singapore, South Africa, South Korea, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Taiwan, Tanzania, Thailand.	2018 to 2022	5
Benin, Dominican Republic, Jordan, Panama, Tunisia.	2019-2022	4
Bahrain, Zimbabwe, Trinidad & Tobago, Paraguay, New Zealand, Lithuania, Lebanon, Cuba, Gabon	2020-2022:	3

erating role in the relationship between the type of device used for e-shopping and purchase intention. The decision of consumers to migrate to mobile shopping is influenced by several factors, including inconvenience, perceived high price, security concerns, perceived usefulness, and perceived ease of use (Tang et al., 2016).

While there is a rapid penetration of smartphones in the online community, this has presented a challenge for retailers to gain consumers' support in providing personalized shopping experiences. One specific concern related to mobile shopping is the privacy of mobile payments, as users may worry about the fate of their supplied data (Ciurlău et al., 2021). The factors that influence mobile users' intention to use m-commerce have been extensively studied. For example, research suggests that habitual products, which have been purchased before, are more likely to be bought using mobile devices (Wang et al., 2015). According to a study conducted by Arshan et al. (2019), the primary determinants of users' behavioral intention are their perception of enjoyment and usefulness in relation to a particular product or service. Additionally, trust and perceived cost also play a significant role in shaping users' attitudes towards mobile commerce. In most cases, the consideration of costs plays a significant role in the decision-making process when it comes to purchasing items online. Huang and Chang (2019) highlight the importance of communication cost and even waiting cost in determining the perceived value of shopping online on foreign vendor's websites. These costs can significantly impact users' perception of the value they derive from engaging in e-commerce activities. Anwar et al. (2021) found that in developing countries, ubiquity has a positive impact on the perceived value of mobile commerce, while risk and cost have a negative influence. The importance of mobile e-shopping services for users in these contexts cannot be overstated, as their availability and accessibility play a vital role.

The younger generation, being more familiar with the internet and mobile devices, has become increasingly susceptible to shopping through mobile apps. This demographic's extensive exposure to technology has shaped their preferences and behaviors, leading them to demand consistent customer experiences and challenging retailers to meet their evolving needs. As highlighted by Semerádová and Weinlich (2021) and Vărzaru et al. (2021), the younger generation's reliance on mobile apps for shopping has significantly influenced the retail industry, prompting businesses to adapt their strategies to cater to this tech-savvy consumer segment.

Reviewing the literature, a huge research gap pertaining to the analysis of how mobile internet costs influence e-shopping was found. This particular study endeavors to address this gap by providing an in-depth examination of the impact of mobile internet costs on e-shopping, thereby paving the way for further investigations in this area. By shedding light on this aspect, this research aims to contribute to the literature and stimulate future research endeavors on this subject.

3. RESEARCH METHODOLOGY

3.1. Variables and Data Sources

The research utilizes information from the 3I-index for a total of 100 nations, encompassing all the accessible data for the period spanning from 2018 to 2022. The dataset can be found online and was obtained from the following source: https://impact.economist.com/projects/inclusive-internet-index/2022. Table **1** provides a list of the countries included in the analysis along with the corresponding years.

The 3I index, also known as The Inclusive Internet Index, is a comprehensive measurement tool developed by Meta and created by the Economist Impact. The main goal is to evaluate the level of accessibility and affordability of the Internet for a diverse population. However, the index goes beyond mere availability and affordability, aiming to evaluate the relevance of the Internet to all users. This relevance is determined by the degree to which the Internet enables usage that leads to positive social and economic outcomes for both individuals and society as a whole. Table 2 provides an overview of the variables that were utilized in the present study, along with their corresponding definitions and units of measurement. This table serves as a reference point for understanding the specific factors that were considered and measured during the research. Nominal GDP and population are two basic indicators of the size of the customer base within a country. Combined with the level of safety of e-shopping, the three control variables are expected to have major positive impacts on the level of e-shopping within a country.

Table 2. Definitions and Units of all Variables.

Variable	Definition	Unit	Source
e-shopping	A linear transformation of data per country of answers to the question: how often do you purchase goods online? Answers are: "about once a month", "once a week", "more than once a week".	%	3I index
nominal_GDP	Measurement of the total economic value of a country.	USD Billions	World Bank
population	The aggregate population in a country.	Millions	World Bank
e-shopping_safety	A linear transformation of data values per country of answers to the question: to what extent do you agree on the following statement? "Making purchases online is safe and secure". Answers are: "somehow agree", "agree", "strongly agree".	%	3I index
mobile_data_cost	The price of a 1 GB prepaid mobile broadband data package.	% of Gross National Income (GNI) per capita	3I index

Table **3** displays information regarding the cost of 1 GB prepaid mobile broadband data internet packages in 2022. According to the table, India has the lowest cost for 1 GB prepaid mobile broadband data, followed by Poland, Ireland, Romania, and Estonia. On the other hand, the countries with the highest cost for 1 GB prepaid mobile broadband data are Congo, Honduras, Madagascar, Liberia, and Burkina Faso.

Table 3. Countries Ordered by Cost of Mobile Data Internet (% GNI per capita) in 2022.

Country	%	Country	%	Country	%	Country	%
India	0.083	Chile	0.390	Vietnam	0.945	Ethiopia	2.330
Poland	0.090	New Zealand	0.401	Botswana	0.964	Kenya	2.384
Ireland	0.099	South Korea	0.426	Bulgaria	0.977	Trinidad & Tobago	2.393
Romania	0.099	Argentina	0.430	Bahrain	0.988	Zambia	2.618
Estonia	0.104	Denmark	0.448	Iran	0.989	Senegal	2.761
Singapore	0.137	Italy	0.459	Colombia	1.010	El Salvador	2.946
Germany	0.145	Pakistan	0.461	Dominican Republic	1.036	Sudan	2.949
Cuba	0.165	Saudi Arabia	0.461	Oman	1.056	Jordan	3.058
Austria	0.176	Australia	0.463	Thailand	1.067	Guatemala	3.111
United Kingdom	0.181	Egypt	0.482	Gabon	1.129	Benin	3.278
Kuwait	0.203	Japan	0.525	Angola	1.244	Rwanda	3.456
Netherlands	0.212	Lithuania	0.525	Tunisia	1.263	Venezuela	3.510
Switzerland	0.215	Uzbekistan	0.534	Bangladesh	1.334	Lebanon	3.969
Sweden	0.222	Canada	0.577	Nigeria	1.400	Zimbabwe	4.256
Kazakhstan	0.235	Greece	0.584	Peru	1.450	Tanzania	4.621
Taiwan	0.238	Mexico	0.586	Philippines	1.487	Mali	4.814
Spain	0.243	France	0.621	Cambodia	1.588	Jamaica	5.350
Hungary	0.253	Malaysia	0.629	Cameroon	1.691	Malawi	5.992
Sri Lanka	0.278	Brazil	0.667	Panama	1.707	Uganda	6.129
Russia	0.285	Portugal	0.680	Côte d'Ivoire	1.859	Mozambique	6.179
China	0.301	Ghana	0.683	Mongolia	1.942	Burkina Faso	6.374
UAE	0.310	United States	0.741	Morocco	1.997	Liberia	7.060

Qatar	0.330	Myanmar	0.773	Paraguay	2.104	Madagascar	7.842
Belgium	0.376	Indonesia	0.857	Algeria	2.214	Honduras	8.134
Turkey	0.383	South Africa	0.931	Namibia	2.221	Congo (DRC)	18.708

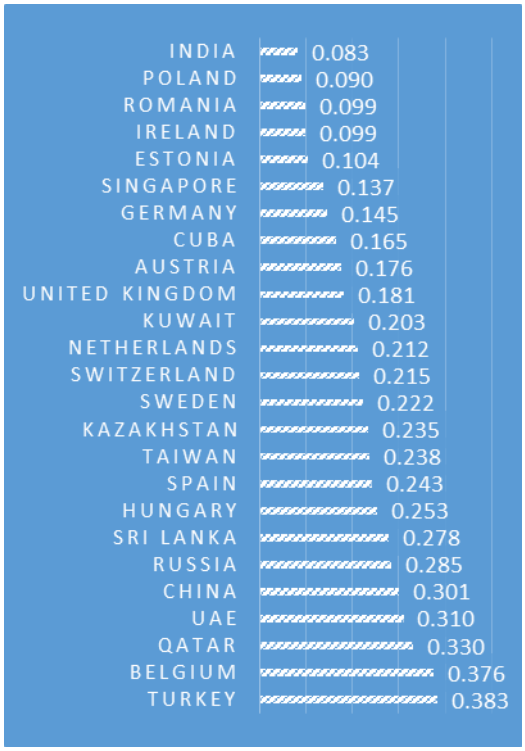
Table 4. Countries ordered by e-shopping frequency in 2022.

Country	%	Country	%	Country	%	Country	%
South Korea	100.0	Mexico	76.0	Canada	64.0	Burkina Faso	50.0
China	98.0	Poland	76.0	Cuba	64.0	Ghana	50.0
Philippines	94.0	Singapore	76.0	Estonia	64.0	Jamaica	50.0
Mongolia	92.0	Italy	74.5	Kenya	62.0	Trinidad & Tobago	48.0
Thailand	92.0	Bangladesh	74.0	Saudi Arabia	62.0	Honduras	46.0
Turkey	90.0	Chile	74.0	Argentina	60.0	Malawi	46.0
Indonesia	88.0	Greece	74.0	Guatemala	60.0	Gabon	44.0
Sudan	88.0	Sweden	74.0	Madagascar	60.0	Uganda	44.0
Vietnam	88.0	Taiwan	74.0	Netherlands	60.0	El Salvador	42.0
Malaysia	86.0	Hungary	73.1	France	58.0	Benin	40.0
Denmark	84.0	Cambodia	72.0	Panama	58.0	Colombia	40.0
Sri Lanka	84.0	Bahrain	70.0	Australia	56.0	Dominican Republic	40.0
United Kingdom	84.0	Bulgaria	70.0	Belgium	56.0	Morocco	40.0
United States	82.0	Egypt	70.0	Jordan	56.0	Senegal	40.0
Uzbekistan	82.0	Ireland	70.0	Liberia	56.0	Tanzania	40.0
UAE	80.4	Japan	70.0	Portugal	56.0	Cameroon	38.0
Qatar	80.0	Pakistan	70.0	Spain	56.0	Congo (DRC)	38.0
Iran	79.5	South Africa	70.0	Venezuela	55.7	Paraguay	36.0
Nigeria	78.4	Mali	68.0	New Zealand	54.0	Zambia	34.0
Germany	78.0	Austria	66.0	Oman	54.0	Namibia	33.3
Myanmar	78.0	Côte d'Ivoire	66.0	Zimbabwe	54.0	Mozambique	31.4
India	76.5	Kazakhstan	66.0	Romania	52.0	Angola	28.0
Brazil	76.0	Peru	66.0	Rwanda	52.0	Tunisia	28.0
Kuwait	76.0	Russia	66.0	Switzerland	52.0	Ethiopia	26.0
Lithuania	76.0	Algeria	64.0	Botswana	51.0	Lebanon	24.0

Table **4** presents the list of countries used in thus study based on the frequency of e-shopping. The data reveals that South Korea occupies the top position in terms of e-shopping frequency, followed by China, the Philippines, Mongolia, and Thailand. Conversely, Lebanon has the lowest frequency of e-shopping among the included countries, with Ethiopia, Tunisia, Angola, and Mozambique following suit.

To provide an understanding of the cost of consuming 1 GB of mobile data internet in the most expensive and cheapest countries, a calculation is conducted using the GNI per capita and multiplying it by the cost per GNI for each country. According to data from the World Bank in 2022, India has a GNI per capita of $1920, while Congo has a GNI per capita of $550. By applying this method, we can determine that the cost of 1 GB of mobile data internet in India is approximately $1.59, whereas in Congo, it is around $102.89.

Table **5** presents the statistical information for all variables utilized in this study. The total number of observations amounts to 475. On average, the frequency of engaging in electronic shopping is approximately 52% of the time, which



Affordable

Moderate

Source: Author's categorization and visualization of data from the 3I index.

Fig. (3). Countries with affordable and moderate costs of consuming 1 GB of mobile data internet in 2022.

closely corresponds to the response option "once a week" for each country. The average nominal GDP is $870 billion, while the average population size is around 74.3 million individuals. Moreover, the average perception of safety in online shopping is approximately 58.4%, which aligns with the response option "agree." The average cost of 1 GB mobile internet is roughly 3% of the GNI per capita for each country. See figures 3 and 4 for a visualization of the costs associated with mobile data internet across countries.

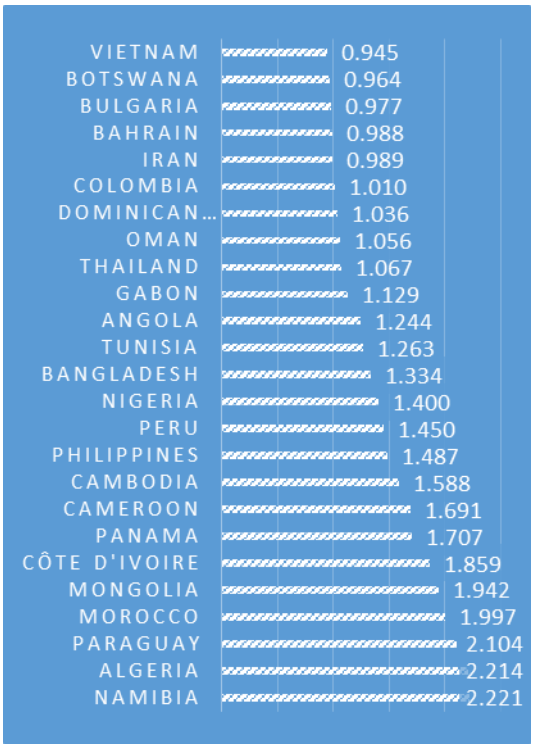
Table 5. Variables' descriptive statistics of the total sample.

Variable	# of obs.	Mean	Std. Dev.	Min	Max
e-shopping	475	52.74105	18.44672	6	100
nominal_GDP	475	870.9926	2681.452	3	22752
population	475	74.32063	201.3159	1.3	1422
e-shopping_safety	475	58.48863	11.86219	27.1	93.6
mobile_data_cost	475	3.020488	7.590021	.005	113.942

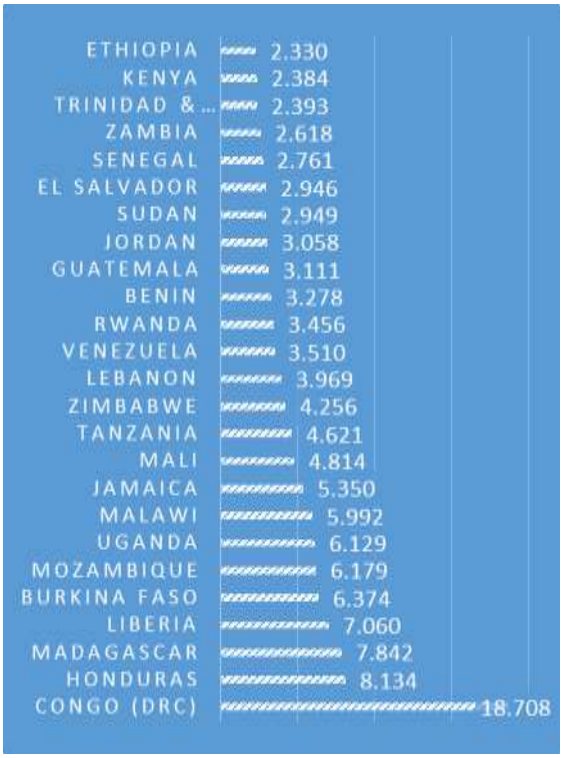
Table **6** presents descriptive statistics of the dependent variable and the independent variable of interest. From the table, two countries belong to the North American region, representing about 80% of the continent's area (the US and Canada), four are from South Asian countries, twelve are from the Middle East and North Africa, fifteen are from Latin America and the Caribbean, fifteen are from East Asia and the Pacific, twenty-five are from Europe and Central Asia, and twenty-seven are from the Sub-Saharan Africa region.

As presented in Table **6**, the frequency of e-shopping is highest among North America (52.05%) and Europe and Central Asia (52.02%), followed by East Asia and the Pacific (50.65%), Latin America and the Caribbean (50.56%), Sub-Saharan Africa (44.6%), South Asia (42.2%), and lastly the Middle East and North Africa (37.09%). The average mobile data cost is the highest among the Sub-Saharan Africa region (7.92%), followed by Latin America and the Caribbean (2.26%), the Middle East and North Africa (1.20%), East Asia and the Pacific (1.11%), South Asia (.913%), North America (.704%), and lastly Europe and Central Asia (.685%).

This study is subject to two restrictions and limitations. Firstly, it suffers from the underrepresentation of certain regions, which means that the findings may not be fully representative of the entire population or target group. Secondly, the study only covers a short span of time, implying that the conclusions drawn may not capture long-term trends or changes.



Expensive



Very expensive

Source: Author's categorization and visualization of data from the 3I index (2022).

Fig. (4). Countries with expensive and very expensive costs of consuming 1 GB of mobile data internet in 2022.

Table 6. E-shopping and mobile data costs variables' descriptive statistics by regions.

Region	# of countries	# of obs.	Mean	Std. Dev.	Min	Max
East Asia & Pacific						
e-shopping	15	73	50.65616	15.96467	12	86
mobile_data_cost		73	1.111589	.7623592	.137	3.689
Europe & Central Asia						
e-shopping	25	119	52.02185	12.49232	24	74
mobile_data_cost		119	.685042	.6830508	.005	3.941
Latin America & Caribbean						
e-shopping	15	65	50.56462	10.60848	18	71.2
mobile_data_cost		65	2.263185	1.836313	.165	9.662
Middle East & North Africa						
e-shopping	12	58	37.09138	9.564816	16	58.8
mobile_data_cost		58	1.206397	1.106164	.103	5.501
North America						
e-shopping	2	10	52.05	9.659221	35.8	66
mobile_data_cost		10	.7049	.2049967	.474	.953
South Asia						

e-shopping	4	20	42.245	16.08636	16	76
mobile_data_cost		20	.913	.6879302	.083	2.349
Sub-Saharan Africa						
e-shopping	27	130	44.60769	11.32848	12	70
mobile_data_cost		130	7.920608	13.20895	.606	113.942

Model Specification

The study aims at finding the impact of mobile costs on e-shopping across different regions. To investigate this relationship, the following function is estimated:

$$e_{shopping_{it}} = f(nominal_{GDP_{it}}, population_{it}, e-shopping\_safety_{it}, mobile\_data\_cost_{it}) \quad (1)$$

To estimate equation (1), a fixed effects model is employed. The intercepts, which are expressed as coefficients of dummy variables, are computed by this model for all units except one out of the total n units. The estimation utilizes data from units with multiple observations, focusing on variables that exhibit variation across this data. By doing so, the model aims to estimate the impacts of these variables. It assumes that the effects of constant, unmeasured variables can be adequately represented by individual-specific, time-invariant dummy variables. The representation of the model is as follows:

$$Y_{ij} = \alpha_0 + \beta_1 X_{it} + \beta_2 X_{it} + \cdots \beta_n X_{it} + \varepsilon_{it} \quad (2)$$

In this context, the equation represents a statistical model where α_0 is the intercept or the constant term, and β_1, β_2, ..., β_n are the coefficients associated with different variables in the model. The variable t represents time, while i represents different countries. The term ε_{it} denotes the error term, which captures the unobserved factors or random variations that affect the dependent variable in the model.

The fixed effect model is used in this study to analyze the pooled cross-sectional data. Pooled cross-sectional data refers to a dataset that combines observations from multiple cross-sectional units over time. In this type of data, each observation represents a different unit at a specific point in time. This model is used to control for unobserved heterogeneity across the cross-sectional units in order to account for individual-specific characteristics that are constant over time but may affect the outcome variable of interest.

To test whether the intercepts are equal across units, researchers often use joint F-test statistics. The joint F-test compares the fit of a model with fixed effects to a model without fixed effects. If the inclusion of fixed effects significantly improves the fit of the model, it suggests that there is indeed variation in the intercepts across units.

A Hausman test is applied to determine whether the fixed effect model or the random effect model is more appropriate for the dataset by examining the correlation between the unobserved heterogeneity and the independent variables of the model. In a random effect model, unobserved heterogeneity is supposed to have no correlation with the independent variables of the model. The intercepts, which are expressed as coefficients of dummy variables, are computed by this model for all units except one out of the total n units. The random effect model can be expressed as follows:

$$Y_{ij} = \alpha_0 + \beta_1 X_{it} + \beta_2 X_{it} + \cdots \beta_n X_{it} + \theta_i + u_{it} \quad (3)$$

In the given equation, α_0 represents the intercept or the constant term. The coefficients of the models are denoted by β_1, β_2 ... β_n. The variable *t* represents time, while *i* represents different countries. The term u_{it} represents the error term, which represents the unexplained variation in the model, while θ_i is introduced to represent the unobserved variables that may influence the relationship between X_{it} and Y_{ij}

To investigate the relationship among the seven regions included in this study, an interaction term is introduced. The introduction of an interaction term allows for the estimation of separate slopes for each region. This means that assessment whether the effect of mobile data cost on e-shopping differs depending on the region. By including this interaction term in the regression model, more nuanced insights into the relationship among the seven regions can be obtained.

4. RESULTS

Results of model specification using the Hausman test are presented in Table **7**. The findings indicate that a fixed effect model is more favorable compared to a random effect model, as evidenced by the statistical test result (Prob>chi2 = 0.0002). The dataset employed in the analysis has a relatively short time span but encompasses a large number of countries. Since the time span is relatively shorter than the number of countries included, cross-sectional dependence is not a concern. To ensure robustness, a robust variance estimation technique was employed, which clustered the standard errors at the country level.

Table 7. Hausman model specification test results.

Variable	(b) Fixed	(B) Random	(b-B)	Square root of S.E
nominal_GDP	.0018949	.0013465	.0005484	.002112
population	.4848207	.0028863	.4819345	.1901947
e-shopping_safety	.3851988	.3755612	.0096376	.0172509
mobile_data_cost	.2027706	.0218001	.1809705	.0396468
Note: (1) Chi2 (3) = 121.50, (2) Probability>chi = 0.0000.				

Table **8** presents the variation in the inflation factors. The findings indicate that there is no indication of multicollinearity among the independent variables, as none of them have a value equal to or greater than 2.

Table 8. Variance inflation factor results.

Variable	VIF	1/VIF
nominal_GDP	1.46	0.683562
population	1.51	0.662019
e-shopping_safety	1.10	0.911766
mobile_data_cost	1.04	0.962097
Mean VIF	1.52	

Table **9** displays the outcomes of the fixed effects model, both with and without the inclusion of regional interaction terms. Among the eight models presented, no indications were discovered to suggest that the overall nominal GDP has any influence on the frequency of e-shopping. However, evidence does indicate that the population size and e-shopping safety are highly significant factors in determining the level of e-shopping across different regions.

With no interactions added to the regression model, the initial model (1) indicated that there is a positive relationship between the cost of mobile data internet in a country and the frequency of e-shopping. However, when interaction terms were included in the analysis, only models (5) and (6) demonstrated statistical significance. These two models correspond to the regions the Middle East and North Africa region and North America.

Table 9. Results of the fixed effect regression model.

	Dependent Variable: e-shopping							
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**
Variables	***No Interaction***	**East Asia & Pacific**	**Europe & Central Asia**	**Latin America & Caribbean**	**Middle East & North Africa**	**North America**	**South Asia**	**Sub-Saharan Africa**
nominal_GDP	.0018949	.0012152	.0018898	.0018495	.0019347	.0017217	.0021049	.0018007
	(.0012559)	(.0015738)	(.0012541)	(.0012727)	(.0012445)	(.0013375)	(.0013655)	(.0012176)
population	.4848207**	.4930412**	.4761659**	.4854978**	.4787151**	.4861622***	.4356934**	.4818858**
	(.1920777)	(.1912378)	(.1907201)	(.1933566)	(.1896043)	(.1926826)	(.4356934)	(.1947624)
e-shopping_safety	.3851988***	.3824404***	.3847717***	.3859048***	.3857872***	.3819302***	.3850281***	.38475***
	(.0593464)	(.0595204)	(.0595017)	(.0594362)	(.0592718)	(.0603746)	(.0592001)	.0593423
mobile_data_cost	.2027706***	.202268***	.2041542***	.2017381***	.2051113***	.2031629***	.2011055***	-.4261152
	(.0451889)	(.0461581)	(.0458042)	(.0444148)	(.0470373)	(.0453914)	(.0442239)	(1.167114)
Interaction	-	-2.36518	.5883787	1.072509	-2.278022**	9.708251***	-3.095909	.6287052
	-	(4.205365)	(1.320142)	(1.069514)	(1.127199)	(3.48587)	(0.609)	(0.590)
2019.year	22.04008***	21.91343***	22.04312***	22.06213***	21.88895***	22.04002***	22.0219***	21.92697***
	(1.559148)	(1.556877)	(1.572285)	(1.560759)	(1.580763)	(1.559223)	(1.558096)	(1.567015)
2020.year	32.0691***	31.87978***	32.08983***	32.07903***	31.92448***	32.0667***	32.06166***	31.93668***
	(1.641445)	(1.616053)	(1.662893)	(1.641819)	(1.639539)	(1.642029)	(1.637841)	(1.628229)
2021.year	31.77128***	31.47185***	31.85412***	31.83783***	31.64995***	31.756***	31.81022***	31.5285***
	(1.649922)	(1.61269)	(1.734652)	(1.651205)	(1.665019)	(1.647913)	1.651032	1.674272
2022.year	34.08971***	33.84061***	34.29218***	34.17138***	34.10719***	34.11871***	34.1052***	33.83433***
	(1.806762)	(1.759188)	(1.932486)	(1.811074)	(1.809189)	(1.810493)	(1.800597)	(1.849154)
Constant	-32.87669**	-32.14933**	-29.76399**	-33.29526**	-33.61096**	-32.78192***	-29.28081**	-31.85941**
	(13.25422)	(13.64944)	(13.17816)	(13.34055)	(13.07634)	(13.28577)	(13.66032)	(13.74835)
Observations	475	475	475	475	475	475	475	475
Countries	100	100	100	100	100	100	100	100

R-squared	0.690	0.691	0.691	0.690	0.691	0.670	0.690	0.690
Probability> F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
*** p< 0.01, ** p< .05, * p<.1 Robust standard errors in parentheses								

In order to comprehend the interaction terms, it is necessary to carry out an assessment at various levels of mobile data costs. When this evaluation was conducted, it was observed that in the North America region, there was a consistent and highly significant positive association between mobile data costs and e-shopping with increased coefficients with higher costs, regardless of the selected cost. This association was consistently found to be statistically significant with a pvalue of less than .001.

However, for the middle east and north Africa, different values of mobile data costs yielded varying results in terms of their association with e-shopping. Table 10 presents an evaluation of the frequency of e-shopping in the Middle East and North Africa region at various costs. The analysis utilizes regression coefficient results to assess different cost levels, starting from the lowest global cost observed in India (0.083%) and progressing upwards. In the Middle East and North Africa region, the cost of mobile data internet appears to have an insignificant positive impact on e-shopping when it is lower than 5.4% of GNI but higher than 3.4%. This suggests that within this range, the cost of mobile data internet does not significantly influence e-shopping behavior. Furthermore, an increase in the cost of mobile data internet seems to be positively and significantly associated with e-shopping if it remains below 3.4% of GNI. In other words, as the cost of mobile data internet decreases within this threshold, there is a corresponding increase in e-shopping activity. However, if the cost of mobile data internet exceeds 5.4% of GNI, the impact on e-shopping becomes negative and insignificant. This implies that when the cost surpasses this threshold, it no longer has a significant effect on e-shopping behavior in the Middle East and North Africa region.

Table 10. mobile data cost evaluations for the Middle East and North America region.

Mobile data costs % GNI	Coefficient	Std. Error	p>t
.083%	12.32807	1.674054	0.000***
2.5%	6.822095	1.888902	0.000***
2.8%	6.138688	2.167629	0.006***
3.2%	5.22748	2.561625	0.044**
3.4%	4.771875	2.765149	0.088*
3.5%	4.544073	2.86814	0.116
4.4%	2.493853	3.819865	0.515
5.4%	.2158306	4.906917	0.965
5.5%	-.0119716	5.016597	0.998
6.5%	-2.289994	6.119476	0.709

DISCUSSION

Mobile data costs have a significant relationship with e-shopping, as they directly impact the accessibility and affordability of online shopping platforms for mobile users. The cost of mobile data refers to the charges imposed by telecommunication companies for accessing the internet through mobile devices. These costs can vary depending on factors such as data plans, network providers, geographical location, and the amount of data consumed. Based on the findings, it appears that raising the price of mobile data internet could potentially encourage the growth of online shopping. However, this outcome is contingent upon the specific threshold set in each geographical area. The results suggest that when the cost of mobile data internet increases, consumers may be more inclined to shift towards e-commerce platforms for their shopping needs. However, it is important to note that the threshold at which consumers perceive the price increase as significant enough to alter their behavior may vary depending on factors such as income levels, cultural norms, and technological infrastructure. Therefore, it is crucial to consider regional variations when analyzing the relationship between mobile data costs and e-shopping trends.

In general, there are several reasons why a higher mobile data cost can be associated with higher e-shopping. Firstly, higher mobile data costs may lead to a greater incentive for individuals to make the most out of their data plans. When users are paying more for their mobile data, they are more likely to maximize its usage by engaging in activities that provide value for their money. E-shopping is a convenient and accessible activity that can be effortlessly carried out on mobile devices, enabling individuals to explore and buy various goods or services through online platforms. Therefore, when the cost of mobile data is higher, individuals may be more motivated to shop online in order to make the most of their data plan. Secondly, higher mobile data costs can also influence consumer behavior by encouraging individuals to seek out cost-saving measures. When faced with expensive data plans, consumers may be more inclined to look for deals and discounts online. E-shopping platforms often offer various promotions, discounts, and coupon codes that can help consumers save money on their purchases. By taking advantage of these cost-saving opportunities, individuals can offset the higher mobile data costs and potentially even save money overall. This financial incentive can further drive individuals towards e-shopping. Thirdly, the convenience factor plays a significant role in the association between

higher mobile data costs and increased e-shopping. The advent of smartphones and mobile internet has revolutionized the way consumers shop, providing them with easy access to various online shopping platforms. This convenience enables individuals to make purchases at their convenience, eliminating the need for physical store visits. When faced with higher mobile data costs, consumers may find it more convenient and cost-effective to shop online rather than traveling to brick-and-mortar stores. The convenience aspect becomes especially significant when taking into account elements like the expenses associated with transportation and the limitations imposed by time constraints. Fourthly, higher prices for mobile data may lead individuals to seek alternative methods of accessing the internet, such as utilizing Wi-Fi networks or public hotspots. As a result, they may spend more time browsing online stores and making purchases from the comfort of their own homes. Lastly, an increase in the cost of mobile data internet might prompt consumers to become more conscious of their e-shopping activity. The increased consciousness could potentially prompt individuals to be more intentional in their purchasing decisions. Consequently, e-shopping platforms may experience a boost in sales as consumers become more selective and intentional with their online transactions.

CONCLUSION

Mobile data costs play a crucial role in promoting e-shopping by enabling users to access online shopping platforms and browse through various products and services. With the increasing popularity of smartphones and the widespread availability of mobile internet, e-commerce has experienced significant growth in recent years. The affordability and accessibility of mobile data have contributed to this growth by allowing consumers to shop conveniently from anywhere at any time. This study is conducted using data from 100 countries scattered over 7 regions. The analysis through a time and country fixed effect regression model has revealed interesting findings regarding the relationship between the cost of mobile data internet and online shopping. The results indicate that increasing the cost of mobile data internet can actually promote online shopping, although this relationship is contingent upon the region. Specifically, for the Middle East and North Africa region, it is recommended to keep the increase in mobile data internet below 3.5% in order to foster online shopping. This implies that a moderate increase in the cost of mobile data internet within this region can have a positive impact on online shopping behavior. The findings of this study contribute to the understanding of the complex dynamics between mobile data internet costs and online shopping across different regions. It highlights the importance of considering regional variations when formulating policies or strategies aimed at promoting online shopping. In light of these findings, policymakers and businesses operating in the MENA region should carefully consider the potential impact of increasing mobile data internet costs on online shopping behavior. Finding a middle ground between keeping prices affordable for consumers and maintaining profitability is essential for fostering long-term and sustainable expansion of e-commerce in this region. Governments and regulatory bodies should consider implementing pricing regulations or policies that prevent excessive increases in the cost of mobile data internet. By keeping the price increase below a certain threshold, such as 3.5% in the case of the Middle East and North Africa region, they can encourage online shopping activities. This can be achieved through monitoring and intervention in the pricing strategies of telecommunication companies. Overall, this study provides valuable insights into the relationship between the cost of mobile data internet and online shopping, emphasizing the need for region-specific approaches. Further research could delve deeper into the underlying mechanisms driving this relationship and explore additional factors that may influence online shopping behavior.

ACKNOWLEDGEMENT

Mr. Mohamed Malika his research assistance and excellent data collection.

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Received: Sep 15, 2023 Revised: Sept 25, 2023 Accepted: Mar 01, 2024