Analysis of the Impact of Marketing Innovation on the Decision of the Adoption of the Algerian Consumer of the Economic Lamp of Electricity Using Modeling with Structural Equations

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Abstract

This study aims to analyze the role of marketing innovation for new products and what are the most important effective strategies in pushing the Algerian consumer to adopt electric energy-saving products, especially the economic lamp. A group of influences that affect the decision to adopt such products intervene. Through this study, we highlight the disparity in their impact, perhaps the most prominent of which is the presence of innovation factors (characteristics) in the product that would entice the consumer to adopt them, and the extent to which he enjoys the innovative features that push him to accept these products, and to achieve Study objectives: Structural equations modeling (SEM) was used through the AMOS program to test the mosaic of hypotheses, which resulted in a direct impact of marketing innovation and innovation factors on consumer adoption decision, and the hypothesis related to consumer innovation traits was implemented as a mediating variable.

The study also sought to classify the decision of the Algerian consumer to adopt the lamp according to the Rogers classifications of adopting consumers, according to the speed of adoption, which resulted in the majority of consumer decisions being classified within the category of laggards with a rate of 32.6%, followed by the late majority category with a rate of 31.4%.

Keywords: Marketing innovation, economic lamp, innovation factors, consumer innovation traits, adoption decision.

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Introduction:

The topic of marketing innovation has garnered significant attention from scholars and researchers in the field of social sciences. Many studies have explored this area, aiming to understand more about the subject and adjust variables and methods in research to serve its objectives. Several relevant studies have been examined in this regard:

1. Costinel Dobre et al. (2009): This study investigated the determinants of consumer innovation characteristics from a marketing perspective, focusing on the relationship between innovators' characteristics and innovation. Findings suggested that innovators tend to be opinion leaders, risk-takers, more likely to obtain information from mass media, influenced by word of mouth, open to new ideas, receptive to change, and relatively young.

2. Halpren Nigel (2010) and Shu Wang (2015): These studies explored sources, capabilities, and outcomes of marketing innovation in airports, advocating for innovative approaches to airport marketing to achieve growth and market survival.

3.Chih-Wei Chao (2010): This study examined the importance of consumer innovation in adopting new products, particularly consumer electronic products. It targeted first adopters according to Rogers' classification, emphasizing the impact of consumer innovation on product adoption.

4. Cheng-Hsum Ho (2011): Investigated the role of consumer innovation in the relationship between new product characteristics and adoption intentions, highlighting the positive impact of consumer innovation on new product adoption. Attention was also given to innovation factors such as comparative advantage, observability, and product complexity.

5. Christine Holland (2014): Explored the characteristics of adopting compact fluorescent lamps (CFL) versus light-emitting diode (LED) lamps in the Pacific Northwest. The study analyzed consumer sensitivity to lamp prices on adoption decisions, with findings indicating that CFLs remained favored due to lower purchase costs, despite the energy-saving benefits of both CFLs and LEDs.

In the context of the study on adopting energy-saving light bulbs, the research by Christine Holland provides insights into consumer behavior and preferences regarding CFLs and LEDs, particularly regarding price sensitivity and income flexibility.

Method and tools used in the study:

The scientific research methodology employed in this study is founded upon rigorous scientific analysis utilizing efficient statistical methods and techniques supported by highly significant quantitative and scientific standards and measures. The study was designed based on a series of predetermined questions and hypotheses formulated prior to the commencement of the research.

Given the nature of the study and its objectives, the analytical descriptive approach was deemed appropriate. This approach aims to thoroughly understand and describe the phenomenon under investigation by collecting and analyzing relevant data. By employing this approach, the study sought to overcome limitations in information availability and credibility.

The descriptive study extends beyond data collection to classification, analysis, and extraction of quantitative and qualitative insights to attain the desired results. In this research, the descriptive method was complemented by the utilization of Structural Equation Modeling (SEM) methodology. SEM is a comprehensive statistical approach used to test hypotheses regarding relationships between latent and observed variables. It enables the representation, estimation, and testing of relationships within a network of variables, including both measured variables and latent constructs.

SEM is a statistical methodology that adopts a hypothesis-testing approach to analyze structural theories influencing phenomena. These theories are based on observations of multiple variables and represent causal processes.

The study targeted a community of general consumers of energy-efficient light bulbs in Algeria. While the extension of the sample size could be measured by the number of subscribers to the electricity sector, it is important to note that not every electricity consumer necessarily uses the specific light bulb under study.

The sample size for this study was determined to be 730 individuals, and data collection was primarily conducted through questionnaires. Statistical analysis was carried out using SPSS version 25 and AMOS version 24.

Validity and Reliability of the Study Tool:

Validity of the Study Tool: The validity of the study tool was assessed using SPSS outputs. The value of α Cronbach related to the questionnaire was found to be 0.885, indicating a high level of internal consistency. This means that 88.5% of the surveyed sample would respond similarly if questioned again, demonstrating the stability of the tool in measuring the relationship between variables in the studied phenomenon. The degree of validity was determined to be 94%.

Hypotheses of the Field Study:

Based on the main hypotheses of the study, the following hypotheses were formulated to address and support the main hypotheses, according to the proposed model:

H1: There is a statistically significant relationship between demographic variables of the consumer (such as sex, age, educational level, job status, income level, and type of housing) and the decision to adopt the economical light bulb.

H2: Marketing innovation has a statistically significant effect on the decision to adopt an economical light bulb.

H3: There is a statistically significant relationship between innovation factors in the product (such as comparative advantage, compatibility, complexity, experience, and observation) and the decision to adopt the economical light bulb.

H4: There is a statistically significant relationship between the consumer's innovation traits (including originality, intellectual fluency, intellectual flexibility, sensitivity to problems, deductiveness, and risk-taking) and the decision to adopt the economical light bulb.

Presentation and discussion of results

1. To classify the attitudes of the respondents' opinions regarding the speed of adopting the economic lamp, we can utilize a categorization based on Rogers' diffusion of innovations theory. This theory categorizes adopters into five groups based on the time it takes them to adopt a new innovation. The classifications are as follows:

1. Innovators: These are the first individuals to adopt a new product or innovation. They are adventurous, risk-takers, and are typically eager to try new ideas. Innovators tend to have higher incomes and are well-educated.

2.Early Adopters: Early adopters follow the innovators. They are opinion leaders within their social groups and are respected for their judgment. Early adopters are more integrated into society than innovators and have a higher social status.

3.Early Majority: The early majority represents the average members of society. They adopt new innovations just before the average person does. They deliberate carefully before making decisions and rely on recommendations from early adopters.

4.Late Majority: The late majority follows the early majority. They are skeptical of change and adopt innovations only after the majority of society has done so. Late majority individuals may be older or less educated than early adopters.

5.Laggards: Laggards are the last to adopt new innovations. They are traditionalists and are often resistant to change. Laggards may have lower incomes and be less educated than other groups.

By classifying respondents' attitudes based on these categories, we can gain insights into the speed and pattern of adoption of the economic lamp within the studied population. This classification can help identify target groups for marketing efforts and tailor strategies to accelerate adoption among different segments of the population.

Figure No. (01): Classification of respondents according to the speed of adoption of the lamp

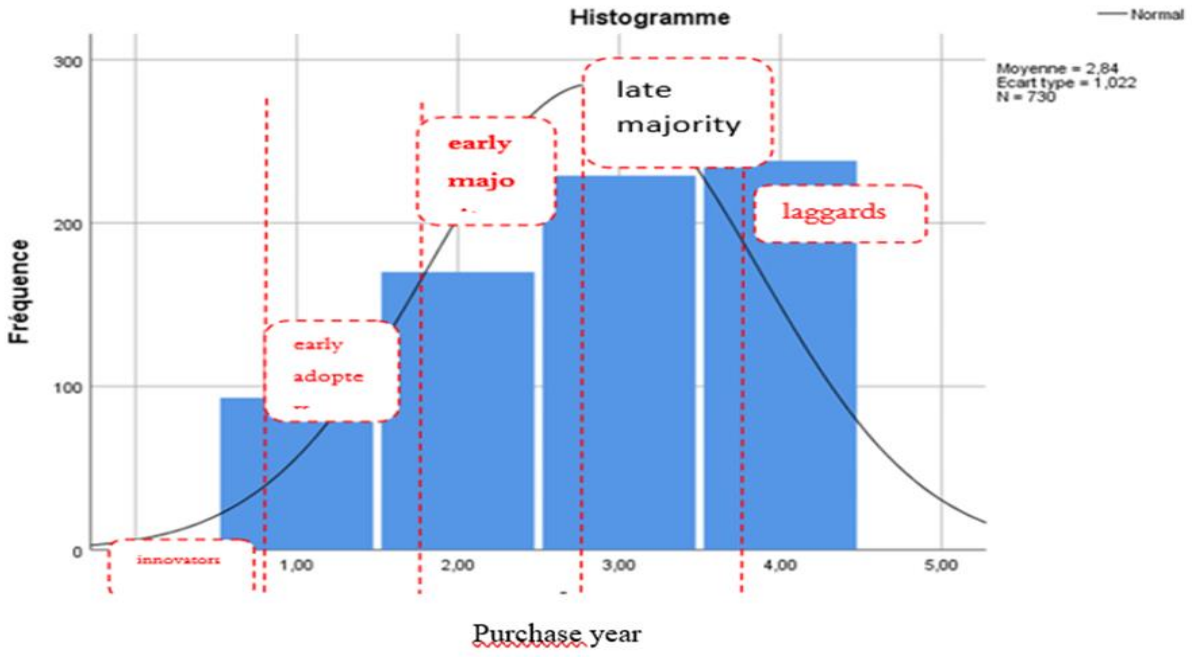


Table No. (01): Distribution of respondents according to the speed of adoption of the lamp

Year of first purchase	variance	percentage %
Before 2014	00	00
early 2014	90	12,7
late 2014	173	23,3
2015-2018	267	31,4
2019-2021	200	32,6
Total	730	100,0

It is evident from the table and figure above that the initial purchase of the economic lamp by Algerian consumers occurred in 2014, coinciding with the year of the lamp's introduction into the Algerian market as officially stated by the Ministry of Commerce. The data reveals that Algerian consumers did not start acquiring the lamp until after its introduction to the market.

The largest percentage, accounting for 32.6% of consumers, purchased the lamp for the first time in 2019-2021, aligning with the category of laggard consumers according to Rogers'

classification. This is followed by 31.4% of consumers, representing the late majority category, who acquired the lamp in 2015-2018. The early majority category comprises approximately 23.3% of consumers who acquired the lamp towards the end of 2014. The early adopters category, with a rate of 12.7%, reflects those who acquired the lamp in early 2014. Notably, the category of innovators did not register any purchases during this period.

Analyze and discuss the results of hypothesis testing

This section entails the presentation of the study's findings aimed at identifying the influence of marketing innovation, consumer innovation, and innovation-related factors on consumers' decisions to adopt energy-efficient light bulbs. The results are presented through analysis and hypothesis testing.

Analyzing the findings of the first primary hypothesis:

This hypothesis examines the relationship between consumer demographic variables (gender, age, educational level, job status, income level, type of housing) and the decision to adopt energy-efficient light bulbs. The study concluded by analyzing the impact of each demographic variable on the adoption decision independently, as summarized in the following table.

Table No. (02 Based on the test results, the hypotheses are as follows:

the number	hypothesis content	test result
$H1_1$	There are statistically significant differences in the decision to adopt the economic lamp due to the gender variable at the significance level of 0.05.	deny the hypothesis
$H1_2$	There are statistically significant differences in the decision to adopt the economic lamp due to the age variable at the significance level of 0.05.	deny the hypothesis
$H1_3$	There are statistically significant differences in the decision to adopt the economic lamp due to the educational level variable at the significance level of 0.05..	deny the hypothesis
$H1_4$	There are statistically significant differences in the decision to adopt the economic lamp due to the employment status variable at the significance level of 0.05..	deny the hypothesis
$H1_5$	There are statistically significant differences in the decision to adopt the economic lamp due to the income level variable at the level of significance 0.05.	deny the hypothesis

$H1_6$	There are statistically significant differences in the decision to adopt the economic lamp due to the housing type variable at the significance level of 0.05.	deny the hypothesis

Source: Prepared by the researcher based on SPSS analysis

Based on the results presented in the table, the first main hypothesis was rejected, indicating that there is no statistically significant relationship between the demographic variables of consumers (gender, age, educational level, job status, income level, type of housing) and their decision to adopt the economic light bulb.

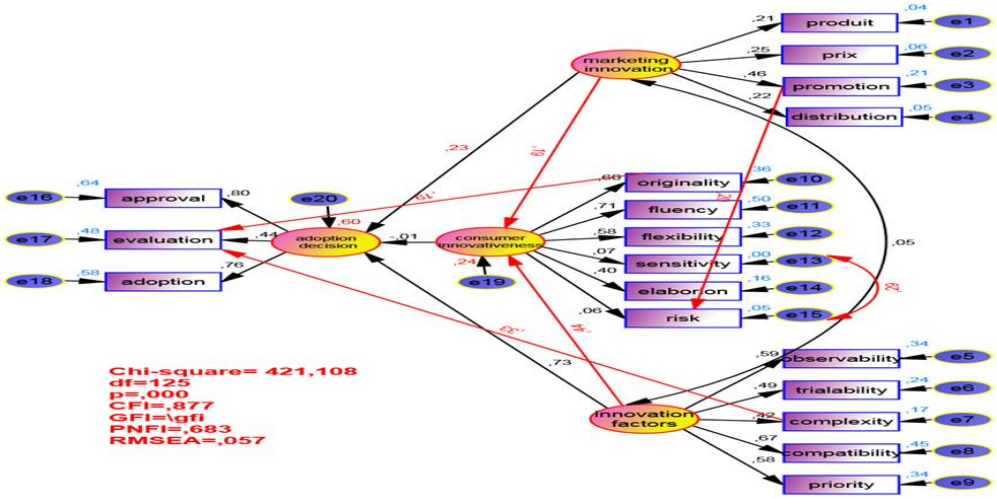
These findings align with a study conducted by Costinel Dobre et al. (2009), which similarly concluded that educational level influences consumer innovation. However, there are differences between the studies regarding the impact of income level. While our study found no significant effect of income level and age on consumer adoption of the economic light bulb, Costinel (2009) concluded that both income level and age influence the adoption of innovative products.

Given the reliance on prior scientific theorizing to formulate hypotheses, our study constructed a factorial model. This involved conducting exploratory factor analysis to refine each variable based on scientific theorizing, followed by confirmatory factor analysis using structural equation modeling provided by the AMOS v24 program.

Analysis of the structural model of the study:

Following the confirmatory factor analysis and refinement of variables through exploratory factor analysis, the study synthesized these variables into a structural model to elucidate the studied phenomenon, as depicted in Figure No. (02).

Figure No. (02): The structural model of the study variables.



This model represents the final configuration of the relationships established, achieved through a series of steps and adjustments aimed at enhancing the model's alignment with real-world data. These adjustments involved reviewing proposed parameters to enhance the model's fit, selecting parameters that, when integrated into the model, enhance its suitability. Preference was given to parameters that significantly improved the model's fit without contradicting theoretical assumptions or introducing logical inconsistencies.

Initially, a model resembling Figure (02) was developed, albeit lacking the red arrows. These arrows denote parameters that notably enhanced the model's fit. The table below outlines the key indicators of model fit before and after the refinement process. Table No. (03): Indicators of matching the model before and after the improvement process.

	Matching indicators											
	Model fit indices			Absolute fit indices			Indicators of economic deprivation			The comparison of fit indices:		
Goodness of fit statistics	CMIN	df	Nc=cmin/df	RMR	GFI	AGFI	RMSEA	AIC	CAIC	CFI	PNFI	NFI
Before the improvement	678,3	129	5,259	0,3670	0,9020	0,8710	0,0760	762,38	997,29	0,7730	0,6210	0,736
After the improvement	421,1	125	3,369	0,2540	0,937	0,9140	0,0570	513,10	770,38	0,8770	0,6830	0,836

Source: Derived from the output of AMOS V 24

It is observed that the model indicators after the improvement process, which affected certain parameters, are deemed acceptable and suggest that the model aligns with reality.

Testing the model hypotheses: Within the outputs of the AMOS program, we can locate Table No. (04), with a focus on the hypotheses under investigation. It's important to note that the table also includes other analyses unrelated to the hypotheses.

Table No. (04): Results of testing the main hypotheses.

			Estimate	S.E.	C.R.	P	Label
Adoption decision	<---	Innovation factors	1,124	0,113	9,923	***	par_15
Adoption decision	<---	Consumer innovativeness	-0,024	0,138	-0,176	0,860	par_17
Adoption decision	<---	Marketing innovation	1,443	0,690	2,092	0,036	par_24

Source: From the output of AMOS V 24

•Estimate values indicate the estimated change in the relationship between variables. For example, for every 1.00 increase in innovation factors, consumer innovation increases by 0.313.

•Standard Error of Regression Weights (S.E) represents the degree of error in the estimated relationship between the variables.

•Critical Ratio For Regression Weights (C.R) indicates the ratio of the relationship between two factors. These values are crucial for determining whether to accept or reject study hypotheses. The significance interval is typically estimated at 1.96. If the CR values exceed 1.96, it indicates that the hypothesis related to the relationship between the two factors is acceptable. CR values are calculated by dividing Estimates by the Standard Error.

•The second main hypothesis:

•H2: There is a statistically significant effect of marketing innovation on the decision to adopt the economic light bulb

•To test this hypothesis, the null hypothesis and the alternative hypothesis were formulated as follows:

• **Hypothe H0:** There is no direct, statistically significant effect of marketing innovation on the decision to adopt the economic light bulb

• **Hypothesis H1:** There is a direct and statistically significant effect of marketing innovation on the decision to adopt the economic light bulb. Through the results of hypothesis testing represented in Table No. (04), the critical ratio (CR) value is 2.092, which exceeds the significance level estimated at 1.96. This indicates rejecting the null hypothesis and accepting the alternative hypothesis, suggesting a direct and statistically significant effect of marketing innovation on the decision to adopt the economic light bulb. This finding aligns with the results of Halpren (Nigel, 2010), which demonstrated the impact of marketing innovation on consumer adoption decisions within the airline industry. It is also consistent with the conclusions of Atallah

Fahd Al-Sarhan (2005), who found a direct impact of marketing innovation on customer decisions. Furthermore, this result partially concurs with Christine Holland's (2014) study on the influence of innovation in pricing on consumer adoption decisions of LED lamps.

The third main hypothesis:

H3: There is a direct and statistically significant effect of innovation factors in the product (comparative advantage, compatibility, complexity, experience, observation) on the decision to adopt the economic light bulb.

To test this hypothesis, the null hypothesis and the alternative hypothesis were formulated as follows:

Null Hypothesis (H0): There is no direct, statistically significant effect of the product innovation factors (comparative advantage, compatibility, complexity, experience, observation) on the decision to adopt the economic light bulb.

Alternative Hypothesis (H1): There is a direct and statistically significant effect of the innovation factors in the product (comparative advantage, compatibility, complexity, experience, observation) on the decision to adopt the economic light bulb.

Based on the results of hypothesis testing represented in Table No. (04), the critical ratio (CR) value is 9.923, which exceeds the significance level estimated at 1.96. This indicates rejection of the null hypothesis and acceptance of the alternative hypothesis, suggesting a direct and statistically significant relationship between innovation factors in the product (comparative advantage, compatibility, complexity, experience, observation) and the decision to adopt the economic light bulb. This finding is consistent with previous studies by Rogers (2003) and Cheng-Hsum Ho (2011), which also found an influence of product innovation factors on the decision to adopt innovative new products.

The fourth main hypothesis:

H4: There is a statistically significant effect of consumers' innovation traits (originality, intellectual fluency, intellectual flexibility, sensitivity to problems, deductiveness, risk-taking) on the decision to adopt the economic light bulb.

To test this hypothesis, the null hypothesis and the alternative hypothesis were formulated as follows:

Null Hypothesis (H0): There is no direct, statistically significant effect of consumers' innovation traits (originality, intellectual fluency, intellectual flexibility, sensitivity to problems, deductiveness, risk-taking) on the decision to adopt the light bulb.

Alternative Hypothesis (H1): There is a direct and statistically significant effect of consumers' innovation traits (originality, intellectual fluency, intellectual flexibility, sensitivity to problems, deductiveness, risk-taking) on the decision to adopt the light bulb.

Based on the results of hypothesis testing represented in Table No. (04), the critical ratio (CR) value is -0.176, which is less than the significance level estimated at 1.96. This indicates rejection of the alternative hypothesis and acceptance of the null hypothesis, suggesting that there is no direct effect relationship with statistical significance for the characteristics of consumer innovation (originality, intellectual fluency, intellectual flexibility, sensitivity to problems, deductiveness, risk-taking) on the decision to adopt the light bulb. This result contradicts the findings of Christine Holland (2014), Chih-Wei Chao (2010), and Cheng-Hsum Ho (2011); these studies found an effect of consumer innovation on the decision to adopt new products, unlike what our current study of this sample found.

The first sub-hypothesis:

This hypothesis is related to the study of the influence relationships between the independent variable and the mediating variable, represented in the impact of marketing innovation on consumer innovation.

H1: There is a statistically significant direct effect of marketing innovation on consumer innovation.

To test this hypothesis, the null hypothesis and the alternative hypothesis were formulated as follows:

• Hypothesis H0: There is no direct, statistically significant effect of marketing innovation on consumer innovation.

• As for the hypothesis, H1: There is a direct and statistically significant effect of marketing innovation on consumer innovation.

• Based on the results of testing the sub-hypotheses shown in Table No. (05), the CR value related to the first sub-hypothesis is 1,826, which is less than the significance level estimated at 1.96, which means rejecting the alternative hypothesis and accepting the null hypothesis that there is no direct effect relationship with statistical significance for innovation Marketing on consumer innovation.

This result is the opposite of the findings of the study (Chih-Wei Chao 2010) as marketing innovation is an intermediate variable that affects and is affected between consumer innovation and the decision to adopt new products.

			Estimate	S.E.	C.R.	P	Label
Consumer innovativeness	<---	Marketing innovation	0,542	0,297	1,826	0,068	par_14
Consumer innovativeness	<---	Innovation factors	0,313	0,047	6,659	***	par_16

Table No. (05): Results of testing sub-hypotheses

Source: From the output of AMOS V 24

The second sub-hypothesis:

This hypothesis pertains to the examination of the influence relationships between the independent variable and the mediating variable, focusing on the impact of product innovation factors on consumer innovation. It can be formulated as follows:

H2: There is a direct and statistically significant effect of product innovation factors on consumer inovation.

To test this hypothesis, the null hypothesis and the alternative hypothesis were formulated as follows:

Null Hypothesis (H0): There is no direct, statistically significant effect of the innovation factors in the product on consumer innovation.

Alternative Hypothesis (H1): There is a direct and statistically significant effect of innovation factors in the product on consumer innovation.

Based on the results of testing the sub-hypotheses shown in the previous table, the critical ratio (CR) value related to the second sub-hypothesis is 6.659, which exceeds the significance level estimated at 1.96. This indicates rejection of the null hypothesis and acceptance of the alternative hypothesis, suggesting a statistically significant direct effect relationship of innovation factors on consumer innovation.

This finding is consistent with the results of the study by Cheng-Hsum Ho (2011), which also found a direct and statistically significant effect relationship of innovation factors on consumer innovation.

The preceding table illustrates the testing of hypotheses with direct effects, while hypotheses regarding indirect effects related to intermediate variables are derived from the standardized direct effects table and the standardized indirect effects table.

Accordingly, the hypothesis regarding the mediating variable is tested, determining whether the mediating variable (consumer innovation) is accepted or rejected as an intermediary between the independent variables and the dependent variable.

The third sub-hypothesis (the mediating variable hypothesis):

This hypothesis relates to the study of indirect influence relationships between the independent variable marketing innovation and the adoption decision in the presence of the mediating variable consumer innovation represented by the impact of marketing innovation on consumer innovation, which in turn affects the adoption decision.

Or in other words, consumer innovation is an intermediate factor between marketing innovation and the adoption decision, and it can be formulated as follows:

H3: Consumer innovation is a mediating factor between marketing innovation and adoption decision.

To test this hypothesis, the values of the relationship between the two variables were relied on and the strongest of them was measured between the direct and indirect influence according to Table No. (06) that follows:

Table No. (06): Results of testing sub-hypotheses for the mediating variable.

Standardized Direct Effects (Group Number 1 - Default Model)				
	Marketing innovation	Innovation factors	Consumer innovativeness	Adoption decision
Consumer innovativeness	0,190	0,441	0,000	0,000
Adoption decision	0,233	0,731	-0,011	0,000
Standardized Indirect Effects (Group Number 1 - Default Model)				
Consumer innovativeness	0,000	0,000	0,000	0,000
Adoption décision	-0,002	-0,005	0,000	0,000

Source: From the output of AMOS V 24

It is evident from the results presented in the upper part of the table that the direct relationship value between marketing innovation and the adoption decision is represented by 0.233, whereas

it is represented by -0.002 in the indirect relationship. Consequently, we deduce that the direct relationship between the study variables (marketing innovation and the adoption decision) is stronger than the indirect relationship. Thus, we can conclude that the consumer innovation variable does not act as an intermediary. This refutes the hypothesis that consumer innovation serves as an intermediate factor between marketing innovation and the adoption decision. This finding contradicts the conclusions drawn by Chih-Wei Chao (2010), who suggested that marketing innovation acts as a mediator between consumer innovation and the adoption of inovative products.

The fourth sub-hypothesis (the mediating variable hypothesis):

This hypothesis explores the indirect influence relationships between the independent variable, product innovation factors, and the adoption decision in the presence of the mediating variable, consumer innovation. Consumer innovation is represented by the effect of product innovation factors on consumer innovation, subsequently affecting the adoption decision. In other words, consumer innovation serves as a mediating factor between product innovation factors and the adoption decision. It can be formulated as follows:

H4: Consumer innovation is a mediating factor between product innovation factors and the adoption decision.

To test this hypothesis, the values of the relationship between the two variables were examined, and the strongest relationship, whether direct or indirect, was measured according to Table No. (06) above:

We observe from the results in the upper part of Table No. (06) that the value of the relationship in the direct way between the innovation factors in the product and the decision to adopt was represented by 0.731, while it was represented by -0.005 in the relationship in the indirect way. Therefore, we infer that the direct relationship between the study variables (innovation factors and the decision to adopt) is stronger than the indirect relationship. Hence, we conclude that the consumer innovation variable does not act as an intermediary. Consequently, we refute the hypothesis that consumer innovation serves as an intermediate factor between product innovation factors and the adoption decision.

This result aligns with the findings of the study by Cheng-Hsum Ho (2011), where the influences of consumer innovation and innovation factors were studied independently on the decision to adopt new products.

Conclusion:

In order to adhere to the methodology of scientific research, this chapter relied on several statistical tests to examine the suitability of the researched sample for analytical study. The

sample was subjected to various tests to confirm its suitability for statistical analysis. Parametric tests were selected due to the fulfillment of important conditions, such as the moderation of the normal distribution, the representativeness of the researcher's population, which comprises consumers of the economic light bulb, the large sample size, and the categorical level of measurement.

Exploratory factor analysis was conducted for all study variables using SPSS V 25 to identify factors saturating the study items and to ensure the models' conformity to the data of the sample studied in reality. After verifying the readiness and viability of the confirmatory factor models for each variable, they were collected to represent the structural model reflecting the mosaic of the hypotheses. The results indicated that the model's conformity to the data was acceptable according to a set of criteria, leading to the testing of study hypotheses, some of which were accepted and others rejected. These results were found to be consistent with some previous studies while contradicting others. The key findings are as follows:

- The first main hypothesis, stating that there is a statistically significant relationship between demographic variables of the consumer and the decision to adopt the economic light bulb, was rejected.
- The second main hypothesis was supported, indicating a statistically significant effect relationship of marketing innovation on the decision to adopt the economic light bulb.
- The third main hypothesis was supported, showing a statistically significant direct effect relationship of innovation factors in the product on the decision to adopt the economic light bulb.
- The fourth main hypothesis, proposing a statistically significant effect relationship of consumer innovation traits on the decision to adopt the light bulb, was rejected.
- The first sub-hypothesis, suggesting a direct and statistically significant effect of marketing innovation on consumer innovation, was rejected.
- The second sub-hypothesis was accepted and proven, indicating a direct and statistically significant effect relationship of product innovation factors on consumer innovation.
- The hypothesis regarding consumer innovation as a mediating factor between marketing innovation and the adoption decision was refuted.
- Similarly, the hypothesis regarding consumer innovation as a mediating factor between product innovation factors and the adoption decision of the surveyed sample was refuted.

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