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Thesis for the Degree of Doctor of Philosophy

Customer Satisfaction and Repurchase Intention of Smart Home Products: The Moderating Role of Perceived Effectiveness of IoT Institutional Mechanisms

by

Qing Ma

Graduate School of Management of Technology

Pukyong National University

August 2021

Customer Satisfaction and Repurchase Intention of Smart Home Products: The Moderating Role of Perceived Effectiveness of IoT Institutional Mechanisms

(스마트 홈 제품의 고객 만족도와 재구매 의도: IoT 제도적 메커니즘에 대한 인지된 유효성의 조절역할을 중심으로)

Advisor: Prof. JaeHak Son

(Co-advisor: Prof. Minghao Huang)

by

Qing Ma

A thesis submitted in partial fulfillment of the requirements

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Graduate School of Management of Technology

Pukyong National University

August 2021

Customer Satisfaction and Repurchase Intention of Smart Home Products: The Moderating Role of Perceived Effectiveness of IoT Institutional Mechanisms

A dissertation

by

Qing Ma

Approved by:

_____
(Chairman) Dong Phil, Chun

_____ _____
(Member) Eunyoung, Nam (Member) Sun-Jin, Kim

_____ _____
(Member) Minghao, Huang (Member) Jae Hak, Son

August 27th, 2021

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스마트 홈 제품의 고객 만족도와 재구매 의도: IoT 제도적 메커니즘에 대한 인지된 유효성의 조절역할을 중심으로

Qing Ma

기술경영 전문대학원

부경대학교

요약

사물 인터넷 기술의 성장으로 스마트 홈 제품은 엄청난 성장 잠재력을 얻을 것으로 예상된다. 산업 및 소비자 측면에서 증가하는 스마트 홈 제품에 대한 관심이 증가하고 있다. 소비자의 태도와 경험을 이해하는 것이 필수적이다. 그러나 스마트 홈 제품 고객은 지속적인 구매 의사가 부족하여 솔루션을 찾는 것이 현재 연구의 중요한 주제가 되었다. 소비자가 제품에 대한 직접적인 정보를 소유할 때는 간접 구매 소스로서의 제도적 메커니즘은 관련성이 없는 것으로 추정된다. 제도적 메커니즘 구조는 거래 환경을 보호하기 위해 시작된 공식적인 규제 구조를 의미한다. 따라서 이 논문의 목표는 사물 인터넷 제도적 메커니즘에 대한 인지된 효과성 (PEIIM) 의 조절 효과를 연구하는 것이다. 많은 실증연구에 따르면 고객 만족과 재구매 의도 사이의 관련된 제도적 맥락에 대한 고려가 충분하지 않다. 스마트 홈 제품의 경우 PEIIM 이 고객 만족과 재구매 의도 사이의 관계에 대한 조절 역할을 더

잘 이해하는 것이 매우 중요하다. 또한 고객의 태도를 이해하기 위해 고객 만족의 선행 요인과 그 매개 효과를 연구하였다.

PEIIM 은 네트워크 환경의 잠재적인 위험으로부터 소비자를 보호하기 위해 스마트 홈 제품 고객이 존재한다고 생각하는 사물 인터넷의 제도적 또는 기능적 보장 메커니즘 (실시간 모니터링, 원격 작동, 보안 보호 등)을 의미한다. PEIIM 은 스마트 홈 제품의 사물 인터넷에 대한 고객의 견해를 포착하고 위험을 완화하는 그 사물 인터넷의 능력을 강조하기 위한 것이라는 것이 강조된다. 본 논문은 스마트 홈 제품 재구매 맥락에서 사물 인터넷 제도적 메커니즘에 대한 인지된 효과성의 조절 역할을 탐구함으로써 이론적으로 관련 문헌에 기여한다. 구체적으로 본 연구는 TAM 및 ECT 모델에 의존하며 스마트 홈 제품 재구매 경험이 있는 602 명의 고객을 대상으로 SPSS 24.0 및 AMOS 24.0 을 사용하여 SEM 모델, 매개 및 조절 효과 분석을 통해서 자료를 분석한 결과 PEIIM 은 고객 만족과 재구매 의도 사이의 관계를 긍정적으로 조절하고 있다는 것을 보여준다. 이는 더 높은 수준의 PEIIM 상황에서 고객 만족과 재구매 의도의 관계가 더 강하게 나탄다는 것을 의미한다. 때문에 기존 고객들이 스마트 홈 제품에 대한 과거의 긍정적인 경험이 이 브랜드에 대한 미래 가치에 대한 기대치를 향상함에 있어 사물 인터넷 기술이 갖고 있는 부작용을 최소화하는 PEIIM 을 형성하는 노력이 필요하다. 또한, 본 논문은 재구매 의도에서 가격의 효과성의 중요성과 평가에 대한 사물 인터넷의 제도적 메커니즘의 흥미로운 역설적 효과를 밝힌다. 한편으로 PEIIM 이 높은 사람들은 가격이 비싸더라도 스마트 홈 제품을 재구매하도록 유도할 수 있는 반면, 다른 한편으로는 재구매 의도 상황에서 전환비용의 중요성을 감소시킨다. 또한, 본 논문은 재구매 의도에서 제품 효과성의 중요성과 재구매 의도에 대한 PEIIM 의 조절 영향을 발견했다. 사물 인터넷의 제도적 메커니즘에 대한 (높은 수준의) 긍정적 인식이 제품 다양성의 효과성을 높이고 제품 다양성의 장점을 완전히 입증할 수 있음을 보여준다.

많은 글들이 고객 만족의 재구매 의도에 대한 매개 효과에 대해 논의했지만 서로 다른 고객 만족의 원천이 서로를 보완할 수 있다는 것을 인식하는 연구는 거의 없다. 본 논문은 고객 만족의 선행 요소를 분석하고 이러한 요인이 고객 만족의 매개 효과를 통해 재구매 의도에 미치는 영향을 연구한다. 그 결과 가격과 서비스에 대한 고객의 인식, 국내 브랜드 및 제품 다양성이 고객 만족을 통해서 재구매

의도에 긍정적 인 영향을 미치는 것으로 나타났다.
주제어: 사물 인터넷 제도적 메커니즘에 대한 인지된 효과성; 스마트 홈 제품; 고객 만족도; 고객의 재구매 의도.

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Customer Satisfaction and Repurchase Intention of Smart Home Products: The Moderating Role of Perceived Effectiveness of IoT Institutional Mechanisms

Qing Ma

Graduate School of Management of Technology

Pukyong National University

Abstract

With the growth of Internet of Things technology, smart home products are expected to have huge growth potential. There is a growing interest in smart home products on both industry and consumer sides. Understanding the attitudes and experiences of consumers is essential. However, since smart home product customers lack continuous purchase intention, it has become an important issue in current research to find a solution to this. Institutional mechanisms, as a second-hand source of the purchase process, are not presumed to be relevant when consumers possess first-hand information about products. Institutional mechanism structure refers to the formal regulatory structure initiated to protect the trading environment. Thus, the goal of this paper is to study the moderating effect of the perceived effectiveness of Internet of Things institutional mechanisms (PEIIM). A large number of empirical studies have shown that relationship between customer satisfaction and repurchase intention has not considered enough on the relevant institutional context. For smart home products, it is vital to

better understand the moderating role of the PEIIM between customer satisfaction and repurchase intention. In addition, in order to understand the attitude of customers, the antecedents of customer satisfaction and mediating effect of it has been studied.

PEIIM refers to the guaranteed institutional or functional mechanisms of the Internet of Things that buyers of smart home products believe to exist (such as real-time monitoring, remote operation, security protection, etc.) to protect consumers from potential risks in the network environment. It is emphasized that PEIIM is used to capture customers' views on the Internet of Things smart home products and to highlight its ability to mitigate risks. This paper extends the literature by exploring the role of Internet of Things institutional mechanisms in the smart home products repurchase context. Specifically, this study draws on the TAM and ECT models, and based on a survey of 602 customers with repurchase experience of smart home products, using SPSS 24.0 and AMOS 24.0 to analyze the data through the SEM model, mediating and moderating analysis, the results show that PEIIM positively moderates the relationship between customer satisfaction and repurchase intention, which means that the relationship will be intensified under the context of higher PEIIM. Thus, companies should make efforts to improve the PEIIM by minimizing the side effect of Internet of Things technology so that extant customers better transform their positive user experiences of smart home products into higher brand value of them. Furthermore, this paper reveals an interesting paradoxical effect of Internet of Things institutional mechanisms on the importance and evaluation of price effectiveness in repurchase intention. On the one hand, a positive (high level) perception of Internet of Things institutional mechanisms can encourage people to repurchase smart home products even if they are expensive, while on the other hand, it

diminishes the importance of switching cost in repurchase intention situations. Moreover, this paper found that Internet of Things institutional mechanisms had an effect on the importance and evaluation of product effectiveness in repurchase intention. It shows that a positive (high level) perception of Internet of Things institutional mechanisms can enhance the effectiveness of product diversity and fully demonstrate the advantages of product diversity.

Numerous studies have discussed customer satisfaction mediating effects on repurchase intention, with few studies recognizing that different sources of customer satisfaction could complement each other. This paper analyzes the antecedents of customer satisfaction and studies the influence of these factors on repurchase intention through the mediating effect of customer satisfaction. The results show that customers' perception of prices and services, domestic brands and product diversity have a positive impact on repurchase intentions through customer satisfaction.

Key Words: perceived effectiveness of Internet of Things institutional mechanisms; smart home products; customer satisfaction; customer repurchase intention

Ⅰ. Introduction

1.1 Research background

In a hyper-connected digital society driven by Internet of Things (IoT) technology, smart home products are expected to have huge growth potential in the next few decades (Kim & Yoon, 2016). However, there are some potential barriers to the adoption of smart home products, such as a lack of understanding of smart home technology, concerns about use difficulties, and connectivity and security concerns, as well as a loss of customer freedom (Klobas et al., 2019). To overcome these barriers, researchers and practitioners are beginning to pay attention to the institutional context where IoT-based smart home products are embedded because better institutional mechanisms will make people feel safer and more protected when they purchase or repurchase smart home products. However, relevant studies in the context of smart home product repurchase intentions are rare because institutional mechanisms, as a second-hand source of the purchase process, are not presumed to be relevant when a consumer possesses first-hand information about products (McKnight et al., 1998; Fang et al., 2014). Thus, this paper explores the role that the perceived effectiveness of IoT institutional mechanisms (PEIIM) plays in terms of its articulated focus on general perception and risk mitigation, and on the relationship between smart home product customer satisfaction and repurchase intention.

With radical social progress and transformation, the traditional way of life and

work will also be fundamentally changed. On the one hand, people are pursuing a more convenient, flexible, and smarter life with data-driven innovations. On the other hand, there are also increasing concerns about sustainability issues such as energy security, climate change threats, and energy price uncertainty, which has created an upsurge of interest in smart home products (Walzberg et al., 2020). The IoT will promote the development of smart home products, and smart home products characterized by connectivity, automation, and security will become dominant, because safety and remote control are the most important basic functions of people's smart lifestyle (Kim & Yoon, 2016). This is closely related to the aging population structure, low birth rate, and increasing number of single or two-parent families. The safety monitoring and real-time operability of the home have become especially important. Furthermore, people's demand for convenient housing is gradually increasing. In these convenient houses, home products and contents will be integrated and connected via IoT technology. It is estimated that by 2025, through data accumulation and enhancement of the algorithm model, China will occupy more than 30% of the market share for smart home products, while the U.S. market will reach 40%. It is also estimated that by 2026, the domestic market for smart homes in Korea will reach $7 billion (Han et al., 2021). Therefore, it is important to have a better understanding of the evolving nature of smart home products and the new features that need to be seriously concerned.

Traditional smart home products refer to automatic control and detection, as well as automatic adjustments by anthropomorphic intelligence that rely on processors and

mechanical chips and the use of mechanical technology, which is configured, anthropomorphic, and can be operated and changed, and adjusted and controlled according to the environment and requirements (Marikyan et al., 2019). With the development of IoT technology, smart home products have been upgraded through connectivity with the Internet. A smart home is defined as “a house equipped with technologies that can promote monitoring and/or independence of the residents as well as improve the quality of life” (Augusto & Nugent, 2006; Kim & Yoon, 2016). Nowadays, this concept of the smart home is being extended to various smart home products that are in the home, but can be controlled automatically and remotely through a mobile phone or PC from the outside. Smart home products refer to home products that are connected through IoT technology to provide smart services for the family (Kim et al., 2017). At present, a large number of smart home products are connected by mobile applications or computer software, and there is no need to consider the network gateway system as in the past. Therefore, the network system of smart home products is not within the scope of this paper. For research purposes, smart home products were defined as all home electronic devices that use the IoT for management, monitoring and control, such as TVs, air conditioners and electric lights, and all other devices that can be used in the house, such as waterworks, door locks, electricity, heating devices, windows, cameras and so on (Kim et al., 2017).

With the development of science and technology, the International Telecommunication Union (ITU) released the “ITU Internet Report in 2005: IoT,” which formally put forward the concept of “IoT.” The report pointed out that the

ubiquitous IoT communication era is around the corner. All physical objects in the world can become active participants in exchanging through the Internet. Along with the “Smart Earth” proposed by the United States and “IoT Action” in the European Union, Korea published the “Basic Plan for IoT Infrastructure Construction,” China had a “Five-Year Plan for the IoT,” and Japan established “I-Japan.” The world had given notice to the IoT and called it another revolution in the information industry following the Internet’s arrival. The application of IoT products will improve the rationality of resource allocation, ensure production quality, and achieve orderly and efficient circulation (Lang, 2011). With the rapid development of IoT technology, more and more devices are connected through smart phones that consumers have purchased. Therefore, competition in the smart home product market for its system construction and product promotion centered on IoT technology is becoming more and more fierce. The operators of traditional home products cooperate with equipment manufacturers and technology developers to lead the smart home product industry (Stojkoska & Trivodaliev, 2017). Scholars believe that with the advent of the Internet of Everything era, the diversified industrial chain structure will lead to diversified competitors, while individual traditional products can no longer adapt to the changes in the smart home product market. Therefore, for smart home product companies that require a combination of software and hardware as the primary presentation method, customer maintenance not only means single product sales income, but also continuous later income that is likely to be obtained through hardware upgrades, the application of additional functions, and connected devices. This process is achieved

through customer-oriented intelligent hardware upgrades, the introduction of cloud products, and the development and operation of various intelligent applications (Lu et al., 2021). Thus, with the development of IoT technology, several major brands, including Samsung, LG, Apple, HUAWEI, and Google, have chosen to integrate and connect the product chain. How to retain existing customers for repurchase is an issue that companies need to consider.

Repurchase is considered the primary manifestation of loyalty and has the most direct commitment to financial returns, and so is deemed desirable and commercially feasible for smart home product companies under IoT technology (Oliver, 1999; Otim & Grover, 2006), as well as the most intuitive manifestation of customer share (Gremler, 1995; Jacoby & Chestnut, 1978). Simultaneously, in the fully mature stage of the traditional home product market, the customer retention rate analysis of smart home products using IoT technology can be reflected by studying customer repurchase. However, one of the reasons why smart home products have not been popularized rapidly is that consumers do not fully understand smart home technologies and services (Yang et al., 2017). The uncertainty about technologies and services may cause people to worry about changes in cost, performance and even lifestyle (Hong et al., 2020). Many consumers worry that the technical and software problems of products may lead to the loss of control of smart home products (Dynatrace, 2018). Furthermore, the complex installation process and difficulties in using smart home products have caused widespread resistance to smart home services (Argus, 2015), which may lead to people’s unwillingness to continue to use or widely switch to smart

home products. As the lack of demand hinders the growth of the market and the development of related technologies, it is worth analyzing the worries that lead to consumers' hesitation and prevent the adoption of smart home products. Fortunately, with the development of IoT technology, there are more and more institutional mechanisms. In 2018, the world's first "Common Criteria" that complies with the international information security standard institutional mechanism was released. It indicates that smart home products have recognized institutional mechanism protection measures in the field of information security. In addition, with the development and popularization of blockchain, the application of this technology to the security field of the IoT can improve a series of IoT security institutional mechanisms. The rapid development of 5G networks provides a guarantee for the network of the IoT institutional mechanisms. Therefore, this paper focuses on analyzing the perceived effectiveness of the IoT institutional mechanisms, and aims to provide an exploratory view of smart home product users' repurchase intentions.

In the basic principles of marketing, acquiring new customers and maintaining the satisfaction of existing customers have always been the two main tasks (Huber et al., 2015). In recent years, due to the development of the IoT institutional mechanisms, the trend of comprehensive smart home product companies has become obvious and customers are more susceptible to temptation from competitors than ever, and it is increasingly difficult for companies to find appropriate methods to maintain customer satisfaction. As a result, more smart home product companies are looking for new means of competition based on price. Companies have gone through a complex

strategy cycle in price setting and increased service performance, hoping to establish a good brand image. By innovating products and enriching the product chain, they establish a stable customer group. From the perspective of marketing, analyzing the customer switching cost of smart home products oriented to the IoT institutional mechanism can find an important basis for customers to effectively balance the price strategy based on the purchasing intention (Dick & Basu, 1994). On the other hand, service will be discussed as another important factor. From a value-added perspective, services play a pivotal role in marketing. Under the IoT institutional mechanisms, the effectiveness of the services of smart home product companies will become particularly important. With the development of technology, international trade has become more and more critical. Many countries pay more attention to the development of domestic brands nowadays; for instance, South Korea has brands such as Samsung and LG, the United States has Apple and Google, and China has HUAWEI and XIAOMI. The analysis of domestic brands and foreign brand effect can help to effectively understand customer choices. According to the 4P theory of marketing and analyzing prices, products are also an important factor. It is also worth discussing whether product diversity is essential for enterprises (Huber et al., 2015). Therefore, starting from the four aspects of price, service, brand and product, the analysis of the antecedent factors of customer satisfaction has great theoretical significance. Although a large number of studies have analyzed customer satisfaction, studies in the context of smart home product customer satisfaction are rare. Thus, this paper will discuss customer satisfaction related to smart home products with the

purpose of discovering the basic needs of users and the sources of satisfaction with smart home products in various market segments, as well as encouraging smart home product providers to plan and develop user-oriented services and competitive marketing strategies.

1.2 Research objectives

This paper studies antecedents of customer satisfaction and institutional context of the mechanisms between customer satisfaction and repurchase intention by introducing the perceived effectiveness of IoT institutional mechanisms, which stresses the mitigation of general contextual risks (Fang et al., 2014). One of the most important objectives of this paper is to empirically test the moderating role that the perceived effectiveness of IoT institutional mechanisms plays in the relationship between customer satisfaction and their intention to repurchase IoT-based smart home products. Customers who fully perceive the effectiveness of the IoT institutional mechanisms will make them more affirmative of their past purchase experience. The perceived effectiveness of IoT institutional mechanisms will positively increase the affirmation of customer satisfaction, and people will be more convinced that the past choice is correct. Therefore, customers can share the experience with other customer groups to encourage new purchase, and companies can use the value-added technical service to establish a customer system. It is believed that the IoT institutional mechanisms will help smart home product companies improve the customer network and ultimately achieving customer retention rate. Moreover, due to the characteristics of smart home products, there are direct impact between price effectiveness, product

effectiveness and customer repurchase intention. Consumer will repurchase the same brand smart home products because the attractive price or product diversity and so on. Thus, this paper will discuss the moderating impact of perceived effectiveness of IoT institutional mechanisms between price effectiveness, product effectiveness and customer repurchase intention. Therefore, the theoretical and practical contribution of this paper can guide the development of other IoT industry.

Firms want customers to be attached to their products with strong feelings. First it is necessary to fulfill customer satisfaction. When customers are satisfied, they show commitment to continuously purchase the same brand (Ballantyne et al., 2006). Although a large number of scholars believe that customer satisfaction has positively significant impact on repurchase intention, however, there are few studies on smart home product customer satisfaction and repurchase intention. Therefore, the second objective of this paper is to verify the relationship between customer satisfaction and repurchase intention of smart home products.

Thirdly, Holbrook (1999) believes that it is necessary to meet customers' needs and improve customer satisfaction to stand out from the competition. Currently, smart home product companies have realized that customer needs have specific characteristics; more and more of them are beginning to attach importance to it and hoping to expand profit margins by establishing stable relationships with customers (Butz Jr & Goodstein, 1996). With the development of IoT institutional mechanisms, market competition for smart home products is no longer driven by a single product. Thus, to establish a strategic market position, companies must implement a

differentiated strategy to improve operational efficiency, which requires companies to consider the needs of customers such as cost, service, brand and product. Therefore, the third objective of this paper is to analyze the impact of the four antecedents, which are price, product, brand, and service effectiveness, on smart home product customer satisfaction. The details are as follows:

1): The market application model of smart home products in the mobile Internet era is difficult to adapt to the IoT era. In terms of the characteristics of IoT institutional mechanisms, the main operational characteristics are mainly manifested in the mutual software connectivity between products (Chen, 2019). Moreover, each project requires specially customized development based on standardized solutions. On the one hand, manufacturers need to invest resources to satisfy the customized connection requirements of smart home product customers; on the other hand, such personalized connection requirements will be challenging to replicate for other customers' needs. This means that there is likely to be a high customer switching cost. For smart home product companies, customers need a simple connection experience, while higher switching costs may cause customers to have more barriers to consideration when choosing to purchase. Under the IoT institutional mechanisms, the relationship between the switching cost of smart home products and the customer repurchase intention is one of the focuses of this paper.

2): The business expansion strategy of smart home product companies under the IoT institutional mechanisms is different from the standardized development path in the Internet era. For example, to help customers establish IoT connection services

between products, it is necessary to understand the professional needs of customers accurately, instead of gradually exploring the rapid iteration of single-application software in the mobile Internet era; therefore, if there is no thorough understanding of the service competition of smart home products and accurate understanding of the service costs paid by customers, it will not succeed in the future with the development of 5G. Looking at the current development status, some problems have caused widespread concern among manufacturers. Thus, this paper will study the effectiveness of smart home product services under the IoT institutional mechanisms.

3): As mentioned above, more and more countries are developing their own smart home product brands. Many domestic smart home product brands are encouraged by national policies, supported by national network operators and other institutional mechanisms, and occupy a large market share. However, how to occupy a favorable market in a foreign country is worth exploring. Besides, foreign industry leader brands also have more loyal customers. Under the IoT institutional mechanisms, the factors that customers consider when choosing a brand will be a focus of this paper.

4): Product innovation originates from market demand; technological innovation activities take market demand as the starting point. It is believed that clarifies the research direction of product technology and creates marketable products suitable for this demand through technological innovation activities to meet demand. Product innovation seeks the best combination of risk and return according to the industry and the company's characteristics with concerns about its own technical capabilities and market demand. Fundamentally speaking, the driving force of product innovation is

the result of technology advancement and the pull of demand. Product innovation has significance for smart home products. However, firstly, the connection between innovative products and existing products is key in studying whether innovative products are suitable under the IoT institutional mechanisms. Secondly, with the development of IoT institutional mechanisms, there is a high compatibility mechanism between products. Due to the same system or software, products under the same brand provide quicker access to the mechanisms of operations and applications. Thus, the development of product diversity is equally essential for smart home products. This paper will discuss innovation and diversity for smart home products.

1.3 Research scope and outline

This paper uses quantitative analysis methods based on consumer behavior in the context of management, and an empirical analysis of the influencing factors of smart home product customers' repurchase intentions will be discussed. In this paper, customer intentions to repurchase smart home products will be analyzed as the key point. Simultaneously, this paper posits that the perceived effectiveness of IoT institutional mechanisms plays the main moderating role of smart home product customer satisfaction on repurchase intention. Secondly, based on an analysis of marketing theory, the four antecedents of smart home product customer satisfaction, which are effectiveness of price, service, brand and product, will be explained. Finally, based on the analysis results of this paper, some theoretical and practical contributions will be discussed.

This paper is composed of five chapters. The first chapter is the introduction, the

second to the fourth chapter is the main body of research, and the fifth chapter is the conclusion.

The introduction mainly elaborates the research background and introduces the research objective, scope and outline.

The second chapter is the literature review. Firstly, there are the analysis of customer satisfaction definitions and models will be discussed. Secondly, in the analysis of the antecedent factors of customer satisfaction part, price perception and switching costs will be talked about, in order to determine how buyers of smart home products make reasonable price decisions during the consumption process to affect customer satisfaction and customer repurchase intention. Taking service factors as the theme, services to maintain the customer's repurchase intention will be discussed. In addition, this part determines brand effectiveness and product effectiveness as antecedent factors. Furthermore, studies on the direct impact of customer satisfaction, price effectiveness, product effectiveness and customer repurchase intention will be discussed. Moreover, it describes the background of IoT technology and the status of the smart home product market. The definition of the perceived effectiveness of IoT institutional mechanisms will be discussed.

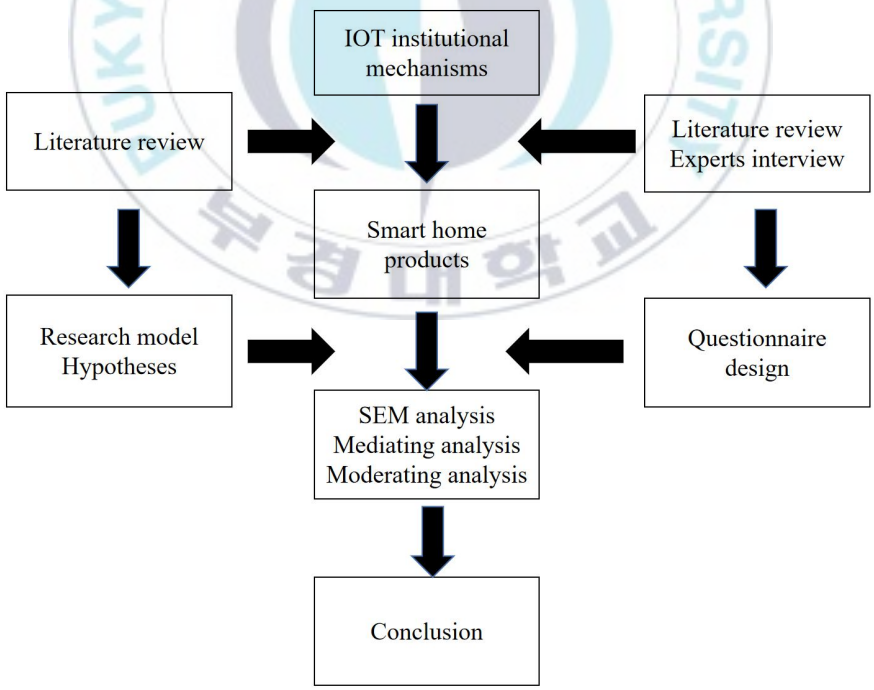
Chapter three is the research model and hypotheses, and establishes a research model based on the literature review and propose hypotheses based on related theories.

Chapter four is data analysis and results. Firstly, it mainly explains how to develop the scale and design the questionnaire for the hypotheses and research model,

describe data collection and data analysis methods and collect a small number of questionnaires for pilot study analysis. Secondly, it is based on theoretical analysis, it conducts structural equation modelling analysis on the structure and path effects of the influencing factors of customers' intentions to repurchase smart home products, uses empirical analysis to verify relevant hypotheses, measures the model and makes adjustments. There are mediating and moderating analysis will be discussed. The result of data analysis will be talked about.

The fifth chapter summarizes the main conclusions, limitations, and research prospects of this paper. The research outline model as shown in Figure 1-1.

<Figure 1-1> Research outline model



1.4 Research contributions

As a second-hand information of purchase process, institutional mechanisms are not presumed to be relevant when consumers possess first-hand information about the products (McKnight et al., 1998; Fang et al., 2014). This paper explores the moderating role of IoT institutional mechanisms in the smart home products repurchase context, it points out the new understanding of IoT institutional mechanisms by discussing the construct of PEIIM and focus on its general perception and risk mitigation. The results of its role in relationships involving satisfaction, price effectiveness, product effectiveness and repurchase intentions which are important contributions to the understanding of how satisfaction and other are evaluated in existing repurchase process of smart home products. Furthermore, these findings provide several managerial implications for both smart home products enterprise and public policy makers. Secondly, this paper builds the model by extending the model of TAM and ECT, the findings add to the smart home products literature by analyzing antecedents of customer satisfaction and identifying important conditions for the relationship between customer satisfaction and repurchase intention. In essence, the contribution of this paper is that adding to the existing literature by demonstrating that a technology-based satisfaction lever (PEIIM) and a process-based satisfaction lever (customer satisfaction) can interact to produce an additional influence on customer repurchase intention of smart home products.

II. Literature Review

2.1 Customer satisfaction

2.1.1 Literature on customer satisfaction

Scholars, represented by Fornell (1992), argued that customer satisfaction as a transference in the purchase process affects the customer's repurchase intention (Bolton, 1998). Many companies have started to focus on and try to improve and maintain satisfaction. The main objective of customer satisfaction management is to enhance the things that make customers satisfied and to eliminate or weaken the things that dissatisfy them. The aim is to promote consumer repurchase intentions (Cardozo, 1965; Oliver, 1999). However, since the level of satisfaction varies with customer characteristics, the reality is that even satisfied customers often switch brands or discontinue their purchases, while dissatisfied customers show a high level of repurchase (Bowen & Shoemaker, 1998). There is no doubt that the key to promoting consumer repurchase intention is customer satisfaction. But the need to reflect on customer satisfaction research, to find industry-appropriate factors affecting customer satisfaction, and to find the key moderators from customer satisfaction to customer repurchase intention to study becomes a key issue.

Although customer satisfaction has been studied many times in the literature, there are few studies on customer satisfaction with smart home products. Studying the mediating effect of customer satisfaction on customer repurchase intention for smart home products first requires defining satisfaction. Keith (1960) emphasized that

economic activities should satisfy customers' needs and desires, and Oliver (1980) suggested that customer satisfaction is an emotional response that arises from the extent to which the actual consumption process differs from the customer's preconceived expectations. Cronin Jr and Taylor (1992) defined customer satisfaction as the psychological state of satisfaction between what the customer gives and what he or she receives for the purchased goods. Customer satisfaction arises when customers compare the product or service they receive with their expectations: if the quality of the product or service exceeds expectations, the customer is satisfied; if the quality does not meet expectations, the customer is dissatisfied (Bearden & Teel, 1983). This paper argues that the above views are conceptually correct and understandable, but they may lead to logical inconsistencies because it does not take into account the degree of expectation assessment, e.g., if the customer only has a low level of expected satisfaction in advance and receives an average quality product or service, the customer is theoretically satisfied based on the above view, but this satisfaction is obviously low in reality. Spreng et al. (1996) suggested that customer satisfaction arises from a comprehensive comparison of the quality of the product or service received with expectations and desires, and that customer satisfaction is not limited to the product or service, but is also related to the information obtained by the customer beforehand. Customers evaluate the product or service as well as the information they receive when determining their overall feelings. However, the concept of prior information acquisition is ambiguous and cannot be easily measured, which causes differences in results. Kotler and Keller (2006) argued that customer satisfaction is a

state of feeling that mainly arises from a comparison of the difference between the performance of a product or service and people's expectations. Satisfaction level is a function of the difference between expected performance and actual performance. For the above definitions, the traditional expectation performance model, which basically does not include such things as a customer's perception of the attributes of the product itself, is used to study customer satisfaction. In addition to customer price and service performance, which directly or indirectly affect customer satisfaction, customer sentiment toward a brand or product also affects customer satisfaction (Han et al., 2004).

Mowen and Minor (1998) stated that consumer satisfaction is the overall attitude indicated from consumer assessment when customers obtain a product or service. It is an assessment resulting from the experience of choosing to purchase and use the goods or services (Minarti & Segoro, 2014). By compiling and analyzing the above definitions, it can be concluded that customer satisfaction is an attitude, evaluation and emotional response that consumers show after the purchase process. Cronin Jr and Taylor (1992) argued that after the first trial of a brand, the level of consumer satisfaction will determine customer repurchase intention. Moreover, during the consumption process, customers develop three different types of satisfaction, namely satisfaction with the best-in-class product or service, satisfaction with the average-in-class product or service, and satisfaction with the product or service for upcoming consumption (Erciş et al., 2012). It is suggested that customer satisfaction as a comparison between internal expectations before purchase and perceptions during

actual consumption, which will be influenced by price and service. Customer satisfaction is influenced not only by cognitive factors (the difference between expectations and performance), but also by affective factors regarding price and brand. Table 2-1 summarizes some other scholars' research on customer satisfaction.

<Table 2-1> Customer satisfaction definitions

Author(s)	Research opinions
Cardozo (1965)	Cardozo first introduced customer satisfaction in marketing, arguing that customer satisfaction motivates customers' buying behavior.
Oliver (1980)	Customer satisfaction is an emotional response that arises from the degree of difference between the actual consumption process and the prior expectations of the customer.
Churchill Jr & Surprenant (1982)	Customer satisfaction is the result of the comparison between the cost paid by the consumer for a product and the effectiveness obtained by the product.
Cronin Jr & Taylor (1992)	After the first trial of a brand, the level of consumer satisfaction determines their repurchase intention.
Brown et al. (1993)	Customer satisfaction should be the emotional response that occurs within the customer after consumption, and the level of satisfaction that the customer receives after consuming a product or service is influenced by the level of the customer's own needs.
Spreng et al. (1996)	Customer satisfaction arises from a comprehensive comparison of the quality of the product or service received with expectations and desires, and customer satisfaction is not limited to the product or service, but is also related to the prior information received by the customer.
Kotler & Keller (2006)	Customer satisfaction is a state of feeling that mainly arises from a comparison of the difference between the performance of a product or service and people's expectations.

In addition, the definition of customer satisfaction has been considered to be transaction-specific satisfaction; most studies have analyzed customer satisfaction

from the perspective of how a specific transaction makes a customer feel, focusing on a single experience in which a customer purchases and consumes a product or service. However, current research defines customer satisfaction as the sum of all customer experiences based on the purchase of a product or service, that is, customer satisfaction based on cumulative transaction experiences (Johnson et al., 1995). Undoubtedly, because a customer's decision to continue with their current brand or company for their next purchase is based on their overall experience of previous consumption, it is believed that customer satisfaction based on cumulative transaction experience is more accurate in predicting customers' future thoughts and behaviors. Therefore, synthesizing the above views, this paper concludes that customer satisfaction is defined as a combination of price perception and brand emotion during the consumption of smart home products, and it is the satisfaction of cumulative transaction experience determined by the customer's expectations of the product or service together with the price perception and brand emotion after consumption.

2.1.2 Analysis of customer satisfaction models

The purpose of studying satisfaction models is to better identify the sources of satisfaction and their influential outcomes. Satisfaction is studied as a mediating variable in almost all models. The compilation of these models can provide a theoretical basis for the construction of the model in this paper. In 1989, the first modern user satisfaction index model, the Swedish Customer Loyalty Barometer (SCSB), was proposed in Sweden, and it was the first national customer satisfaction index model. The SCSB model is composed of five indicators: perceived performance

(value), customer expectations, customer satisfaction, customer complaints, and customer loyalty. Customer expectations and perceived performance (value) are the independent variables, which are a prediction of the state of the product or service before the customer purchases the product, while customer complaints and customer loyalty are the outcome variables of customer satisfaction, and loyalty is the final dependent variable in the model (Fornell, 1992). The SCSB model suggests that satisfaction as a mediating variable has a positive and significant effect on customer loyalty. However, the SCSB model does not provide a clear definition of perceived performance (value) and customer expectations, and lacks consideration of antecedent influences on satisfaction.

The American Customer Satisfaction Index (ACSI) model was proposed in the United States in 1994 (Fornell et al., 1996). Compared with the SCSB model, the ACSI model has added the independent variable of perceived quality, which is the main innovation of the ACSI model, and distinguishes it from perceived value. The concept of perceived quality is added because the satisfaction with a product or service quality can be judged by perceived quality, while perceived value focuses on satisfaction with price, and the main source of user satisfaction can be identified relatively clearly after comparison. The model has been adopted in numerous academic studies (Morgeson III et al., 2015). The ACSI model suggests that overall quality and value and customer expectations are the three antecedents of customer satisfaction. It is worth mentioning that Fornell et al. (1996) argued that customer loyalty is considered a direct consequence of repurchase intention in this model.

Based on the American ACSI model, the European Customer Satisfaction Index (ECSI) model was proposed in 1999. The model consists of six elements (Ciavolino & Dahlgaard, 2007). Compared with the ACSI model, the ECSI model adds image and removes customer complaints, and the ECSI model considers the user's willingness to recommend the company to others and willingness to spend money again as indicators of customer loyalty. It is noteworthy that the ECSI model clearly affirms the relationship between loyalty and repurchase; the model considers repurchase intention as one of the indicators of loyalty. However, the ECSI model also has some limitations. This is because the ECSI model does not clearly define the image, and there is a possibility of error in the judgment of customer satisfaction. According to Sheth et al. (2004), customer loyalty is a very positive attitude of customers towards a brand or supplier, and is reflected by consistent repurchases (Minarti & Segoro, 2014). Similarly, Kotler and Keller (2006) considered the factors of loyalty to be repurchases (loyalty to the purchased product) and retention (resistance to the negative effects of the company), among others (Minarti & Segoro, 2014). Therefore, although the final variable of the above three satisfaction models is loyalty, since repurchase intention is one of the manifestations belonging to loyalty, it can be considered that the satisfaction models can be discussed and studied as theoretical reference models for this paper.

In addition to models that measure satisfaction indices, Davis et al. (1989) proposed the Technology Acceptance Model (TAM) to analyze and predict people's attitudes towards using IT and acceptance behaviors from cognitive and affective

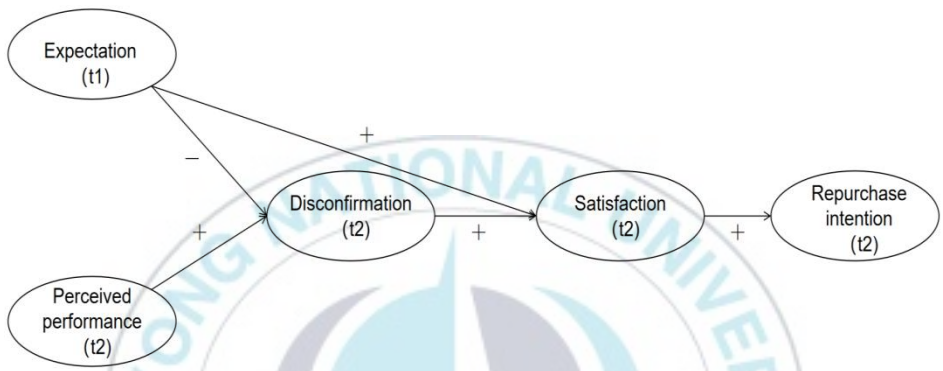
perspectives. TAM suggests that customers' perceived usefulness and perceived ease-of-use of information technology will jointly influence their attitudes toward technology use, and that individual attitudes and perceived usefulness will have an impact on the intention to use technology and eventually on use behavior. In addition, some extraneous variables indirectly influence individual attitudes and final use intention and behavior through individual perceived usefulness and ease-of-use. Owing to the fact that the research topic of this paper is smart home products under the institutional mechanisms of IoT, TAM also provides theoretical assurance for the model construction of this paper. Based on this model, perceived usefulness and perceived ease-of-use can be considered a customer's perceived effectiveness of the product or service, attitude toward use can be considered customer satisfaction, and intention to use can be considered repurchase intention.

Expectation-confirmation theory (ECT) was proposed by Oliver (1980) and said that consumption is based on confirmation between pre-purchase expectation and post-purchase perceived performance to determine whether customers are satisfied with a product or service, and satisfaction becomes the sole reference of repurchase intention. ECT has been widely used in research on customer satisfaction and repurchase intention (Oliver, 2014). The model assumes that a customer's intention to repurchase a product or service depends primarily on their satisfaction with previous use of the product or service, as shown in Figure 2-1 (Liao et al., 2017). ECT has been successfully used to explain customer satisfaction and repurchase intention in the consumer behavior literature. However, the ECT model does not consider the role of

other factors that make up satisfaction. Referring to theories of expectancy and cognitive response processes, customers go through a series of pre-purchase stages for need identification, information search and alternative assessment, and then experience positive or negative satisfaction, which in turn affects repurchase intention (Petty & Cacioppo, 1984). The inclusion of these purchase stages is the only way to more rigorously explain the entire consumption process of the customer. Customers can easily search for information about brands, evaluate prices and product or service options and choose between multiple providers, and these antecedents affect post-consumption satisfaction and thus repurchase intention (Yim et al., 2007) Therefore, although ECT provides the basis for a rigorous explanation, customer repurchase intention in the context of smart home products still needs to be discussed. This paper argues that customer repurchase intention should be re-examined by adding factors that relate the factors involved in the purchase process to ECT. The existing literature suggests that the evaluation of a product or service occurs during the pre-purchase stage, where customers compare what they know about different products and brands with what they consider most important in order to narrow down alternatives before making a final decision (Hofacker et al., 2016). Customers measure purchases by price, brand, and the characteristics of the product or service itself, generating a corresponding satisfaction rating after the purchase (Beatty & Smith, 1987). Antecedent factors play a crucial role in the customer's decision-making process in the repurchase intention of the product. So, adding them to ECT can create a model that better explains repurchase intention. The results can help smart home

product companies to understand consumer purchasing psychology and provide assurance for improving customer satisfaction and eventually increasing repurchase intention.

<Figure 2-1> Expectancy disconfirmation theory[1]



Note: t1 = pre-consumption variable; t2 = post-consumption variable

2.1.3 Analysis of antecedents of customer satisfaction

In 1987, Westbrook (1987), an American marketing professor, first conducted an empirical test on the influence of customer consumption perceptions on customer satisfaction. According to his findings, a customer's perceptions of price, brand and product or service attributes in the consumption process directly affect the customer. Oliver (1990) also added customer response variables for product validity to the empirical model and conducted extensive empirical tests, which showed that customer-perceived validity had a significant effect on customer satisfaction. Customers who will buy the same brand of machine again or buy other machines

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[1] *Source: Oliver, 2010； Liao et al., 2017.*

under the same brand can be considered to be satisfied with the brand (Wang & Johnson, 2008). Hempel (1977) pointed out that customer satisfaction is determined by the degree of realization of the performance expected by customers, i.e., the degree of agreement between response expectations and actual results. By analyzing the above factors of measuring customer satisfaction, this paper identifies four influencing factors according to the characteristics of smart home products: price effectiveness, service effectiveness, brand effectiveness, and product effectiveness.

Price effectiveness

Effectiveness is the degree to which the results achieved by an activity are completed. In market research, validity refers to the degree to which quantitative measurement attempts actually works. Therefore, in this paper, validity is defined as the impact of a variable, i.e., the degree achieved by the performance of the variable. For smart home products, switching costs are to be considered. In addition, smart home products are generally considered high-priced products. Therefore, this paper defines price effectiveness as consisting mainly of switching costs and price perception.

Price effectiveness--Switching cost

Switching cost refers to the cost of switching from one supplier's product to another, and the cost of retraining the user (Dick & Basu, 1994). Ping Jr (2003) claimed that switching cost refers to cost and effort required to switch providers. This cost is not only financial, but also involves time, effort and emotion, and it is an important issue that constitutes the competition of a company (Chen, 2019). If

customers potentially lose a great deal of time, energy, money and relationships by switching from one firm to another, they will not consider it even if they are not completely satisfied with the firm's services. The problem of customer satisfaction consists of two elements; one is customer acceptance and the other is customer switching. Switching cost is a perceived value that can negatively affect the customer's decision (Beerli et al., 2004). When a customer agrees with a new service or product, he or she will usually abandon the previous service or product partially or completely. Thus, customers often switch in the process of accepting something new and abandoning something old, a phenomenon known as switching costs. Knieps (1997) argued that customers tend to think that it is "not worth to switch or replace" when they perceive barriers such as search costs, transaction costs, customer consumption habits, perceived effort, risk from money as well as psychological. Undoubtedly, customer switching cost is a very important part of the customer's perceived value, and is an important part of the customer's decision to switch. The study of customer switching costs for smart home products is considered to be a starting point for competitive analysis. Dick and Basu (1994) argued that switching costs are expressed as psychological and time costs caused by the uncertainty of facing a new service provider, in addition to monetary costs. There is no doubt that the cost of customer switching is worth considering under the IoT institutional mechanisms, where smart home product firms have their own operating systems with products or software under the same system. Therefore, many smart home product companies recognize that switching costs affect the maintenance of customer

relationships, and companies will consciously adjust switching costs as a way to strive for higher customer satisfaction.

It is often difficult for researchers to directly quantify switching costs. Borenstein (1991) used an empirical approach to study the gasoline market and argued that it is the existence of switching costs in the gasoline market that leads to price discrimination. Djotyan et al. (2000) used an empirical approach to study the impact of switching costs in electronic markets and concluded that a firm's choice to increase switching costs may lead customers to prefer products that interest them. Burnham et al. (2003) argued that there are three types of factors that influence switching costs, namely learning costs, persistence costs, and sunk costs. It is suggest that the cost factors that hinder customer switching mainly include learning cost, transaction cost, compatibility cost, time cost, uncertainty cost and psychological cost (Klemperer, 1987). The characteristics of the IoT institutional mechanisms, such as connectivity and professional manipulation, are taken into account. Combining the previous research results, this paper adopts the various dimensions and related elements of switching costs summarized by Klemperer (1987) and Ping Jr (2003), and divides the switching costs into three categories, namely, vertical switching costs, learning costs and time costs. vertical switching costs refer to the ongoing preferences and additional benefits of the current supplier's relationship and the guarantee of providing high-quality services; learning costs refer to the expenditure of energy on information acquisition, transaction and evaluation; and time cost refers to the length of time spent when the relationship changes.

Farrell and Klemperer (2007) argued that while higher switching costs allow for more customer lock-in and sustained revenue, they may nevertheless lead to a lower sense of customer experience to the extent that there is reduced customer satisfaction. Fornell (1992) was one of the first scholars to focus on switching costs, and to incorporate switching costs into the impact of customer satisfaction, the concept of switching costs was introduced. In his research, it was found that customers may buy because they are really satisfied or are dissatisfied with a service, but it is difficult for them to switch to the existing company because of the relatively high switching costs in the process; similarly, customers may not buy because they are very dissatisfied or satisfied, but because of the low switching costs in the market. Anderson and Sullivan (1993) demonstrated the role of switching costs in their study on customer satisfaction and customer retention elasticity, arguing that the moderating effect of switching costs on customer satisfaction and customer purchase relationships is influenced by market structure. If the market has a single or large market operator (e.g., a monopolist), the moderating effect of switching costs on customer satisfaction will be small; if there are many firms to choose from in the market, switching costs become very important, and in such competitive markets, firms can increase customer satisfaction by controlling switching costs. Chen (2019) argued that if the switching cost of a product is high, the influence of customer satisfaction on repurchase of the product will be weakened, and when customers have high satisfaction, there is no significant correlation between switching cost and repurchase, but if customers have low satisfaction, there is a significant positive correlation between switching cost and repurchase. The network

size of smart home products in the IoT regime means that manufacturers need more connections between software and hardware. Therefore, the switching cost of smart home products is of concern for both network cost and price level impact. For manufacturers, higher switching costs mean higher protection and more customer stability, but they also mean lower satisfaction levels. With the development of technology, there has been discussion about the compatibility design of smart home products. In their study on smart home products in Korea, Kim and Yoon (2016) noted that a simple and easy switching experience is more likely to result in customer satisfaction. In summary, it is worth noting that there exists a conversion cost for smart home products that should be discussed. This is because smart home products require systems and software to be connected and high switching costs are likely to exist and lead to customer dissatisfaction. In other words, customers are more satisfied with lower switching costs.

Price effectiveness--Price perception

Price perception usually refers to the monetary and non-monetary embodiment of value that customers pay to obtain a product (Petrick, 2002), with monetary price being the price of a product or service as defined by the consumer and behavioral price being the time and effort that consumers spend searching for a product or service. These definitions provide an important source for accurately expressing customer feelings. Price is an important external cue for consumers (Zeithaml, 1988). Price is a source of stimulus for consumers to create a purchase experience, and in most cases has a positive impact on the experience (Puccinelli et al., 2009; B Joseph Pine &

Gilmore, 1998; Rageh Ismail, 2010). Price perception refers to the customer's estimation of demand and cost analysis (Brakus et al., 2009; Yasri et al., 2020). Studies have concluded that price perception includes both positive and negative cues for consumers (Erickson & Johansson, 1985; Lichtenstein et al., 1988; Lichtenstein et al., 1993). Lichtenstein et al. (1993) defined value perception as a concern about the price paid relative to the quality received. On the other hand, the price quality model and reputation sensitivity have been considered positive perceptions of price. The price perception that customers can recognize is the concept of obtaining a level of quality that is equivalent to price, i.e., one that customers perceive as value for money. In addition, price perception reflects the overall evaluation of the customer's actual experience with a particular transaction (Kashyap & Bojanic, 2000). Monetary price is often considered to be price perception because it is seen as the consumer's sensitivity to the economic expenditure for the product (Petrick, 2002). Thus, price perception is usually considered the customer's approval of the pricing of the product, the perception that the brand offers value for money and that the brand's price represents its quality.

Smart home products are relatively high priced, and the customer's perception of price is important because price is perceived as first-hand information affecting their satisfaction. Customer satisfaction with a product stems from the degree of perceived price (Narangajavana et al., 2014). Johnson et al. (2001), improving on the shortcomings of previous models, first proposed a "price index" instead of "value" to establish a link between price factors and customer satisfaction. Churchill Jr &

Surprenant (1982) stated that customer satisfaction is the degree to which consumers recognize the price cost of the product purchased, i.e., the effect of the cost paid versus the benefit. Price perception represents the customer's assessment of the quality of the product (and service) sought relative to its price and is expected to have a positive impact on their satisfaction (Fornell et al., 1996).

Service effectiveness

Li et al. (2021) argued that service quality research is concerned with the customer's perception of the firm's or brand's overall service and the impact of the customer's perception on the subsequent adoption of ideas or behaviors by the customer. Therefore, this paper determines that service effectiveness refers to the degree of customer recognition of the company's service quality and the degree of effectiveness of the company's service to the customer, i.e., the degree of customer-perceived service. In 1982, the famous service marketing expert Christian Gronroos proposed the "customer perception service quality model," which believes that the customer's evaluation of service quality is the result of comparing the actual feelings of the customer in the process of receiving the service with the psychological expectations before receiving the service (Kang & James, 2004). The core of Gronroos' model is that "the effectiveness of service quality is evaluated by customers," which requires service providers to evaluate and manage the effectiveness of service quality from the perspective of customers.

Gremler (1995) argued that when customer demand for a company's services increases, there is a tendency for customers to continue to use the service provider as

the sole source of supply. Perceived service quality is defined as the customer's assessment of the overall strengths and weaknesses of the service (Zeithaml, 1988). Lin et al. (2014) stated that perceived service quality should be viewed as a concept that weighs the customer's assessment of the benefits of using the service against the price. The effectiveness of service quality has been widely recognized and is considered a major factor in enhancing the competitive advantages of a company (Zeithaml, 1988; Li et al., 2021). Because smart home products under the institutional mechanisms of the IoT are connected, higher effectiveness and professionalism of the services provided by smart home product companies are required.

Meshack and Datta (2015) argued that a customer's assessment of service quality effectiveness and satisfaction depends on the gap between their expectations and their experience of actual performance levels. Perceived service quality effectiveness is a measure of the extent to which a service meets consumer expectations and understands their needs. Kim et al. (2004) argued that overall customer satisfaction can be measured by general satisfaction with the service versus general satisfaction with the service provider. The results of Ye et al. (2014) showed that the convenience of shopping services and the security of product payment services affect customer satisfaction; research on customer perceptions of service effectiveness focuses on the relationship between perceived service quality and affective behavior (Kim, 2010). Oni et al. (2016) conceptualized that the effect of service quality on behavioral intention is indirectly influenced by psychological behavior. The effectiveness of service quality, the mechanisms of perceived quality and the process of personal

expectations and value assessment, are the perceived response to service price and the non-monetary price response to satisfaction are the best predictors of repurchase intention (Petrick, 2002). Liu and Lee (2016) showed that consumer repurchase intention combines their perceptions of service and price together, suggesting that consumers incorporate the concept of trade-offs between service quality and price into their ratings. While research on service and satisfaction has been discussed a great number of times, for smart home products, the product itself is worthy of being recognized for its service, and it is the matching service that needs to be further discussed. Because the context of IoT institutional mechanisms such as consulting services and training use services are of greater interest to customers, this paper needs to again determine the impact of services on customer satisfaction.

Brand effectiveness

Colombo and Morrison (1989) argued that the likelihood that a customer will choose a brand or service over time is an indication of customer satisfaction. In this paper, brand effectiveness is defined as the importance of the brand in the marketing process. Companies often use brands as symbolic and experiential resources, and consumers are used to associating brands with countries or cultures (Aaker et al., 2001). As mentioned above, with the development of technology, many countries have national brands of smart home products. Wang and Lin (2009) argued that a customer's inherently positive attitudes or local sentiments toward a brand will promote repurchases. Cultural identity and consumer ethnocentrism have different concerns and emotions for local and imported brands (Shimp & Sharma, 1987).

Several studies have examined the positive effect of consumer ethnocentrism on the purchase of national brands (e.g., Ishii, 2009; Wang & Chen, 2004). In addition, because smart home product manufacturing is a high-tech industry, the brand effect of global industry leaders is also a fairly important consideration in customer purchase choices. Consumers from economically less developed or technologically less advanced countries may also make purchases when faced with high quality, prominent foreign brands (Wang & Chen, 2004). In summary, the factors studied regarding the branding of smart home products start from two dimensions: domestic brand and foreign industry leader brand.

A foreign brand is defined as a brand that has a physical market in multiple countries or regions, and derives a significant portion of its revenue from non-domestic markets (Dimofte et al., 2008). It is commonly assumed that foreign brands are generally industry leader brands. Domestic brands are defined as brands produced and manufactured in the home country (Dimofte et al., 2008), and that originate from the consumer's country (Eckhardt, 2005). Consumer ethnocentrism can drive people towards buying domestic products (Shimp & Sharma, 1987). The tendency of ethnocentric consumers to show a preference for domestically produced products over imported products has been well documented in the literature (Cleveland et al., 2009). On the other hand, if a foreign industry leader brand is perceived to have high brand equity, it is one of the main drivers that constitute consumer purchases of foreign products (Wang & Chen, 2004; Zhou & Hui, 2003). Moreover, if a foreign industry leader brand is perceived to have a more prestigious

image than a domestic brand, consumers may flaunt their wealth by purchasing imported products (Ger et al., 1993).

Scholars have found that domestic brands receive affirmation from domestic consumers about the quality of domestic products and thus influence satisfaction perceptions and purchase intentions (Wall et al., 1991; Li et al., 1993; Laroche et al., 2005). The choice of national and foreign industry leader brands affects consumer satisfaction and thus serves as a measure to influence purchase intentions. He and Wang (2015) argued that consumers' ethnocentric tendencies lead them to maintain a higher level of satisfaction with national brands. However, in less technologically developed countries, imported industry leader brands are generally perceived as high quality and have higher satisfaction levels (Wang & Chen, 2004). It is worth noting the impact of domestic brands versus foreign industry leader brands on people's repurchase intention of smart home products as products that are relevant to their lives.

Product effectiveness

Product innovation refers to the creation of a new product or the innovation of a new or old product's function. Product innovation can be divided into new product innovation and improved product innovation. New product innovation refers to a significant change in the use of a product (Zhang et al., 2020). Improved product innovation refers to functional extensions and technical improvements to existing products based on market needs without significant changes in technology. New product innovation is both propelled by technology and pulled by demand. The driving

mechanism of improved product innovation is generally led by demand. In addition, smart home product companies under IoT institutional mechanisms need to continuously enrich product diversity and adopt innovative and diverse products to maintain customer satisfaction. Therefore, this paper defines product effectiveness as product innovation and product diversity.

Product effectiveness--product innovation

Rogers (2003) first proposed that product innovation can be perceived and defined perceived product innovation as consumers' subjective judgment of the difference between a particular product in terms of novelty and usefulness and similar products. Fu et al. (2008) defined consumer assessment of product attribute innovation and functional innovation as product innovation. Lowe and Alpert (2015) stated that consumers perceive product innovation as the degree of novelty and speed of improvement of a new product over existing available alternatives. By examining the above scholars' definitions of product innovation, it is thought that consumers are the evaluators of product innovation. In addition, Rogers (2003) used innovation significance and novelty to classify product innovation. Zhang et al. (2020) used smart toys products as the research object to classify the dimensions of product innovation in terms of functional, operational, and appearance aspects. The research object of this paper is smart home products, so it draws on method of Zhang et al. (2020) and Lowe and Alpert's (2015) measurement dimensions. Meanwhile, based on the analysis of literature related to smart home products, this paper divides product innovation into product technology innovation and product innovation speed, and defines product

functional innovation under the IoT institutional mechanisms as the degree of novelty and improvement that consumers recognize in smart home products beyond existing available alternatives in terms of functionality, and defines product innovation as the degree to which consumers perceive the connection between innovative products and existing products.

Most scholars believe that product innovation can promote consumer satisfaction by attractively satisfying consumers' needs, but others believe that consumer perceptions of product innovation can increase perceived risk and their concerns about financial and use costs, and negatively affect the willingness to repurchase a product. Goldsmith et al. (2006) found that product innovation can increase satisfaction among consumers with more purchase experience. Product innovation is very important for smart home products because they are new high-tech products, and more feature development and technology use to improve customer satisfaction and customer-perceived risk is what companies need to focus on.

Product effectiveness--Product diversity

In an era of increased competition and oversupply of products, customer needs are gradually diversifying, and companies need to provide a broader product portfolio or diversified products to meet various customer needs and retain customers if they want to maintain a competitive advantage and sustain profits. Fisher et al. (1999) considered that the range of products offered by a company within a certain period of time and the rate at which the company replaces its existing products with new products is called product diversity, and this definition mainly emphasizes the range of

products and the rate of product substitution. Product diversity refers to the different product combinations that manufacturers are willing and able to offer to meet customers' individual needs (Kim, 2006). Ratner and Kahn (2002) argued that product diversity comes from a diverse mix of product forms and functions. In this paper, based on the characteristics of smart home products, product diversity is defined as the different combinations of product diversity offered by a brand.

Research on product diversity has mostly investigated its relationship with customer brand choice, customer satisfaction, and impulse purchase intentions. Kahn and Wansink (2004) argued that customers pay more attention to products with a high degree of diversity. Beatty and Ferrell (1998) suggested that stores that offer a larger selection of products are more likely to generate customer satisfaction. Kim (2006) argued that product variety increases customer satisfaction, while, Terblanche and Boshoff (2006) argued that diversified products can meet the various needs of consumers and thus increase customer satisfaction. It is necessary to study product diversity for smart home products. This is because an important institutional mechanism of IoT is the connectivity of products. Brands with a wide selection of products can improve and optimize the the connectivity mechanism of IoT.

In summary, this paper is based on an extension of the TAM theoretical model and the ECT theoretical model, and there is no doubt that customer satisfaction has an important transmission role in the purchase process as a mediating variable. However, there are many factors influencing consumer satisfaction and repurchase intention, and different scholars will come to separate research conclusions from different

perspectives or based on different theories. By sorting out the studies, they found that the reason for the dissimilar theories is that the research subjects are different, and most of the studies will choose the range of variables according to the research subject so as to reconstruct a model of satisfaction and repurchase intention to study its effect on satisfaction or repurchase intention. Therefore, it is noteworthy that the validity of the model of repurchase intention depends mainly on whether its constituents are the main influencing factors of repurchase intention. Based on such a background, this paper constructs a research model of the factors influencing customer satisfaction and repurchase intention of smart home products based on a combination of the TAM model and the ECT model, from four dimensions: price effectiveness, service effectiveness, brand effectiveness and product effectiveness. This paper identifies the need to study the influence of antecedent factors on customer satisfaction and repurchase intention.

2.2 Repurchase intention

2.2.1 Literature on repurchase intention

From the perspective of psychology, human behavior originates from consciousness. Because consciousness is expressed in action, it becomes an external behavior, and consciousness itself becomes an internal behavior. Consumer behavior refers to the actions of consumers in finding, buying, using and evaluating products and services that meet their needs. Both consumers' repurchase intentions and behavior are forms of post-purchase performance, and repetition is measurable in mathematical terms, i.e., two or more times. Repurchase intention, as an intrinsic

behavior, is the motivation for external behavior, so the analysis of repurchase intention is more rigorous.

The importance of repurchase for companies has been recognized (Frank et al., 2014). Jacoby and Chestnut (1978) argued that the underlying nature of loyalty and repurchase intention are different. However, in terms of the complete conceptual connotation, repurchase intention has only been more fully explained in the field of customer loyalty. Repurchase intention belongs to the conceptual category of customer attitude loyalty (Oliver, 1999). When a customer purchases a product or service from a brand and has a positive experience, leading to an intention to repurchase that product or service from the same brand again in the future. This is known as repurchase intention (Hellier et al., 2003; Knox & Walker, 2001). Repurchase intention is the likelihood that a customer will continue to use an existing service or product in the future and is a psychological representation of consumers who will assess their propensity to repurchase a branded product or service based on their perception of having purchased it (Jones & Sasser, 1995). Repurchase intention is influenced by factors such as customer cost, perceived service value, satisfaction, brand preference, and product attractiveness (Jacoby & Chestnut, 1978). Fishbein and Ajzen (1977) argued that the factors affecting consumers' repurchase intention are multiple. However, the multiple influences have not been studied in depth. Therefore, based on the analysis of TAM and ECT models, this paper has determined that customer satisfaction will act as a mediating variable to influence customer repurchase intention. Furthermore, it was found through the study that price effectiveness and product

effectiveness can influence repurchases through customer satisfaction. In addition, these two factors can also directly influence customer repurchase intention. This is because, according to the research topic of this paper, the special nature of smart home products, price and product effectiveness will be particularly important. Therefore, it is necessary to discuss their direct influence on repurchase intention. Table 2-2 provides some studies that discuss the definition of repurchase intention.

<Table 2-2> Customer repurchase intention definitions

Author(s)	Research opinions
Fishbein & Ajzen (1977)	The most direct way to predict whether consumers will take a repurchase behavior in the future is to understand their repurchase intention.
Jacoby & Chestnut (1978)	Repurchase intention is influenced by factors such as customer cost, perceived service value, satisfaction, brand preference, and product attractiveness.
Jones & Sasser (1995)	Repurchase intention is the possibility that customers will continue to use existing services or products in the future, and it is a psychological representation of consumers.
Oliver (1999)	Repurchase intention belongs to the concept of customer loyalty
Knox & Walker (2001)	Repurchase intention is a self-explanatory term, and to a certain extent, it simply means that consumers have the idea of repurchasing the same brand after experiencing a certain brand.
Hellier et al. (2003)	Repurchase intention refers to the customer's intention to purchase the same product or service again after thinking and evaluation of purchasing and using a product or service.

2.2.2 Customer satisfaction and repurchase intention

Customer satisfaction is a prerequisite for repurchase intention (Rose et al., 2012; Javed & Wu, 2020). Marketing literature demonstrates a positive correlation between

satisfaction and behavioral intentions (Nagengast et al., 2014). Roca et al. (2006) studied people's intention to continuously use online learning services based on the expectation alignment theory and TAM model, and the results of the study showed that price usefulness, information quality, degree of consistency, and service quality were important. Chiu et al. (2012) showed that the value of the product positively influences user satisfaction and thus repurchase intention. Lee et al. (2001) integrated the technology acceptance model and expectation consistency theory to investigate the determinants of customers' repurchase intention, and the study pointed out perceived value, perceived product ease of use, brand reputation, and product functionality all have significant positive effects on a customer's repurchase intention through customer satisfaction. The relationship between satisfaction and repurchase intention is asymmetric. Although customers conscious of repurchase are usually satisfied, satisfaction does not universally translate into repurchase intention (Liao et al., 2017). In other words, satisfaction is an incomplete precursor of repurchase intention. Moreover, satisfaction is a necessary step in building repurchase intention, but still begins to build repurchase intention through other mechanisms. The effect of satisfaction on repurchase intention has been extensively studied. For example, satisfaction enhances repurchase intention when consumers are characterized as having a higher risk preference (Wu & Chang, 2007). The relationship between satisfaction, perceived risk and repurchase intention was explored by An et al. (2010). Kim et al. (2009) demonstrated that a model combining trust and satisfaction can predict longitudinal repurchase intention from pre-purchase to purchase and

post-purchase. They explored trust in the pre-purchase stage and satisfaction in the post-purchase stage, and their study provided important theoretical support for combining satisfaction and trust to predict repurchase intention and switching intention. Ranaweera and Prabhu (2003) made a higher claim when they argued that the role of satisfaction has a significant impact on customer repurchase. A compilation of the above related literature reveals that most of the literature is based on the TAM and ECT models; in addition, customer satisfaction is studied as a mediating variable to establish the relationship between antecedents and customer repurchase intention; this is similar to the theoretical structure of this paper. However, numerous scholars hold different view on whether satisfied consumers will have repurchase intention. Therefore, the relationship between customer satisfaction and repurchase intention will be further analyzed in this paper.

2.2.3 Price effectiveness and repurchase intention

In the field of customer relationship management, the role of switching costs in customer purchase has long attracted widespread academic attention because customers may maintain their relationship with a company not out of genuine loyalty, but because of the cost of time and effort or the lack of alternative companies in the process of switching to existing companies and developing new relationships. This provides an important way to better explain and predict whether customers will buy again. Kim et al. (2004) argued that switching costs affect repurchase rates. If the switching cost is high, the repurchase rate of customers will increase. However, if customers are not satisfied with the firm and are only forced to show a high

repurchase rate due to high switching costs, the customer relationship is not strong. Once the competitive environment changes, the company's customer churn rate will increase. Switching costs directly affect customer repurchase intention and play an important role in explaining customer repurchase intention (Jones et al., 2007; Pick & Eisend, 2014). For smart home products, high switching costs may initially be key to repurchase intention, and firms may adopt a high switching cost strategy to control for greater repurchase intention, although this strategy can lead to reduced customer satisfaction. However, as the IoT institutional mechanisms continue to mature and the compatibility of smart home products is proposed, higher switching costs are likely to become a repurchase choice. The consideration of switching cost becomes more important for smart home products precisely because they can directly affect repurchase intention. In addition, price perception can describe the emotional experience of the customer in obtaining the product, and can be a positive or negative signal of repurchase intention (Lichtenstein et al., 1993). For example, if a customer's perception of price is positive, it has a good impact on purchase intention (Alford & Biswas, 2002). Similarly, Yasri et al. (2020) also found that price perception may increase repurchase intention. In the marketing field, existing research also suggests that price perception has a positive impact on repurchase intention (Petrick, 2002; Ladhari et al., 2019). An increase in price level perception reduces the intention to purchase a product (Dodds et al., 1991). Price can positively influence the probability of repurchase by conveying exclusivity and quality (Zeithaml, 1988). Research on price perception suggests that consumer repurchases depend not only on the (objective)

price itself, but are also influenced by the price information framework (Tversky & Kahneman, 1981). Therefore, this paper argues that perceptions of price can influence repurchase intentions. Although smart home products are perceived to be expensive, the experience of value for money is perceived to frame the price information and may directly contribute to the repurchase intention.

2.2.4 Product effectiveness and repurchase intention

The direct role of product effectiveness and customer repurchase intention is discussed because smart home products are goods with distinct product attributes, unlike bulk products, which are goods that depend on their own product attributes. Consumers may choose to repurchase directly because the products possess special qualities; therefore, this paper discusses the direct effects of product innovation and product diversity on customer repurchase intention from two dimensions. Chang et al. (2012) divided perceived product innovation into three dimensions: appearance innovation, functional innovation, and operational innovation, and investigated the effects of these three dimensions on impulse buying. The results of the study showed that appearance innovation and operational innovation directly and positively promote repurchase. When consumers need uniqueness, novelty and innovation as tools for creating specialness will directly influence repurchase intention (Snyder, 1992; Ruvio, 2008; Chan et al., 2015). In addition, Chung and Lee (2003) conducted an empirical study on the factors influencing repurchase behavior of shopping mall customers, and the results indicated that product diversity affects customer repurchase. It is believed that product diversity has a significant positive impact on customers' purchase

intention because it can satisfy different consumers' purchasing needs (Beatty & Ferrell, 1998; Ruvio, 2008).

In summary, in an extended study on the TAM and ECT theoretical models, it was found that although there exists a large number of researches on customer satisfaction for customer repurchase intention, this paper again identifies the importance of customer satisfaction as a mediating variable. In addition, it presents and theorizes the corresponding antecedents affecting customer satisfaction based on the characteristics of smart home products. This paper also provides an additional discussion of the relationship between price and product effectiveness and repurchase intention. This is because factors such as switching costs, price perception, product innovation, and product variety are specific properties of smart home products that will likely have a direct impact on the generation of consumer repurchase intention. However, regarding the stability of repurchase intention, this paper argues that the perceived usefulness of IoT institutional mechanisms is what needs to be proposed. With the development of technology and social progress, a sound IoT institutional mechanism will provide more satisfaction and thus a more stable and trusting consumer repurchase intention.

2.3 Smart home products and IoT institutional mechanisms

2.3.1 Research on IoT technology and smart home products

Studying the industry context regarding IoT technology and smart home products helps to provide more certainty about the IoT institutional mechanisms. Because by analyzing the development and current status of IoT technology and the smart home

product market, the characteristics of IoT institutional mechanisms can be accurately defined. The concept of IoT first appeared in 1995 in Bill Gates' The Road Ahead, and was only limited by the development of a wireless network, hardware and sensing devices and did not attract much attention (Gates et al., 1995; Lee et al., 2017). Jia et al. (2012) defined IoT as a device with various information sensors, radio frequency identification technology, global positioning system, etc., which can connect and control various objects in real time to realize the connection between things and things and things and people, with the purpose of intelligent identification and management of objects. IOT is an emerging technology from a technical point of view, and needs the support of various technologies such as radio frequency identification technology (RFID), sensing technology and artificial intelligence technology. Nowadays, IoT technology allows the world to enter a fully intelligent stage. With the development of the 5G network, the high time efficiency, large connectivity and corresponding facility services based on IoT network are addressed. The development of IoT is a big help for global economic development. As a result of the 2008 financial crisis, countries around the world have experienced varying degrees of economic growth delay or even recession, and IoT, as a new economic growth point with great potential, establishes a more intelligent and efficient social platform for countries, thus significantly improving the efficiency of national operation, and IoT technology revolutionizes the way people live and work.

Here are some studies on IoT for smart home products. Khan et al. (2018) studied the design system of smart home under IoT technology, which mainly focused on the

design of smart home products according to IoT technology. Kim et al. (2017) studied the the adoption of smart home products or service under IoT technology; this paper claims a new understanding of IoT-based smart home products or service via using TAM model and VAM (Value-based Adoption) model. Through the analysis of two models, the result suggested that it is imperative for smart home product enterprises to establish and secure appropriate infrastructure for customers when they use smart home products or service. Furthermore, it is important that develop the security mechanisms. In addition, Balta-Ozkan et al. (2014) analyzed the smart home market in the UK, Germany and Italy, comparing the differences in perceptions of smart homes between countries, and the study focused on the public perceptions of the role of utilities and the government. The study argued that smart home products should be optimized according to differences in household preferences and use, and calls for more interdisciplinary research in this area. Kim and Yoon (2016) studied the smart home market in South Korea, and through six group interviews, found that consumers believe that the IoT is still far from their daily lives and that smart homes are still generic and new concepts. The study concluded that the adoption of smart home products is related to the lifestyle of the users. Customers' privacy concerns are a key barrier to their adoption. The growing number of studies in this category, with significant results, provides important guidance and references for the background theoretical research in this paper.

The concept of a smart home originated in the United States, which started to develop and own smart buildings in 1984. Then the smart home went through three

stages: home electronics (HF), home automation (HA), and smart home (SH). King (2003) argued that an IoT smart home is one that contains a communication network that connects home products and services and allows remote control, monitoring, or access to these devices and services. Balta-Ozkan et al. (2014) considered a smart home to be a residential network equipped with communication devices that connect sensors, home products that can be monitored, accessed or controlled remotely and provide services to meet the needs of the residents. Stojkoska and Trivodaliev (2017) claimed the ability to communicate and connect smart devices or products ranging from sensors of simple home products to complex home products. A home network consisting of these objects falls under the concept of IoT smart home. Smart homes are "residential environments with information and communication technologies that provide features appropriate to the convenience, security, entertainment, and comfort needs of residents" (Marikyan et al., 2019). With the above definitions, smart home can be defined as a system based on IoT technology that can autonomously generate and transmit information to other people and objects to improve the quality of life in a household. In this paper, smart home products are defined as a generic term based on a family of products and services that serve the smart home; they refer to solutions that provide smart home services based on a network of all electronic devices (e.g., refrigerators, air conditioners, boilers, lights) and all other devices that can be used in the home for monitoring, controlling, and managing connections under IoT technology, such as running water, electricity, heating devices, door locks, surveillance cameras, car identification systems, etc. The Internet era has given rise to smart products of

trans-generational significance: cell phones and computers, which people use to connect with other people. Gokhale et al. (2018) believed that the emergence of IoT enables the entire world of products to be intelligently sensed and more interconnected. At present, the application of IoT technology in the home field has greatly improved the quality of people's lives. According to this technical feature, major manufacturers of smart home products have converted the market from single product supply to the development of an entire ecosystem of branded products. Based on the products already purchased by consumers, they use the IoT institutional mechanisms to recommend other smart home products with the same brand to consumers.

Smart home products are attracting more and more interest from the perspective of energy-efficient homes and comfortable living. Many ICT and energy technologies enable residents to easily integrate technologies and services. IoT-based smart home products are becoming an attractive market with great potential for companies seeking new growth drivers. Home connectivity existed ten years ago, but at a basic level, and home automation developed into a huge industry where smart devices are integrated with high-speed wired and wireless Internet, big data, and cloud (Kim et al., 2017). Data show that the size of the global IoT smart home market is expected to show accelerated growth, with a 5-year CAGR of more than 35% and close to $100 billion in 2020. Major smart product companies have developed their own brand systems for smart home products: South Korea's LG smart home products (HomNet) are based on cutting-edge technology to break the barriers in the field of smart home networking solutions and network the company's electronics portfolio; Google acquired

NESTLabs, a company called the “smart home Apple,” and since then, Google has established Google Home. There is also Samsung smart home, while Apple launched its smart home platform Apple-Home-Kit, China’s Haier developed U-home and Alibaba developed Ali Intelligence. Along with the emergence of voice interaction, the smart home developed to a more humane and borderline interaction, and Amazon launched Echo. In addition, XIAOMI continues to expand its ecosystem, and has launched a large number of smart home products. The popularity of smart phones and tablets has activated the smart home product market. Along with various technological breakthroughs, smart home products have more possibilities, and some technologies that are usually used by a large number of people in various environments began to be applied to the smart home field. The 5G platform provides a good basis for the application of smart home products, and video calls, home remote monitoring, cell phone network control and other functions have created great opportunities for the development of the smart home product industry. The application of technologies such as blockchain gives smart home products a more secure protection mechanism. In addition, some systems have been proposed by the government to give smart home products more attention and affirmation. Therefore, it is believed that the enhancement of IoT institutional mechanisms is an important driving factor for the growth of the smart home product market.

2.3.2 Perceived effectiveness of IoT institutional mechanisms

Institutional mechanisms are created for the purpose of safe and successful transactions or use processes and are generally implemented by third parties rather

than individual structures (Pavlou & Gefen, 2004; Fang et al., 2014). In general, institutional mechanisms include governmental systems and related safeguards that are applicable to almost all industries (Lewis & Weigert, 1985). These mechanisms are neither transaction-specific nor party-specific; rather, they are the “common external world,” institutionalized to ensure the orderly and secure functioning of the social order (Zucker, 1987). A contribution to the literature is made by extending the understanding of the IoT institutional mechanisms to the context of the repurchase of smart home products. Although institutional mechanisms may not directly affect intentions in repetitive transactions with smart home products, they may still play a role by reducing risk in the context. Thus, defining and highlighting the role of contextual risk mitigation at a general level for PEIIM may still have important implications for customer perceptions of repurchase intentions that affect satisfaction.

While useful technical research may exist to address many of the cybersecurity issues in the IoT space, laws and policies are lagging behind and failing to adequately capture this progress (DeNardis & Raymond, 2017; Van Deursen & Mossberger, 2018; Smith et al., 2021). In terms of a regime for smart home products, the SCA actively worked with the International Standards Committee in 2018 to develop the world's first technical specification for smart home information security standards (Common Criteria) in line with the international information security standards system. The regulation covers the communication, device and control security requirements for IoT smart home products (de la Piedra & Collado, 2021). In addition, the Smart Home Information Security International Standard Technical Specification Promotion Group

has been established, remarking that smart home products in the field of information security “have a law to follow.” The international standards are ISO/IEC TR 29108: 2013 Information technology-Terminology for intelligent homes, which specifies the terminology of smart home products. The European General Data Protection Regulation (GDPR) or the Stop Hacking and Improve Electronic Data Security Handling (SHIELD) act proposed in New York have little protection for technology users from a public policy perspective, but aim to protect these users directly in newer environments such as IoT (Smith et al., 2021)

In recent years, mechanisms in the IoT environment have emerged in various forms. Smart home products are designed to enhance the convenience of people’s home operations, efficient management and reliable control of the home (Andola et al., 2020). Smart home products using IoT technologies require most of the commands to be executed, such as collecting, processing and transmitting data, including the management of operating systems and basic system services (Dorri et al., 2017). For encrypted transmission data in communication protocols, the use of encryption algorithms with high security strength to prevent information leakage and theft is key (Priyanka et al., 2020). Therefore, blockchain technology is used in the authentication process of IoT smart home products to ensure that the transmitted data and private user content are not accessed by third parties beyond their authority. Blockchain is a mechanism that provides data integrity among the parties involved in transaction processing and handling by providing proof of decentralized trust to all participants in the network. The use of blockchain technology in the IoT application industry can

protect the security of information and optimally enhance the security mechanisms of the IoT (Ma, 2020). Traditionally, information security mechanisms for smart home products networks have had to be “hosted” using trusted third parties. Thankfully, blockchain replaces this trusted third party by generating an immutable chronological transaction history (Minoli, 2020). It can serve as an effective institutional mechanism for providing security in IoT environments. It eliminates the need for trust (Chen et al., 2020). Lee et al. (2020) proposed blockchain-based secure firmware updates for embedded devices in IoT smart home product environments. Given that each peer retains a copy of all transactions in the blockchain, time-stamped information is always accessible; the blockchain provides an authentic and reliable mechanism for recording information about smart home products (Gong et al., 2020). In addition, some key products in the smart home require high functional availability and have a network state. For example, video surveillance must be routinely activated by activity, and typically, HVAC is always on during a given season. Availability aims to ensure that authorized entities can use the product when needed, and the decentralized nature of blockchain, which eliminates single points of failure, can facilitate this goal.

Smart home products can communicate with each other and with the cloud to address the needs of the occupants and allow remote access. To avoid malicious devices from joining the home LAN, it is important to ensure proper authentication of all devices on the home LAN of smart home products. Mobile terminal security risk refers to the security threats faced by smart home-related APPs. Important information such as the user registration process, password change process and login process are

generally secured by mechanisms such as authentication and identification, access control and so on. The current mechanisms measure are designed for secure access. Enhance authentication, clarify the correspondence between users and privileges, and adopt “administrator identity” and “access invitation” policies to prevent vulnerabilities. Blockchain can provide secure and distributed authentication (Li et al., 2018). A secure authentication mechanism can be provided to buyers of smart home products for reliable and authentic private identity verification. In addition, the confidentiality mechanism is designed to ensure that only authorized parties can view the content of transactions. Unauthorized information is prevented from being disclosed. When using blockchain, private and public keys can be used on the content of the transaction (Dorri et al., 2017). Integrity aims to ensure that transaction data is not altered by any unauthorized party. Essentially, blockchain aims to protect the data while preventing it from being modified, which is achieved through a hashing mechanism (Li et al., 2018). Therefore, the information security and confidentiality mechanism of smart home products when they are interconnected can be enhanced by blockchain technology.

Smart home product does not refer to a separate product alone, but a broad concept of systemic security products. To manage Authentication and Access Control (AAC) for a large number of devices, Behrad et al. (2020) propose a Slice Specific Authentication and Access Control (SSAAC) mechanism that leverages the flexibility provided by virtualization technology to delegate authentication and access control of smart home products to third parties that provide these devices, thus reducing the load

on the connection provider CN (Core Network) while increasing the flexibility and modularity of the overall IoT network.

Along with mobility, security is one of the most important aspects of cellular systems. AAC plays a critical role in ensuring the expected level of security. Also, 5G is here to help address the connectivity of a large number of smart home products. The growth rate of connected devices is expected to be high in the case of the IoT (Reyna et al., 2018; Gubbi et al., 2013; Behrad et al., 2020). The large number of attachment requests from these devices may trigger signaling congestion by increasing the CN load of the connection provider (Ferrag et al., 2018). Considering this pattern, consumers may refuse to adopt smart home products owing to long waiting times due to too many devices accessing, failed authentication and long device connection times or even connection loss (Behrad et al., 2020).

5G introduces the concept of integrated virtualization technologies and network function virtualization (NFV) to the IoT application industry. These virtualization technologies provide a cost-effective and flexible infrastructure for cellular systems, allowing them to provide services in a dynamic manner by transforming the physical entities of the network into virtual network functions (Behrad et al., 2020). Using the concept of network slicing, virtualization technology enables third parties (any commercial player that is not a network operator, such as IoT smart home product companies) to customize the use of cellular systems. In fact, each network slice can be assigned to general needs or special cases, such as the overall smart home products network, or it can be dedicated to a third party to address its own specific requirements,

for example, a customized authentication system or waiting times for smart home products (Zhang et al., 2017; Afolabi et al., 2018). Undoubtedly, the emergence of 5G optimizes and enhances the connectivity mechanism of the IoT smart home products.

With the advancement of technology, it is consistently found that the improvement of institutions and the enhancement of mechanism functions directly contribute to the initial trust beliefs of consumers of smart home products, in which case the understanding of institutional mechanisms may be a consistent understanding of technological mechanisms. In addition, institutional structural assurances directly influence initial purchase intentions because customers rely on information provided by trusted third parties, such as national policies and laws, to feel comfortable transacting with unknown suppliers of smart home products. Therefore, consumer confidence in the IoT institutional mechanisms will influence the repurchase intention of smart home products based on already purchased smart home products and their foundations. Customer satisfaction will change depending on the industry and consumer psychology. For IoT smart home products, it becomes especially critical for customers to have a repurchase intention after they have generated a certain level of satisfaction through price, service, brand, and product. Relative to traditional home products, the PEIIM will be discussed as a moderating factor. First, the high-speed network operation and sliced private network customization of 5G technology can optimize the operational mechanisms of IoT technology and solve concerns such as remote connection and real-time control; second, increasingly robust international IoT smart home product security technology standards are made for smart home products

mechanisms to provide security, privacy laws are proposed, and systems such as manager access or invitation settings guarantee the privacy security of smart home products. In addition, the trustworthiness of the security system mechanisms of IoT smart home products can be enhanced with the use of blockchain technology. Therefore, this paper defines the IoT institutional mechanisms mainly from the characteristics of IoT technology itself. Based on a background analysis of IoT technology and smart home products in the paper, as well as the relevant research discussions on IoT institutional mechanisms, the perceived effectiveness of IoT institutional mechanisms (PEIIM) of smart home products is defined, which is real-time monitoring, remote control, security protection, etc.

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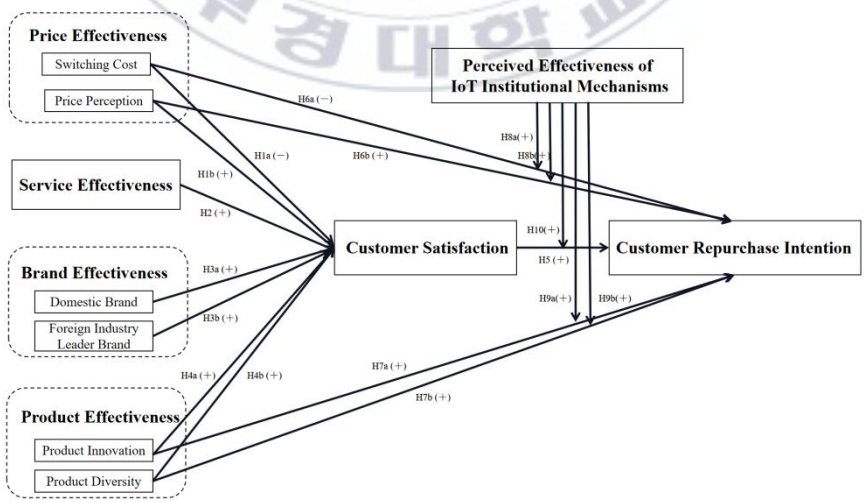
III. Research Model and Hypotheses

3.1 Research model

In a study on online repurchase intention, Fang et al. (2014) proposed the perceived effectiveness of institutional mechanisms of e-commerce (PEEIM) and applied this effect as a moderating role in customer satisfaction, trust and customer repurchase intention. In doing so, the study finds that PEEIM does not directly affect trust or repurchase intention, but has a negative moderating impact in the relationship between trust and customer repurchase intention. This means that PEEIM decreases the importance of trust in the repurchase intention. PEEIM positively moderates the relationship between customer satisfaction and trust. To a certain extent, an institutional mechanism can replace trust and a process-based lever (customer satisfaction) can interact to produce an additional influence on customer repurchase intention. Thus, the moderating role of the perceived effectiveness of IoT institutional mechanisms (PEIIM) will be discussed in this paper. Hellier et al. (2003) suggested that product satisfaction is completely different from the degree of satisfaction that leads to customer repurchase intention. Furthermore, the relationship between customer satisfaction and repurchase intention exists, but is unstable and may be biased due to attitudes or actions, or nonlinear (Hellier et al., 2003). A large number of studies have investigated the mediating effect of customer satisfaction in the process of consumer repurchase. Hsu and Tsou (2011) selected customer experience as the antecedent variable, customer satisfaction as the mediating variable, and customer

repurchase intention as the outcome variable, and studied the relationship between customer experience and customer repurchase intention. The research suggested that a good customer purchase experience will have a positive impact on a customer's repurchase intention, and customer satisfaction plays a mediating role. According to the above analysis, customer satisfaction may play a mediating role in the relationship between a customer's first purchase experience and repurchase intention to a certain degree. It is believed that customer repurchase intention is a complex outcome variable. The final result reflects the level of satisfaction and the role of many other influencing factors. Therefore, based on an analysis of the literature, and extending the TAM and the ECT model, this paper regards price effectiveness, service effectiveness, brand effectiveness and product effectiveness as the antecedent factors, and analyzes their effects on customer repurchase intention via customer satisfaction. As shown in Figure 3-1, there is the research model.

<Figure 3-1> Research model



3.2 Research hypotheses

Dwyer et al. (1987) defined the switching cost as the service costs, evaluation and related search, which are required when changing to other providers. The switching costs are important in maintaining customer relationships (Colgate & Lang, 2001). The overall customer satisfaction is affected by expectations, perceptions and inconsistencies as well as by switching costs (Oliver, 1999). In addition, price perception is the customer's assessment of the goods or services value. Chiu et al. (2012) pointed out that reasonable prices are more easily perceivable by consumers, thereby obtaining customer satisfaction. This is evident in some literature (Fang et al., 2011; Zheng et al., 2013; Hsu et al., 2014). This paper also finds the relationship between customer satisfaction and price perception. Based on these studies, this paper put forward hypotheses about the price effectiveness and customer satisfaction:

H1a: Price effectiveness (switching cost) has a significant negative effect on customer satisfaction

H1b: Price effectiveness (price perception) has a significant positive effect on customer satisfaction.

Bu et al. (2020) suggested that smart and connected products (SCP) are gradually replacing traditional functional products, and service, as a crucial part of SCP iterative improvement, has a significant positive impact on customer satisfaction. It is suggested that service is a recognized characteristic that significantly influences customer satisfaction (Griffin & Lowenstein, 2002). Kim et al. (2004) claimed that service quality and value-added services will improve customer satisfaction. The

after-sales service satisfaction has a more significant impact on repurchase intention than pre-sales service satisfaction (Posselt & Gerstner, 2005). The research of Szymanski and Henard (2001) explored the influencing factors of customer satisfaction, and the results show that the convenience of shopping services and the security of payment services affect customer satisfaction. Hong et al. (2020) pointed out that more professional installation and teaching services will increase consumer interest in smart home products. Based on these suggestions, this paper put forward the following hypothesis on the relationship between service effectiveness and customer satisfaction:

H2: Service effectiveness has a significant positive effect on customer satisfaction.

Griffin and Lowenstein (2002) believed that customer satisfaction has the characteristics of tolerating the occasional mistakes made by product providers, because the customers are satisfied with the brand. Research by Belk et al. (2005) pointed out that brand performance increases customer satisfaction; He and Wang (2015) believed that customer satisfaction comes from the inner emotions and intuitive feelings of consumers. For instance, consumers are more likely to be satisfied with domestic brands. From the perspective of brand information experience mechanism, Sharma et al. (1994) proposed that domestic brand affinity will enhance the perception of brand utility and affect customer satisfaction. It is suggested that domestic brand affinity will attract consumers to make choices quickly. It is now well established from various studies that the smart home product industry is a high-tech industry, and the brand effectiveness of foreign industry leaders will be discussed. Based on these

studies, this paper put forward the following hypotheses on the relationship between brand effectiveness and customer satisfaction:

H3a: Brand effectiveness (domestic brand) has a significant positive effect on customer satisfaction.

H3b: Brand effectiveness (foreign industry leader brand) has a significant positive effect on customer satisfaction.

Dahl and Hoeffler (2004) proposed a relationship between product innovation and customer attitude. Orfila-Sintes and Mattsson (2009) suggested that product innovation has an impact on customer satisfaction in the hotel industry. Zhang et al. (2020) took smart toy products as the research object, pointing out that product innovation has a positive impact on customer satisfaction. Selnes (1993) claimed that customers will spontaneously promote a company, influence others around them, and give others a positive reputation when they are satisfied with its products. LaTour and Peat (1979) believed that multiple categories of products will increase customer satisfaction. Kim (2006) pointed out that product diversity increases customer satisfaction. Halstead and Page (1992) suggested that product-level satisfaction has a significant positive effect on repurchase intention. Based on these studies, this paper put forward the following hypotheses on the relationship between product effectiveness and customer satisfaction:

H4a: Product effectiveness (product innovation) has a significant positive effect on customer satisfaction.

H4b: Product effectiveness (product diversity) has a significant positive effect on

customer satisfaction.

For the current smart home product market, most of the first purchase behavior of customers comes from price concessions, professional pre-sales services, brand reputation, product diversity, etc. Keeping customers continuing to use upgraded software or repurchase the same brands of goods are the competitive advantages of smart home product companies based on IoT technology. Several studies have postulated a convergence between customer satisfaction and customer repurchase intention. Reichheld and Sasser (1990) believed that customer satisfaction is an important determinant of word-of-mouth effects, customer loyalty and customer repurchase. Spreng et al. (1995) believed that customer satisfaction is an important determinant of repurchase intention. Oliver and Swan (1989) claimed that customer satisfaction is the main driving factor for customer repurchase. Fornell (1992) proposed that satisfaction has a positive impact on future purchase intention. Furthermore, this correlation affects the attitude of customers. Lin and Lekhawipat (2014) studied the influencing factors of online repurchase intention, and the results showed that customer satisfaction is an effective driving factor for customer repurchase intention. A large number of studies have proved that customer satisfaction has a positive and significant impact on repurchase intention (Fang et al., 2011; Yap et al., 2012; Jang et al., 2013; Jun & Kang, 2013; Hsu et al., 2014). Therefore, based on these studies, this paper put forward the following hypothesis on the relationship between customer satisfaction and customer repurchase intention:

H5: Customer satisfaction has a significant positive effect on customer

repurchase intention.

Nagengast et al. (2014) pointed out that customers who perceive higher switching cost have lower repurchase intention, and the reason is that consumers who have high switching costs maybe feel trapped, and as a result develop a feeling of resistance that can negatively affect repurchase intention. Switching costs influence customer intention directly, and it plays an important role when explaining customers' repurchase intention (Pick & Eisend, 2014). Some studies have suggested that switching costs have a significant negative effect on repurchase intention (Anderson et al., 1994; Patterson & Smith, 2003; Jones et al., 2007). In addition, Dodds et al. (1991) claimed that there is a relationship between pricing and repurchase intention. Similarly, Arslan and Zaman (2015) suggested that reasonable prices are more easily perceivable by customers to make purchases. Graciola et al. (2018) pointed out that price affects customer repurchase intention. Based on these findings, hypotheses on the relationship between price effectiveness and customer repurchase intention are proposed:

H6a: Price effectiveness (switching cost) has a significant negative effect on customer repurchase intention.

H6b: Price effectiveness (price perception) has a significant positive effect on customer repurchase intentions.

Related literature has found that product innovation has an essential effect on market power and market driving (Dhanora et al., 2018; Kuncoro & Suriani, 2018). Eisingerich and Rubera (2010) suggested that when products are more capable of meeting a customer's needs, they will maintain their repurchase intention with the

company in return. When there is a need for uniqueness, products that are novel and scarce act as the tools to build specialness (Snyder, 1992). There is no doubt that innovative products are unique products. Thus, Chan et al. (2015) claimed that materialistic consumers who seek unique products will have higher repurchase intention because of innovative or scarce products. Furthermore, they point out that product quality will directly affect customer repurchase intention. Hoch et al. (1999) believe that product diversity plays a vital role when consumers evaluate products. Kahn and Wansink (2004) suggested that customers will pay more attention to products with a high degree of diversity. Based on these reviews, hypotheses on the relationship between product effectiveness and customer repurchase intention are proposed:

H7a: Product effectiveness (product innovation) has a significant positive effect on customer repurchase intention.

H7b: Product effectiveness (product diversity) has a significant positive effect on customer repurchase intention.

Patterson and Smith (2003) pointed out that switching costs have a significant negative effect on repurchase intention. However, smart home products are high-tech products, and customers may be dissatisfied with them but have to repurchase them because of the same operating system between branded products. Therefore, when PEIIM is high, a customer may reduce their dissatisfaction about switching costs and have repurchase intention of smart home products. In addition, it is suggested that price perception has a direct impact on repurchase intention (Graciola et al., 2018).

When PEIIM is high, customers will more recognize the price, resulting in repurchase intention. Based on these results, this paper proposes the following hypotheses:

H8a: The perceived effectiveness of IoT institutional mechanisms (PEIIM) positively moderates the relationship between the price effectiveness (switching cost) and customer repurchase intention.

H8b: The perceived effectiveness of IoT institutional mechanisms (PEIIM) positively moderates the relationship between the price effectiveness (price perception) and customer repurchase intention.

As far as the market for high-tech products is concerned, the advantages of innovative products are obvious. However, Hong et al. (2020) claimed that product innovation might increase perceived risk. The institutional mechanisms establish a less risky environment by decreasing the background uncertainties via explicit regulatory assurances (Shapiro, 1987). Thus, when PEIIM is high, it might create a less risky use environment for customers when they chose innovative smart home products. In addition, the diversity of smart home products under the same brand is worthy of discussion. The IoT institutional mechanisms upgrade and optimize smart home products, which are more efficient and convenient. Based on these studies, the following hypotheses are proposed:

H9a: The perceived effectiveness of IoT institutional mechanisms (PEIIM) positively moderates the relationship between the product effectiveness (product innovation) and customer repurchase intention.

H9b: The perceived effectiveness of IoT institutional mechanisms (PEIIM)

positively moderates the relationship between the product effectiveness (product diversity) and customer repurchase intention.

Based on previous studies, the perceived effectiveness of IoT institutional mechanisms (PEIIM) will be defined as a moderating variable in this paper. As mentioned in the literature review chapter, the real-time monitoring, remote operation, security protection of IoT institutional mechanisms will be perceived by customers. Customer satisfaction is known as the evaluation of the results of past transactions with providers (Fang et al., 2014). Holmes (1991) claimed that past experience evaluation is the most influential. In order to save the time cost of choice, customers tend to judge new purchase decisions based on past purchase experience (Kim et al., 2005). It is assumed that when the PEIIM is higher, the relationship between customer satisfaction and repurchase intention will be stronger. Because the repurchase process is supported by high PEIIM, it has low uncertainty. In such a specific and stable purchase environment, the customer will be more certain that past satisfaction is correct and reliable (Louis & Sutton, 1991; Fang et al., 2014). In other words, past experience is a reliable information clue that provides information for future decisions and contributes to build stable and long-term relationships. In the case of affirming PEIIM, customers pay more attention to past experience. On the contrary, when the PEEIM is low, the previous purchase experience may be interrupted by uncertainty or inconsistency, because situational uncertainty may cause the customer to question the applicability of the new situation experience to the past (Louis & Sutton, 1991; Fang et al., 2014). In this case, people tend to pay attention to collect new information

rather than relying on past experience. This means that customer satisfaction has a weak impact on repurchase intention. Therefore, this paper puts forward the following hypothesis:

H10: The perceived effectiveness of IoT institutional mechanisms (PEIIM) positively moderates the relationship between customer satisfaction and customer repurchase intention.

Ⅳ. Data Analysis and Results

4.1 Questionnaire design and data collection

4.1.1 Measurement development

The research subjects of this paper are people who have smart home product purchase experience. A survey strategy is applied in this paper by using a questionnaire to collect primary data. The questionnaire includes an introduction part, demographic questions, and research questions. In the introduction part, the researcher has provided a brief explanation of smart home products. The respondents were asked to consent to the research to ensure voluntary participation. Research questions consisted of rating questions asking how strongly the respondent agrees or disagrees with an opinion. The research questions were developed in accordance with the number of variables in the research model. Responses were based on a five-point Likert rating scale, ranging from “disagree very much” (1) to “agree very much” (5). There were two language options for respondents: English and Chinese.

Combining the characteristics of smart home products, this paper draws on the research methods of Fang et al. (2014) on customer satisfaction and customer repurchase intention, and introduces the perceived effectiveness of IoT institutional mechanisms (PEIIM) as a moderating variable, which is the innovative view point for this paper. Through an analysis of literature reviews and models, this paper draws on the academic views of Oliver (1999); Kim et al. (2004); Petrick (2002); Li et al. (2021) and other scholars. The antecedents of consumer satisfaction are divided into price

effectiveness (switching cost and price perception), service effectiveness, brand effectiveness (domestic brand and foreign industry brand) and product effectiveness (product innovation and product diversity). Combined with the relevant research results of the literature review in the previous chapter, the definition of each construct in this paper as shown in Table 4-1.

<Table 4-1> The definitions of constructs

Construct	Definitions
Switching cost (SC)	The cost borne by customers when switching brands or service providers (such as learning time and so on)
Price perception (PP)	The customer's perception of the price when purchasing goods or services
Service effectiveness (SE)	The effectiveness of the service for consumer satisfaction and repurchase intention (such as convenience or professional services, etc.)
Domestic brand (DB)	A brand designed and produced independently in the country of customers
Foreign industry leader brand (FB)	The industry leader brand belonging to a foreign country
Product innovation (PI)	Innovative products produced according to market demand or technological development
Product diversity (PD)	Multiple choices of products under the same brand (e.g., XIAOMI TV; XIAOMI carema; XIAOMI refrigerator, etc.)
Consumer satisfaction (CS)	The customer's attitude towards goods or services through the purchasing experience
Perceived effectiveness of IoT institutional mechanisms (PEIIM)	Customers' perceived effectiveness of IoT institutional mechanisms in smart home products, including real-time monitoring, remote control and security protection of smart home products, etc.
Consumer repurchase intention (CRI)	A customer's intention of repurchasing the same brand of product or service, which can be influenced by factors such as price, product and customer satisfaction

The determination of the measurement scale for factors mainly refers to the scale

developed by scholars such as Ping Jr (1993), Yasri et al. (2020), Diamantopoulos et al. (2019), Zhang et al. (2020), Kim (2006) and so on. Combining this with the purpose of this paper, the question items were modified, and the final measurement items of each variable are shown in the table. The price effectiveness variable (abbreviated as PE) is composed of two factors: switching cost (abbreviated as SC) and price perception (abbreviated as PP), and a total of seven items were used to measure consumers' views on the switching cost and price perception of smart home products. The service effectiveness variable (abbreviated as SE) consists of five items, and measures consumers' perceptions of smart home product services. The brand effectiveness variable (abbreviated as BE) is composed of two factors: domestic brand (abbreviated as DB) and foreign industry leader brand (abbreviated as FB), and a total of six items were composed to measure consumers' perceptions of domestic smart home product brands and foreign leader brands in the smart home product industry. The product effectiveness variable (abbreviated as PRE) includes product innovation (abbreviated as PI) and product diversity (abbreviated as PD), and the two factors consist of seven items that measure consumers' perceptions of the innovation of smart home products and the product diversity of smart home product companies. As shown in Table 4-2, there are a series of measurement items of this paper will be designed.

<Table 4-2> Measurement items (1)

	Sources	Items
SC1	Items adapted and modified from	The cost of renewal or interconnection between smart home products of the same brand is important (vertical switching cost)

SC2	Ping Jr (1993) Kim et al. (2004) Nagengast et al. (2014) Chen (2019)	The cost of taking a lot of time and effort to switch to another smart home product providers is important. (horizontal switching cost)
SC3		The cost of learning a new service between different brands of the same home products is important. (horizontal switching cost)
PP1	Items adapted and modified from Petrick (2002) Yasri et al. (2020)	You can afford the cost of smart home products
PP2		You can afford the cost of use fees for smart home products if you think the price is reasonable
PP3		You think that buying smart home products is worth the money
PP4		Generally speaking, the quality of smart home products is high
SE1	Items adapted and modified from Li et al. (2021)	You think the services provided to you by the smart home products currently selected are easy to use, accessible, and user-friendly
SE2		You think the service professionalism provided by the currently selected smart home products is good
SE3		You think the smart home products currently selected can solve the problem quickly
SE4		You think the service quality of the smart home products you have selected is satisfactory and well supported
SE5		Compared with other smart home product brands, the existing smart home product brand has good service quality
DB1	Items adapted and modified from Verlegh (2007) He & Wang (2015) Diamantopoulos et al. (2019)	Will choose domestic smart home product brands to support and promote domestic economic development
DB2		Will choose domestic smart home product brands because of the convenience of purchase and maintenance, even if you have to pay more
DB3		Will choose domestic smart home product brands because of the network operator effect
FB1	Items adapted and modified	Will choose the foreign industry leader brand because of the popularity of the industry leader (more experienced and more

	from	resources)
FB2	Balabanis & Diamantopoulos (2016) Diamantopoulos et al. (2019)	Will choose the foreign industry leader brand because foreign brands outperform domestic ones
FB3		Will choose the foreign industry leader brand because of trust in it
PI1	Items adapted and modified from Rogers (2003) Fu & Elliott (2013) Zhang et al. (2020)	Product innovation technology is important
PI2		The degree of product innovation is important
PI3		A smart home product is an innovative product
PI4		Smart home products represent a new product category for consumers
PD1	Items adapted and modified from Kim (2006) Terblanche & Boshoff (2006)	The product diversity of smart home product enterprises is important
PD2		The software connectivity between smart home products is important (should cater to a wide range of preferences)
PD3		With the development of smart home products, enterprises need to offer customers a satisfactory choice of products

Consumption stems from comparison with the actual performance of the product; furthermore, it is the expectation and evaluation after using the goods or services (Minarti & Segoro, 2014). Customer satisfaction refers to the attitudes of consumers after purchasing goods or services, which is related to the price effectiveness, service effectiveness, brand effectiveness and product effectiveness perceived by consumers. This paper draws on the research scales of Fang et al. (2014); Garbarino & Johnson (1999); and Oliver & Swan (1989), combined with the industrial characteristics of smart home products, and designed customer satisfaction (abbreviated as CS) measurement items, as shown in the Table 4-3.

<Table 4-3> Measurement items (2)

	Sources	Items
CS1	Based on and modified from Fang et al. (2014) Garbarino & Johnson (1999); Oliver & Swan (1989)	Overall, extremely satisfied
CS2		Overall, extremely pleased
CS3		Your expectations were exceeded
CS4		You would recommend this smart home product enterprise to relatives and friends

This paper takes the perceived effectiveness of IoT institutional mechanisms as a moderating variable. For the rigor of the research, this paper used preliminary qualitative interviews with experts to discuss the characteristics of the IoT institutional mechanisms. After that, based on interviews with experts working in the smart home product industry, measurement items on the perceived effectiveness of the IoT institutional mechanisms (abbreviated as PEIIM), were determined as shown in the Table 4-4.

<Table 4-4> Measurement items (3)

	Sources	Items
PEIIM1	New scale developed based on definition, recent literature (e.g., Fang et al., 2014), and preliminary qualitative interviews	When using smart home products, you are confident that there are IoT mechanisms in place to protect you against any potential risks (e.g., real-time monitoring, remote operation, security protection, etc.) if something goes wrong with the smart home products
PEIIM2		You have confidence in third parties (such as IoT technology companies that cooperate with smart home product companies) to protect you against potential risks (e.g., real-time monitoring, remote operation, security protection,

		etc.) if something goes wrong with the smart home products
PEIIM3		You are sure that it is correct because of using smart home products under IoT institutional mechanisms (e.g., real-time monitoring, remote operation, security protection, policies and laws, etc.)

Customer repurchase intention refers to consumer awareness of repurchasing the same brand of products. This paper draws on the research scales of Fang et al. (2014), and Jarvenpaa et al. (2000), combined with the industrial characteristics of smart home products, and designed measurement items of customer repurchase intention (abbreviated as CRI), as shown in the Table 4-5.

<Table 4-5> Measurement items (4)

	Sources	Items
CRI1	Based on and modified from Fang et al. (2014) Jarvenpaa et al. (2000)	Your likelihood/probability of buying smart home products again from the enterprise you had in mind as you filled out this questionnaire. (In the medium term?)
CRI2		Your likelihood/probability of buying smart home products again from the enterprise you had in mind as you filled out this questionnaire. (In the long term?)
CRI3		All things considered, and on a scale from 1-5, what is the probability that you will purchase smart home products from the same enterprise again?

4.1.2 Data collection

An online questionnaire was made by the author through the survey website Questionnaire Star. The distribution of the questionnaire was carried out over the Internet. There was a pilot study analysis after the questionnaire is completed. By collecting 200 questionnaires, 176 valid questionnaires were finally obtained. Reliability and the validity analysis of pilot study for questionnaires will be discussed.

The pilot study was conducted to ensure that the questions were appropriate and the respondents had no problems in understanding or answering them (Saunders et al., 2009). The questionnaire was updated based on feedback from the pilot study, and the formal questionnaire was finally completed (as shown in Appendix).

The questionnaire QR code was shared with the author's mutual friends and contacts through social networking sites (e.g., WeChat, KakaoTalk, etc.). It is believed that the number of samples collected will determine the quality of the empirical results of the questionnaire. As the number of questionnaires increases, the questionnaire data regarding the structural equation model will be more reliable. Furthermore, the stability of the questionnaire will be stronger (Wu, 2009). Most scholars suggest that in the case of normal distribution data, the ratio of the sample size to the number of measurement items should be at least 10:1 (DeMars, 2003; Osborne & Costello, 2004). Furthermore, Bentler and Chou (1987) proposed that the sample size should be more than 10 times the observed variable. Moreover, Loehlin (1987) believed that in order to get a stable result, the sample number should be greater than 200. Based on the above standard, this paper issued and recovered a corresponding number of questionnaires. Specifically, the data collection process for this paper lasted 2 months, from the beginning of March to the end of April 2021. In the end, the author collected a total of 700 questionnaires, and the collected data were examined to check for certain issues before further analysis (Hair et al., 2016). Based on the data examination, 602 valid questionnaires were obtained, excluding 88 invalid questionnaires with completely the same answers, as well as when the answering time was too long (over

10 minutes) or too short (less than 1 minute), with an effective rate of 86%.

4.1.3 Pilot study analysis

In order to improve the reliability and validity of the questionnaire and finally form a high-quality questionnaire, it is necessary to analyze a pilot study on the questionnaire before gathering a large number of samples. This was mainly conducted by issuing questionnaires to professors, users of smart home products and employees of smart home products companies for the pilot study. A total of 200 questionnaire was issued, and 176 valid questionnaires were recovered. After the questionnaires were collected, SPSS24.0 software was used to test the reliability and validity of the questionnaire.

Reliability analysis of pilot study

The reliability coefficient is an important indicator to measure the consistency of all items in the questionnaire. The most commonly used detection method is the Cronbach's α coefficient, which verifies the reliability of the questionnaire through the Cronbach's α coefficient. Generally speaking, Cronbach's α coefficient between 0.70 to 0.80 is Acceptable; and more than 0.80 is good (George & Mallery, 2016). The CITC value can be used as a reference indicator for whether an item needs to be deleted. When the CITC coefficient is greater than 0.50, it indicates that the overall correlation of the construct is strong and the reliability is good. If the CITC coefficient is less than 0.50, it indicates that the internal reliability of the construct is poor, and should consider whether the item needs to be deleted.

<Table 4-6> Reliability analysis of pilot study

Construct	Items	CITC	Cronbach's α If item is deleted	Cronbach's α
SC	SC1	0.645	0.734	0.803
	SC2	0.642	0.739	
	SC3	0.661	0.718	
PP	PP1	0.673	0.802	0.841
	PP2	0.683	0.796	
	PP3	0.632	0.818	
	PP4	0.719	0.780	
SE	SE1	0.699	0.681	0.778
	SE2	0.723	0.684	
	SE3	**0.160**	**0.872**	
	SE4	0.652	0.709	
	SE5	0.663	0.700	
DB	DB1	0.700	0.800	0.846
	DB2	0.757	0.745	
	DB3	0.689	0.813	
FB	FB1	0.678	0.785	0.834
	FB2	0.732	0.731	
	FB3	0.673	0.790	
PI	PI1	0.759	0.630	0.776
	PI2	**0.334**	**0.837**	
	PI3	0.584	0.724	
	PI4	0.690	0.665	
PD	PD1	0.729	0.762	0.843
	PD2	0.739	0.752	
	PD3	0.660	0.827	
CS	CS1	0.754	0.842	0.881
	CS2	0.707	0.861	
	CS3	0.739	0.848	

	CS4	0.767	0.837	
	PEIIM1	0.698	0.800	
PEIIM	PEIIM2	0.738	0.758	0.845
	PEIIM3	0.702	0.794	
	CRI1	0.724	0.793	
CRI	CRI2	0.728	0.789	0.852
	CRI3	0.718	0.799	

The Table 4-6 shows that all the constructs of Cronbach's α coefficient are over 0.80 except the Cronbach's α coefficient of service effectiveness and product innovation. Most of the CITC coefficient is greater than the critical standard of 0.50, indicating that each item has a strong correlation relationship with the corresponding construct. However, the CITC coefficient of service effectiveness 3 is 0.160, and the Cronbach's α coefficient if the item is deleted is 0.872, which is greater than the Cronbach's α coefficient of service effectiveness of 0.778. It indicates that this item is not highly correlated with other items and needs to be deleted to improve the final Cronbach's α coefficient; for the same reason, the item of product innovation 2 should be deleted. Therefore, according to the recommendations of the statistical data detection results, the author reviewed the questionnaire and found that the scope of the question content of service effectiveness 3 was too narrow, and its content could be understood as being included in the item of service effectiveness 1, which could easily confuse the respondent. Thus, the author decided to delete service effectiveness 3; similarly, product innovation 2 items had the same problem, and the product innovation 1 item included the meaning of the product innovation 2 item. Finally, by comprehensively considering the theme of this paper, the product innovation 2 item

was likewise deleted.

<Table 4-7> Reliability analysis after deleting items

Construct	Items	CITC	Cronbach's α If item is deleted	Cronbach's α
SE	SE1	0.694	0.857	0.872
	SE2	0.800	0.810	
	SE4	0.720	0.841	
	SE5	0.718	0.840	
PI	PI1	0.707	0.770	0.837
	PI3	0.693	0.791	
	PI4	0.713	0.763	

As shown in Table 4-7, after deleting the items with CITC coefficient that were less than 0.50, the reliability analysis was carried out once more. The Cronbach's α coefficient of service effectiveness and product innovation were both above 0.80 and all of CITC coefficient were greater than 0.50. Therefore, it indicates that the reliability of questionnaire was perfect and met the research requirements.

Validity analysis of pilot study

Although every scale in this paper was adopted and modified from the scales developed in other mature literature, because the research object of this paper is a new topic, two items were deleted in the reliability analysis; therefore, the validity analysis of pilot study was analyzed.

Firstly, the pilot study analysis of content validity was completed. Content validity, also known as surface validity, refers to the suitability of the questionnaire for sampling related content. After the preliminary design of the scale was completed, the

author discussed it with school professors and experts in the smart home product industry, and revised it once again based on their opinions. Therefore, the questionnaire has perfect content validity.

Exploratory factor analysis (EFA) is a technique used to find the essential structure of multivariate observational constructs and process them for dimensionality reduction, so that constructs with intricate relationships can be integrated into a few core factors. In this paper, 176 valid questionnaires were obtained for exploratory factor analysis. Previous studies have shown that the KMO test and Bartlett's Test of Sphericity should be performed before exploratory factor analysis (Watson, 2017). In general, the KMO index should be more than 0.70, in addition, Bartlett's Test of Sphericity should be the significant value which means Bartlett's Test of Sphericity should be less than 0.05, The sample is suitable for exploratory factor analysis if the two tests meet the standard at the same time (Leech et al., 2005). The results are shown in the Table 4-8.

<Table 4-8> KMO test and Bartlett's Test of Sphericity

KMO		.788
Bartlett's Test of Sphericity	Approx. Chi-Square	3123.832
	Df	528
	Sig.	.000

The KMO index is 0.788, the Approx. Chi-Square value is 3123.832, and the value of Bartlett's Test of Sphericity is also significant, indicating that the data is suitable for exploratory factor analysis. Principal component analysis method was used to extract the factors, and factors with the characteristic value greater than 1 were

extracted, and the maximum variance method was used for orthogonal rotation, showing that the absolute value of factors loading were greater than 0.40 (Hair et al., 2016). Finally, ten mutually independent common factors were extracted (Table 4-9). The ten factors altogether explain 76.178% of total variance of items, which can explain the original information in the questionnaires, and all met the requirements of statistics. In addition, it is shows that each measurement item is well included in the respective factors after using the rotation analysis method (Table 4-10). Thus, all of these test results suggest good structure validity of questionnaire.

<Table 4-9> Total variance explained

component	Initial eigenvalues			Extraction sums of squared loadings			Rotating scale sum of squares		
	Total	Variance%	Cumulative%	Total	Variance%	Cumulative%	Total	Variance%	Cumulative%
1	6.971	21.124	21.124	6.971	21.124	21.124	3.111	9.427	9.427
2	3.267	9.901	31.025	3.267	9.901	31.025	3.071	9.305	18.732
3	2.976	9.019	40.045	2.976	9.019	40.045	2.813	8.524	27.256
4	2.685	8.137	48.182	2.685	8.137	48.182	2.399	7.269	34.525
5	2.372	7.188	55.370	2.372	7.188	55.370	2.378	7.205	41.731
6	1.781	5.398	60.768	1.781	5.398	60.768	2.365	7.168	48.898
7	1.514	4.588	65.356	1.514	4.588	65.356	2.335	7.077	55.975
8	1.333	4.040	69.396	1.333	4.040	69.396	2.239	6.785	62.761
9	1.223	3.705	73.101	1.223	3.705	73.101	2.238	6.782	69.542
10	1.015	3.077	76.178	1.015	3.077	76.178	2.190	6.635	76.178
11	0.676	2.049	78.227						
12	0.535	1.620	79.847						
13	0.533	1.615	81.462						
14	0.504	1.529	82.990						
15	0.476	1.442	84.432						

16	0.445	1.347	85.779
17	0.429	1.299	87.078
18	0.413	1.252	88.329
19	0.375	1.137	89.467
20	0.370	1.120	90.586
21	0.347	1.051	91.638
22	0.336	1.017	92.655
23	0.316	0.957	93.612
24	0.276	0.837	94.448
25	0.271	0.822	95.271
26	0.253	0.767	96.038
27	0.232	0.702	96.740
28	0.216	0.656	97.396
29	0.207	0.627	98.022
30	0.187	0.566	98.589
31	0.174	0.529	99.117
32	0.154	0.468	99.585
33	0.137	0.415	100.000

Extraction method: principal component analysis.

<Table 4-10> Rotated component matrix

Item	Ingredient									
s	1	2	3	4	5	6	7	8	9	10
CS2	**0.824**	-0.002	0.028	0.076	0.076	0.012	0.115	0.157	0.064	0.047
CS3	**0.823**	0.094	-0.054	-0.105	0.087	0.101	0.175	0.045	0.086	0.106
CS4	**0.814**	0.102	0.081	-0.001	0.154	-0.020	0.140	0.136	0.066	0.123
CS1	**0.797**	0.090	0.088	-0.034	0.149	-0.024	0.093	0.083	0.14	0.165
SE2	0.135	**0.857**	-0.029	0.060	0.132	0.040	0.080	0.056	0.02	0.135
SE1	-0.011	**0.825**	0.116	0.014	0.061	0.149	0.052	-0.063	0.153	0.082
SE5	0.096	**0.815**	0.030	-0.017	0.087	-0.093	0.101	0.217	0.027	0.099
SE4	0.055	**0.798**	-0.024	0.056	0.083	0.066	0.086	0.152	0.065	0.129
PP4	-0.033	0.010	**0.870**	0.057	0.196	0.033	0.051	0.014	-0.034	-0.028

PP1	-0.014	0.092	**0.813**	-0.007	0.003	0.021	-0.082	-0.044	0.115	0.098
PP2	0.071	-0.012	**0.803**	0.074	0.042	-0.026	-0.093	0.143	-0.072	0.174
PP3	0.116	-0.013	**0.743**	-0.008	-0.060	0.065	-0.084	-0.098	0.104	0.231
PD1	-0.060	0.029	0.030	**0.862**	-0.006	0.117	0.022	-0.061	0.11	0.084
PD2	0.015	0.069	0.037	**0.847**	-0.002	0.055	-0.021	-0.126	0.203	0.016
PD3	-0.012	0.004	0.040	**0.832**	-0.082	-0.064	0.005	0.027	0.172	-0.013
PEIIM2	0.149	0.109	0.070	-0.066	**0.838**	-0.009	0.101	0.161	0.055	0.102
PEIIM1	0.207	0.056	0.087	-0.031	**0.832**	0.091	0.101	0.043	0.04	-0.031
PEIIM3	0.079	0.191	0.021	0.007	**0.812**	0.029	0.075	0.195	0.101	0.088
FB2	0.027	-0.047	0.032	-0.013	-0.012	**0.873**	0.005	0.193	0.011	0.007
FB3	0.027	0.117	-0.067	0.027	0.108	**0.855**	-0.093	0.099	0.076	0.109
FB1	-0.005	0.087	0.148	0.118	0.009	**0.784**	0.102	0.237	-0.048	-0.164
CRI1	0.172	0.031	-0.045	-0.042	0.077	0.033	**0.850**	0.035	0.06	0.168
CRI2	0.187	0.096	-0.078	0.014	0.136	-0.002	**0.834**	0.085	0.054	0.018
CRI3	0.139	0.200	-0.093	0.050	0.065	-0.034	**0.812**	0.167	0.173	0.007
DB2	0.096	0.121	0.037	-0.015	0.183	0.145	0.154	**0.848**	0.058	0.09
DB3	0.166	0.091	0.002	-0.126	0.097	0.250	0.120	**0.755**	0.095	0.149
DB1	0.238	0.189	-0.042	-0.062	0.186	0.283	0.033	**0.724**	0.065	0.017
PI3	0.002	0.123	0.093	0.109	-0.024	0.015	0.101	0.035	**0.887**	0.014
PI1	0.188	0.110	0.015	0.211	0.102	0.039	0.072	0.102	**0.794**	-0.026
PI4	0.219	0.019	-0.003	0.327	0.171	0.000	0.125	0.067	**0.743**	0.078
SC2	0.099	0.041	0.190	0.032	0.118	-0.028	0.077	0.082	0.056	**0.811**
SC1	0.223	0.227	0.069	0.039	-0.039	-0.040	0.020	0.122	0.066	**0.778**
SC3	0.106	0.215	0.225	0.032	0.074	0.051	0.108	0.026	-0.081	**0.771**

Extraction method: principal component analysis.

Rotation method: Varimax with Kaiser Normalization.

4.2 Descriptive statistics analysis

Before the empirical test, this paper mainly used demographic variables to carry

out a corresponding descriptive statistical analysis of the data. Table 4-11 provides the specific analysis of demographic characteristics. Furthermore, the analysis of the measurement indicators of each variable was analyzed to clarify the overall structure of the sample (Table 4-12). The main purpose had two aspects: one was to examine the representativeness of demographic variables, and the second was to analyze and judge the data form of the sample. This paper mainly used the mean, standard deviation, skewness and kurtosis of each item to judge the data. It is required that the data conform to the normal distribution when a structural equation model is used (Fornell & Larcker, 1981), so as to eliminate its influence on the significance of the chi-square statistics and path coefficient of the model.

<Table 4-11> Demographic characteristics analysis

Statistical characteristics	Categories	Frequency	Percentage (%)
Gender	Male	264	43.9
	Female	338	56.1
Age	Under 25	130	21.6
	26-35	172	28.6
	36-45	150	24.9
	Over 46	150	24.9
Highest education level	High school and below	76	12.6
	Diploma or undergraduate	288	47.8
	Master	204	33.9
	Doctor or above	34	5.6
Monthly income（$）	Under $700	86	14.3
	$701-$1300	251	41.7
	$1301-$1900	199	33.1
	Over $1901	66	11.0
Home products	1 and none	57	9.5

	2-5	171	28.4
	6-10	199	33.1
	Over 11	175	29.1
	1 and none	109	18.1
Smart home products	2-5	178	29.6
	6-10	162	26.9
	Over 11	153	25.4

From the perspective of demographic variables, the structure of the sample data is relatively reasonable (as shown in the Table 4-11). In terms of the gender distribution of the sample, there were 264 male consumers, accounting for 43.9%, and 338 female consumers, accounting for 56.1%. In terms of gender, there was no significant difference in the ratio of males to females, indicating that the data is relatively reliable; in terms of the age distribution of the sample, 130 people were under 25 years old, accounting for 21.6%, and 172 people were 26-35 years old, accounting for 28.6%, 150 people aged 36-45, accounting for 24.9%, and 150 people over 46, accounting for 24.9%. The data showed that consumers over 25 years old accounted for a large proportion; in terms of sample education distribution, 76 people were high school and below, accounting for 12.6%, 288 samples chose diploma or undergraduate, accounting for 47.8%, 204 customers were master's degree, accounting for 33.9%, and 34 were doctors and above, accounting for 5.6%. The statistics showed that the proportion of diploma or undergraduate is relatively high. For the monthly income distribution of the sample, 86 people had a personal monthly income of less than US$700, accounting for 14.3%, 251 people had US$701-1300, accounting for 41.7%, 199 people had US$1301-1900, accounting for 33.1%, and 66 people had a

monthly income of US$1901, accounting for 11%. The data showed that $701-$1900 consumers are the main purchasing power of smart home products. Regarding the current number of home products, 57 people chose one or no home products, accounting for 9.5%, 171 people answered 2-5, accounting for 28.4%, 199 people answered 6-10, accounting for 33.1%, and 175 people answered more than 11, accounting for 29.1%. Analysis of the sample data shows that the home products penetration rate is relatively high; in terms of the current number of smart home products, 109 people answered one or none, accounting for 18.1%, 178 people answered 2-5, accounting for 29.6%, 162 people answered 6-10, accounting for 26.9%, and 153 people chose more than 11, accounting for 25.4%.

<Table 4-12> Descriptive statistics of measurement items

Construct	Items	Mean	Standard deviation	Skewness		Kurtosis	
				Skewness	S.E.	Kurtosis	S.E.
SC	SC1	3.87	1.085	-0.926	0.1	0.365	0.199
	SC2	3.81	1.136	-0.861	0.1	0.064	0.199
	SC3	3.84	1.115	-0.859	0.1	0.079	0.199
PP	PP1	3.66	1.210	-0.752	0.1	-0.312	0.199
	PP2	3.85	1.154	-0.867	0.1	0.023	0.199
	PP3	3.94	1.104	-0.962	0.1	0.268	0.199
	PP4	3.88	1.076	-0.879	0.1	0.247	0.199
SE	SE1	3.66	1.218	-0.749	0.1	-0.341	0.199
	SE2	3.88	1.066	-0.867	0.1	0.224	0.199
	SE4	3.94	1.041	-1.027	0.1	0.598	0.199
	SE5	3.99	1.085	-1.068	0.1	0.552	0.199
DB	DB1	3.93	1.099	-0.984	0.1	0.322	0.199
	DB2	3.86	1.122	-0.883	0.1	0.081	0.199
	DB3	3.86	1.183	-0.934	0.1	0.065	0.199

FB	FB1	3.81	1.090	-0.768	0.1	-0.021	0.199
	FB2	3.84	1.147	-0.994	0.1	0.272	0.199
	FB3	3.82	1.126	-0.867	0.1	0.110	0.199
PI	PI1	3.98	1.097	-1.127	0.1	0.746	0.199
	PI3	3.65	1.250	-0.682	0.1	-0.538	0.199
	PI4	4.01	1.077	-1.115	0.1	0.695	0.199
PD	PD1	3.91	1.058	-0.930	0.1	0.383	0.199
	PD2	3.97	1.093	-1.155	0.1	0.813	0.199
	PD3	3.93	1.079	-1.119	0.1	0.834	0.199
CS	CS1	3.86	1.078	-0.808	0.1	0.095	0.199
	CS2	3.91	1.094	-1.048	0.1	0.661	0.199
	CS3	3.87	1.076	-0.978	0.1	0.557	0.199
	CS4	3.88	1.100	-0.956	0.1	0.355	0.199
PEIIM	PEIIM1	3.81	1.117	-0.775	0.1	-0.113	0.199
	PEIIM2	3.75	1.119	-0.753	0.1	-0.086	0.199
	PEIIM3	3.85	1.069	-0.810	0.1	0.110	0.199
CRI	CRI1	3.88	1.072	-0.948	0.1	0.394	0.199
	CRI2	3.86	1.052	-0.769	0.1	0.061	0.199
	CRI3	3.92	1.136	-1.049	0.1	0.506	0.199

The standard deviation of all measurement items is above 0.50, the absolute value of skewness is below 3, and the absolute value of kurtosis is below 10, the sample conforms to the normal distribution; otherwise it is non-normal (Huang, 2005). It can be seen from the table that the standard deviation of the items in this questionnaire is between 1.041 and 1.250, the absolute value of skewness is between 0.682 and 1.127, and the absolute value of kurtosis is between 0.021 and 0.834, the data quality is perfect, meeting the normal distribution standard.

4.3 Reliability and validity analysis

4.3.1 Reliability analysis

Reliability analysis is mainly done to test whether the scale has stability and consistency in measuring related variables (Wu, 2010). In previous studies, it was suggested that internal consistency reliability is assessed by evaluating the Cronbach's α coefficient. This paper used SPSS 24.0 to analyze the reliability of each construct in the model. Generally speaking, Cronbach's α coefficient should be greater than 0.80 in the formal questionnaire (George & Mallery, 2016).

<Table 4-13> Reliability analysis

Construct	Items	CITC	Cronbach's α If item is deleted	Cronbach's α
SC	SC1	0.703	0.793	0.845
	SC2	0.717	0.779	
	SC3	0.716	0.780	
PP	PP1	0.738	0.801	0.856
	PP2	0.703	0.816	
	PP3	0.689	0.822	
	PP4	0.672	0.829	
SE	SE1	0.724	0.805	0.854
	SE2	0.689	0.818	
	SE4	0.669	0.826	
	SE5	0.710	0.809	
DB	DB1	0.694	0.780	0.837
	DB2	0.705	0.769	
	DB3	0.702	0.774	
FB	FB1	0.702	0.779	0.84
	FB2	0.736	0.745	
	FB3	0.674	0.806	
PI	PI1	0.729	0.796	0.855
	PI3	0.742	0.789	
	PI4	0.720	0.805	
PD	PD1	0.705	0.768	0.837

CS	PD2	0.710	0.762	0.872
	PD3	0.682	0.790	
	CS1	0.705	0.844	
	CS2	0.749	0.826	
	CS3	0.740	0.830	
	CS4	0.708	0.843	
PEIIM	PEIIM1	0.701	0.752	0.83
	PEIIM2	0.685	0.768	
	PEIIM3	0.679	0.774	
CRI	CRI1	0.721	0.785	0.848
	CRI2	0.723	0.784	
	CRI3	0.709	0.798	

According to the Table 4-13, the Cronbach's α of all of the constructs is above 0.80, and the overall CITC coefficient of the item is above 0.50. Therefore, the reliability of the questionnaire is perfect and meets the research requirements.

4.3.2 Validity analysis

Validity refers to the ability to measure the effectiveness of the measurement results of a scale (Wen et al., 2004). Content validity and structural validity were selected for testing. Content validity is used to test the rationality of the content of the measurement scale. Structure validity refers to the degree of consistency between the constructs and the measurement items of the scale. Structure validity includes convergent validity and discriminant validity. Convergent validity measures the correlation of all measurement items in the same construct, while discriminant validity measures the degree of difference between different constructs (Wu, 2010).

Content validity analysis

Content validity reflects whether the measurement scale can include the content

of all measurement items. When the typical characteristics of all the items in the questionnaire are mostly mentioned, the content validity of the measurement scale is relatively high (Wu, 2010). The measurement scales of four effectiveness factors used in this paper, customer satisfaction, perceived effectiveness of IoT institutional mechanisms (PEIIM) and customer repurchase intention, refer to the mature scales in relevant domestic and foreign studies. These scales have also been used and tested by authoritative scholars many times. In addition, in the pilot study stage, whether the scale items need to be purified was tested. The results showed that the scale content can reflect all constructs well. Therefore, the measurement scale has good content validity.

Convergent validity analysis

Generally, three indicators are selected to test convergent validity: factor loading, combined reliability (abbreviated as CR) and average variance extraction (abbreviated as AVE). The standardized factor loading critical value needs to be greater than 0.70, indicating that the aggregation validity is good (Fornell & Larcker, 1981). The CR value and AVE value can be calculated from the factor loading. When the CR value is greater than 0.70 and the AVE is greater than 0.50, it indicates that the internal quality is perfect (Fornell & Larcker, 1981).

Combination Reliability (CR) Calculation Formula:

$$CR = \frac{(\sum \lambda)^2}{(\sum \lambda)^2 + \sum \theta}$$

Average Variance Extracted (AVE) Calculation Formula:

$$\text{AVE} = \frac{\sum \lambda^2}{\sum \lambda^2 + \sum \theta}$$

PS: λ represents standard factor loading; θ represents variation of manifest variables ($\theta = 1 - \lambda^2$).

<Table 4-14> Convergent validity: Standard factor loading of items

Construct	Items	SL	SE	T value
SE	SE1	0.791		
	SE2	0.769	0.044	19.149***
	SE4	0.744	0.044	18.479***
	SE5	0.787	0.045	19.629***
CS	CS1	0.757		
	CS2	0.833	0.055	20.362***
	CS3	0.808	0.054	19.757***
	CS4	0.774	0.055	18.865***
PEIIM	PEIIM1	0.809		
	PEIIM2	0.779	0.055	17.669***
	PEIIM3	0.774	0.052	17.616***
CRI	CRI1	0.810		
	CRI2	0.816	0.049	19.999***
	CRI3	0.797	0.053	19.647***
PP	PP1	0.822		
	PP2	0.773	0.045	19.737***
	PP3	0.761	0.044	19.393***
	PP4	0.739	0.043	18.742***
SC	SC1	0.787		
	SC2	0.825	0.055	19.913***
	SC3	0.798	0.054	19.408***
DB	DB1	0.792		
	DB2	0.798	0.054	19.035***
	DB3	0.797	0.057	19.029***
FB	FB1	0.797		

	FB2	0.848	0.058	19.281***
	FB3	0.75	0.054	18.051***
	PI1	0.811		
PI	PI3	0.835	0.058	20.413***
	PI4	0.803	0.049	19.949***
	PD1	0.795		
PD	PD2	0.816	0.054	19.704***
	PD3	0.773	0.053	18.831***

<Table 4-15> Convergent validity: CR and AVE of constructs

Construct	CR	AVE
SE	0.856	0.598
CS	0.872	0.630
PEIIM	0.830	0.620
CRI	0.849	0.652
PP	0.857	0.600
SC	0.845	0.646
DB	0.838	0.633
FB	0.841	0.639
PI	0.857	0.667
PD	0.837	0.632

As shown in the Table 4-14, the factor loading value of the ten constructs, which are thirty-three measurement items of the scale, is between 0.739-0.848, which is at an ideal level greater than 0.70 and less than 0.95, indicating that the factor loading of the variable (standardized path coefficient) reached a significant level. According to Table 4-15, the CR value of each construct is between 0.830-0.872, at a level greater than 0.70; the AVE value for each construct is between 0.598-0.667, at a level greater than 0.50. In summary, the inherent quality is ideal, and the convergent validity of the ten

constructs is perfect, which further shows that the model has good structural validity.

Discriminant validity analysis

The steps to test the discriminant validity of each construct are mainly based on the method of Fornell and Larcker (1981). It is believed that if the square root of the AVE value is greater than the value of the correlation coefficient, the measurement model of each latent construct is significantly distinguishable. The results of the discriminant validity test are shown in the Table 4-16. It can be seen that for the service effectiveness factor, its AVE of 0.773 is greater than its correlation coefficient with other factors; for the customer satisfaction factor, its AVE of 0.793 is greater than its correlation coefficient with other factors. For the perceived effectiveness of IoT institutional mechanisms (PEIIM) factor, its AVE of 0.787 is greater than its correlation coefficient with other factors; for the customer repurchase intention factor, its AVE of 0.807 is greater than its correlation coefficient with other factors; for the price perceived factor, its AVE of 0.775 is greater than its correlation coefficient with other factors; for the switching cost, its AVE of 0.804 is greater than its correlation coefficient with other factors; for the domestic brand factor, its AVE of 0.796 is greater than its correlation with other factors; for the foreign industry leader brand factor, its AVE of 0.799 is greater than its correlation coefficient with other factors; for the product innovation factor, its AVE of 0.817 is greater than its correlation coefficient with other factors; and for the product diversity factor, its AVE is 0.795 is greater than its correlation coefficient with other factors. According to the test standard of discriminant validity, the value of the square root of the AVE of each construct is

greater than the absolute value of the correlation coefficient between the constructs, indicating that the measurement scale has good discriminant validity.

<Table 4-16> Discriminant validity

Construct	1	2	3	4	5	6	7	8	9	10
1.SE	**0.773**									
2.CS	0.602	**0.793**								
3.PEIIM	0.234	0.231	**0.787**							
4.CRI	0.281	0.465	0.166	**0.807**						
5.PP	0.321	0.373	0.049	0.307	**0.775**					
6.SC	-0.53	-0.562	-0.19	-0.419	-0.252	**0.804**				
7.DB	0.489	0.500	0.117	0.294	0.294	-0.466	**0.796**			
8.FB	0.249	0.243	0.01	0.163	0.155	-0.262	0.412	**0.799**		
9.PI	0.215	0.181	0.071	0.257	0.059	-0.317	0.162	0.045	**0.817**	
10.PD	0.526	0.557	0.185	0.425	0.478	-0.484	0.471	0.224	0.254	**0.795**
Mean	3.865	3.880	3.802	3.885	3.831	2.158	3.872	3.825	3.880	3.933
Standard Deviation	0.922	0.924	0.952	0.953	0.950	0.972	0.800	0.976	1.007	0.935

The diagonal elements represent the square root of AVE (average variance extracted)

4.4 Structural equation model

4.4.1 Initial model

This paper is based on a conceptual model and the structural equation model (SEM) was used for analysis. Khine (2013) claims that SEM can measure the direct and indirect influences between variables in a theoretical model. SEM is widely used in empirical information systems studies (Urbach & Ahlemann, 2010) and is the one of the most powerful research methodologies (Richter et al., 2016). Firstly, AMOS24.0 software was used to design the initial path of the model (Figure 4-1). Secondly, the λ2/ df chi-square degree of freedom ratio (CMIN/DF), root mean square error of

approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square residual (RMR) were selected to test the model fitting effect. The standards and results of model fitting analysis are shown in the Table 4-17:

<Table 4-17> Initial model fitting results

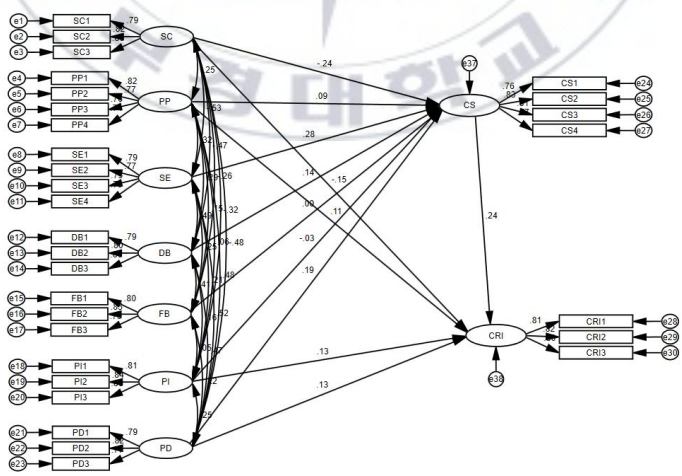
Index	Standard	Result	Evaluation
CMIN/DF	<3	1.209	Excellent
GFI	>0.90	0.953	Excellent
RMR	<0.05	0.032	Excellent
RMSEA	<0.05	0.019	Excellent
NFI	>0.90	0.952	Excellent
TLI	>0.90	0.990	Excellent
CFI	>0.90	0.991	Excellent
PGFI	>0.50	0.762	Excellent
PNFI	>0.50	0.814	Excellent

After associating the sample data with the model and analyze in AMOS 24.0, it can be seen from the table that the CMIN/DF index is 1.209, which is significantly less than the standard value of 3. The GFI index is 0.953, which is greater than the standard value of 0.90. Furthermore, the RMR index is 0.032, which is smaller than the standard value of 0.05. Moreover, the RMSEA index is 0.019, which is significantly less than the standard value of 0.05. Therefore, it can be seen that the absolute fitting index item fits well. In the value-added fitting index, the NFI index is 0.952, which is greater than the standard value of 0.90, and the indexes of TLI and CFI are 0.990 and 0.991 respectively, which are both greater than the standard value of 0.90, so the value-added fitting index item fits well. In the parsimonious fitting index, PGFI is 0.762, which is greater than the standard value of 0.50, and the PNFI index is

0.814, which is also greater than the standard value of 0.50; thus, the result of the parsimonious fitting index is perfect. Integrating the fitting results of the absolute fitting index, the value-added fitting index and the parsimonious fitting index, it can be seen that the structural equation model in this paper is at an excellent level of data fitting, and the external quality of the model is perfect.

Model evaluation refers to verifying each hypothesis path in the structural equation model, and judging whether the model hypothesis has reached statistical significance through the T value or P value (Wen et al., 2004). The direct path existing between the constructs was tested (Table 4-18). ST-Estimate is the standardized value of each path coefficient, and SE is the standard error. The P value was used to judge whether the model hypotheses reached statistical significance. At the significance level, P value should be less than 0.05.

<Figure 4-1> Initial model path



<Table 4-18> Initial model path coefficient

H		Path		ST-Estimate	S.E.	T value	P value	Result
H1a	CS	<---	SC	-0.245	0.049	-4.748	***	Support
H1b	CS	<---	PP	0.093	0.036	2.132	0.033	Support
H2	CS	<---	SE	0.28	0.044	5.368	***	Support
H3a	CS	<---	DB	0.138	0.048	2.711	0.007	Support
H3b	*CS*	<---	*FB*	*-0.003*	*0.039*	*-0.073*	*0.942*	*No Support*
H4a	*CS*	<---	*PI*	*-0.033*	*0.036*	*-0.83*	*0.407*	*No Support*
H4b	CS	<---	PD	0.191	0.053	3.492	***	Support
H5	CRI	<---	CS	0.238	0.065	3.924	***	Support
H6a	CRI	<---	SC	-0.151	0.059	-2.578	0.01	Support
H6b	CRI	<---	PP	0.109	0.044	2.151	0.031	Support
H7a	CRI	<---	PI	0.125	0.045	2.729	0.006	Support
H7b	CRI	<---	PD	0.132	0.064	2.128	0.033	Support

It can be seen from the Table 4-18 that most of the hypotheses in this paper passed the verification, but the P values of the two paths of foreign industry leader brand to customer satisfaction and product innovation to customer satisfaction are 0.942 and 0.407, and both of them are greater than 0.05. This is considered statistically insignificant. Therefore, it suggests that the model should be revised.

4.4.2 Model modification

Model modification refers to adding parameters or constraints to a model to improve the accuracy of the model. Many scholars have proposed that the revision of a model cannot only rely on the revision index, but also needs theoretical support (Wen et al., 2004). In the initial model test results of this paper, the direct influence of the foreign industry leader brand on customer satisfaction and product innovation on customer satisfaction was not significant, and the corresponding model modification

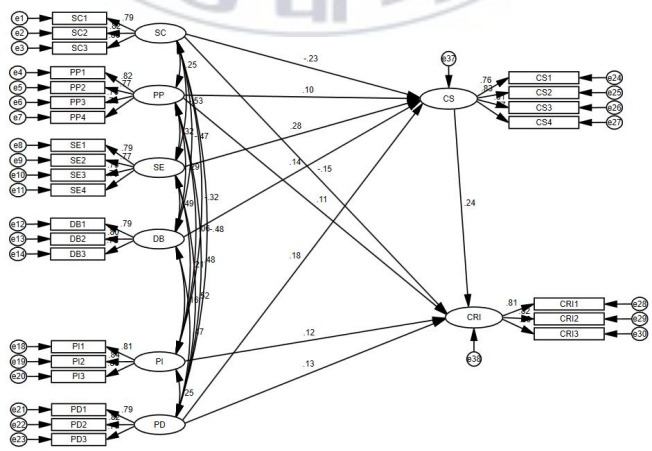
measure is to disconnect these two paths (Figure 4-2).

After correcting the model, the calculation was analyzed once more in AMOS software, and the revised model fitting results are shown in the Table 4-19. It can be seen that, compared with the fitting results before the correction, several of the fitting indicators of each dimension after model correction were improved to a certain extent, indicating that the fit between the model and the data has been improved.

<Table 4-19> Final model fitting results

Index	Standard	Result	Evaluation
CMIN/DF	<3	1.219	Excellent
GFI	>0.9	0.958	Excellent
RMR	<0.05	0.033	Excellent
RMSEA	<0.05	0.019	Excellent
NFI	>0.9	0.957	Excellent
TLI	>0.9	0.991	Excellent
CFI	>0.9	0.992	Excellent
PGFI	>0.5	0.758	Excellent
PNFI	>0.5	0.815	Excellent

<Figure 4-2> Final model path



<Table 4-20> Final model path coefficient

H		Path		ST-Estimate	S.E.	T value	P value	Result
H1a	CS	<---	SC	-0.235	0.048	-4.703	***	Support
H1b	CS	<---	PP	0.096	0.035	2.228	0.026	Support
H2	CS	<---	SE	0.280	0.044	5.357	***	Support
H3a	CS	<---	DB	0.138	0.045	2.891	0.004	Support
H4b	CS	<---	PD	0.185	0.053	3.415	***	Support
H5	CRI	<---	CS	0.238	0.064	3.934	***	Support
H6a	CRI	<---	SC	-0.150	0.059	-2.591	0.01	Support
H6b	CRI	<---	PP	0.109	0.044	2.149	0.032	Support
H7a	CRI	<---	PI	0.125	0.045	2.727	0.006	Support
H7b	CRI	<---	PD	0.132	0.064	2.140	0.032	Support

The revised model was re-evaluated, and T value was used to judge whether the model hypothesis reached statistical significance. At the significance level of P<0.05, the absolute value of the T value should be greater than 1.96. As shown in Table 4-20, the revised model passed all hypotheses, including “customer satisfaction<---service effectiveness,” “customer satisfaction<---switching cost,” “customer satisfaction<---product diversity,” “customer satisfaction<---domestic brand” and “customer satisfaction<---price perception,” and the coefficient of the T values of the five paths were 5.357>4.703>3.415>2.891>2.228, and the P values were all less than 0.05, indicating that service effectiveness and switching cost, product diversity, domestic brand and price perception have a significant impact on customer satisfaction. According to the standardized path coefficient, service effectiveness has the greatest influence on customer satisfaction (0.280), and price perception has the least influence on customer satisfaction (0.096).

In the analysis of the impact of customer satisfaction on customer repurchase

intention, the path coefficient was standardized to 0.238, and the T value was 3.934, indicating that the path of “customer repurchase intention<---customer satisfaction” passed the P<0.001 significance level. It can be concluded that customer satisfaction plays a very significant role in promoting the formation of customer repurchase intentions.

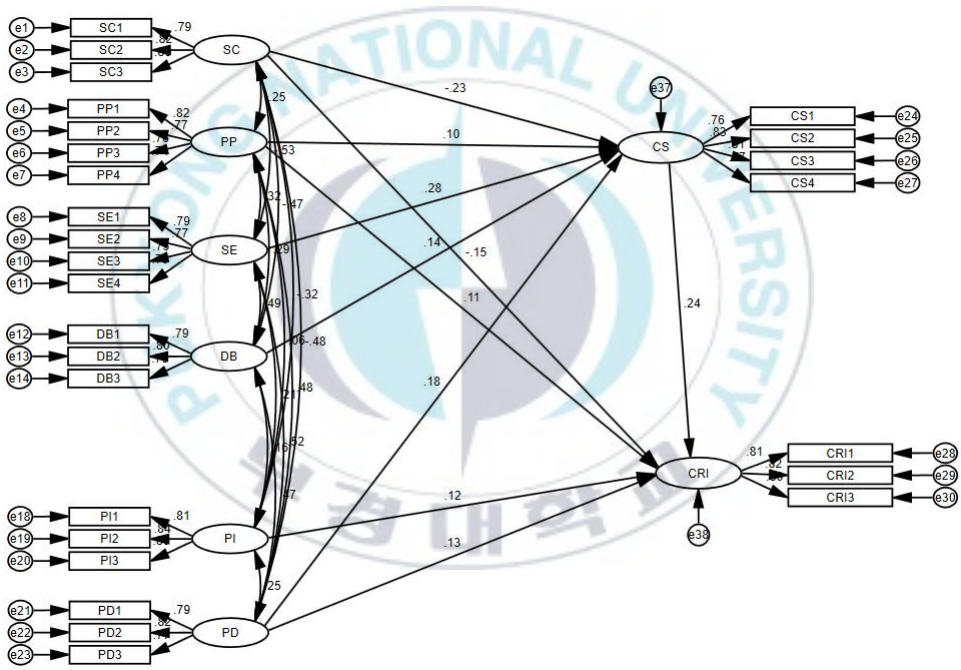
In the path analysis of customer repurchase intentions, “customer repurchase intention<---product innovation,” “customer repurchase intention<---switching cost,” “customer repurchase intention<---price perception,” “customer repurchase intention<---product diversity” the coefficient of T values of the four paths of the were 2.727>2.591>2.149>2.140, and the P values were 0.01, 0.014, 0.017, 0.028, respectively, indicating that these four paths passed the test at a significance level of 0.05. It shows that switching costs, product diversity, product innovation and price perception have a certain positive impact on customer repurchase intention. According to the standardized path coefficient, the generation of customer repurchase intention is mainly affected by high product diversity (0.132) and low switching cost (0.150). In contrast, product innovation (0.125) and price perception (0.109) have less influence, but still play a significant role in promoting it.

4.5 Mediating effect of customer satisfaction

According to Baron and Kenny’s study (1986), the independent variable affects the dependent variable through mediating variables. As proposed by numerous scholars, it is important to apply bootstrap to reconfirm the results of mediating impact analysis (Hayes, 2012). Bootstrap is a re-sampling procedure to test the indirect effect,

and is a method of sampling with replacement whereby one instructs the algorithm to take the sample size from the existing dataset (Hair et al., 2016). The bootstrap of this paper was conducted with 2000 resamples in the existing dataset and bias-corrected confidence interval of 95%. The significance of the mediating effect can be ascertained by nonzero effects.

<Figure 4-3> Mediating effect analysis model



The model used is shown in the Figure 4-3, and the bootstrap method is used to test the mediation effect of customer satisfaction in the above model. As shown in the figure 4-3 above, there are a total of five intermediary paths, namely SC-->CS-->CRI, PP-->CS-->CRI, PD-->CS-->CRI, SE-->CS-->CRI and DB-->CS-->CRI. Among them, the impact of the three variables, which are SC, PP, and PD on CRI includes the

mediating path and the direct path.

The results of the bootstrap test are shown in the Table 4-21. From the analysis results, the mediation effects of the five paths are all significant, because with 95% confidence, zero is not within this interval. Among the three variable relationships that have both a mediating influence path and a direct influence path, the mediating effect of SC on CRI accounts for 27.18% of the total effect, and the mediating effect of PP on CRI accounts for 17.42% of the total effect. The mediating effect of PD on CRI accounts for 25.00% of the total effect.

<Table 4-21> Mediating effect analysis

Path	Effect Types	Effect Value	Bootstrap BC 95%CI		Indirect Effect Ratio
			LCL	UCL	
SC-->CS-->CRI	Indirect Effect	-0.056	-0.116	-0.019	27.18%
SC-->CRI	direct Effect	-0.15	-0.312	-0.003	
PP-->CS-->CRI	Indirect Effect	0.023	0.002	0.062	17.42%
PP-->CRI	direct Effect	0.109	0.018	0.233	
PD-->CS-->CRI	Indirect Effect	0.044	0.009	0.108	25.00%
PD-->CRI	direct Effect	0.132	0.039	0.296	
SE-->CS-->CRI	Indirect Effect	0.067	0.025	0.119	/
DB-->CS-->CRI	Indirect Effect	0.033	0.006	0.089	/

LCL is the lower confidence limit; UCL is the upper confidence limit.

4.6 Moderating effect of PEIIM

The data was analyzed with SPSS24.0, and the method of gradual regression was used to test the perceived effectiveness of IoT institutional mechanisms (PEIIM) as the moderating role. Gender, age, highest education level, monthly income the number of home products and smart home products were used as control variables, while

switching cost (SC), price perception (PP), product innovation (PI), product diversity (PD) and customer satisfaction (CS) were independent variables, the PEIIM was the moderator, and the customer repurchase intention (CRI) was the dependent variable. In order to avoid the influence of multicollinearity on the test results, the independent variables and moderator variables were processed centrally. In the results, β represents the non-standardized regression result, T represents the test statistic of the regression coefficient, and VIF represents the expansion coefficient, which is an index for testing collinearity. The tolerance rate of VIF should be within 8. It has been suggested that stepwise regression be used to test the moderating effect. The control variables were put into model 1, and the independent variables, moderating variables and interaction terms were put into model 2.

It can be seen from the stepwise regression results that in Model 2 (as shown in the Table 4-22), the switching cost of the independent variable had a significant positive impact on customer repurchase intention ($T=8.485$, $p<0.001$), and the perceived effectiveness of IoT institutional mechanisms had a significant impact on customer repurchase intention ($T=2.217$, $p<0.05$), while the interactive item of switching cost x the perceived effectiveness of IoT institutional mechanisms had no significant impact on customer repurchase intention ($T=0.145$, $T<1.96$), indicating that the perceived effectiveness of IoT institutional mechanisms has no significant moderating effect between switching cost and customer repurchase intention.

<Table 4-22> The moderating role of PEIIM in SC to CRI

Variable	Model 1			Model 2		
	β	t	VIF	β	t	VIF
Gender	0.023	0.563	1.016	0.003	0.075	1.025
Age	0.016	0.389	1.015	0.031	0.814	1.019
Highest education level	-0.022	-0.52	1.051	-0.014	-0.358	1.055
Monthly income	0.016	0.376	1.053	-0.013	-0.34	1.061
Home products No.	0.015	0.372	1.006	0.013	0.344	1.007
Smart home products No.	0.019	0.463	1.015	0.018	0.467	1.025
SC				-0.338	-8.485***	1.084
PEIIM				0.087	2.217*	1.059
SCxPEIIM				0.019	0.485	1.079
F		0.187			10.291	
R2		0.002			0.135	
ΔR2		0.002			0.133	

*p<0.05; **p<0.01; ***p<0.001

As shown in the Table 4-23, independent variable product innovation had a significant positive impact on customer repurchase intention (T=5.114, p<0.001), and the perceived effectiveness of IoT institutional mechanisms also had a significant positive impact on customer repurchase intention (T=3.208, P<0.01), and the interactive item of product innovation x the perceived effectiveness of IoT institutional mechanisms had no significant effect on customer repurchase intention (T=-0.859, T<1.96), indicating that there is no significant moderating effect of perceived effectiveness of IoT institutional mechanisms between the product innovation and the customer repurchase intention.

<Table 4-23> The moderating role of PEIIM in PI to CRI

Variable	Model 1			Model 2		
	β	t	VIF	β	t	VIF
Gender	0.023	0.563	1.016	0.025	0.632	1.021
Age	0.016	0.389	1.015	0.019	0.48	1.019
Highest education level	-0.022	-0.52	1.051	-0.019	-0.463	1.055
Monthly income	0.016	0.376	1.053	0	0.004	1.057
Home products No.	0.015	0.372	1.006	0.019	0.47	1.008
Smart home products No.	0.019	0.463	1.015	0.026	0.658	1.021
PI				0.206	5.114***	1.026
PEIIM				0.129	3.208**	1.024
PIxPEIIM				-0.035	-0.859	1.031
F		0.187			4.762	
R2		0.002			0.068	
ΔR2		0.002			0.066	

*p<0.05; **p<0.01; ***p<0.001

As shown in the Table 4-24, the independent variable price perception had a significant positive impact on customer repurchase intention (T=6.820, p<0.001), and the perceived effectiveness of IoT institutional mechanisms also had a significant positive impact on customer repurchase intention (T=3.376, p<0.001), and the interactive item of price perception x the perceived effectiveness of IoT institutional mechanisms had a significant impact on customer repurchase intention (T=3.084, p<0.01), indicating that the perceived effectiveness of IoT institutional mechanisms has a significant moderating effect between price perception and customer repurchase intention.

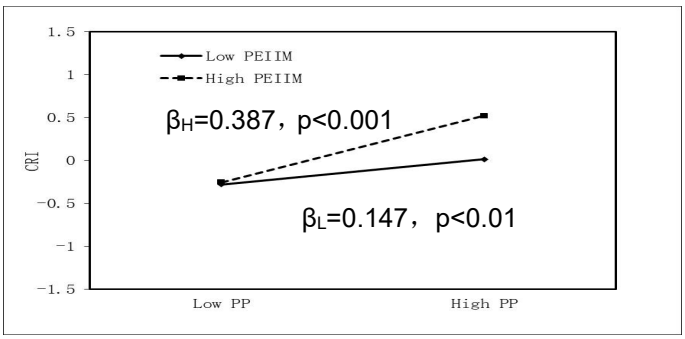
<Table 4-24> The moderating role of PEIIM in PP to CRI

Variable	Model 1			Model 2		
	β	t	VIF	β	t	VIF
Gender	0.023	0.563	1.016	0.042	1.059	1.020
Age	0.016	0.389	1.015	0.028	0.717	1.019
Highest education level	-0.022	-0.52	1.051	-0.022	-0.539	1.061
Monthly income	0.016	0.376	1.053	0.015	0.386	1.055
Home products No.	0.015	0.372	1.006	0.007	0.177	1.008
Smart home products No.	0.019	0.463	1.015	0.043	1.093	1.023
PP				0.267	6.820***	1.011
PEIIM				0.132	3.376**	1.016
PPxPEIIM				0.12	3.084**	1.008
F		0.187			7.736	
R2		0.002			0.105	
ΔR2		0.002			0.103	

*p<0.05; **p<0.01; ***p<0.001

From the moderating line chart below (Figure 4-4), it can be seen that when the perceived effectiveness of IoT institutional mechanisms is at a low level, the positive effect of price perception on customer repurchase intention is 0.147; when the perceived effectiveness of IoT institutional mechanisms is at a high level, price perception has a positive effect on customer repurchase intention at 0.387, which is greater than the low level of the perceived effectiveness of IoT institutional mechanisms. It shows that the perceived effectiveness of IoT institutional mechanisms will increase the positive effect of price perception on customer repurchase intention.

<Figure 4-4> Moderating line chart (PP-CRI)



As shown in the Table 4-25, the independent variable product diversity had a significant positive impact on customer repurchase intention (T=9.620, p<0.001), and the perceived effectiveness of IoT institutional mechanisms had a significant positive impact on customer repurchase intention (T= 2.823, p<0.01), and the interactive item of product diversity x the perceived effectiveness of IoT institutional mechanisms also had a significant impact on customer repurchase intention (T=3.282, p<0.01), indicating that there is a significant moderating effect of the perceived effectiveness of IoT institutional mechanisms between product diversity and customer repurchase intention.

<Table 4-25> The moderating role of PEIIM in PD to CRI

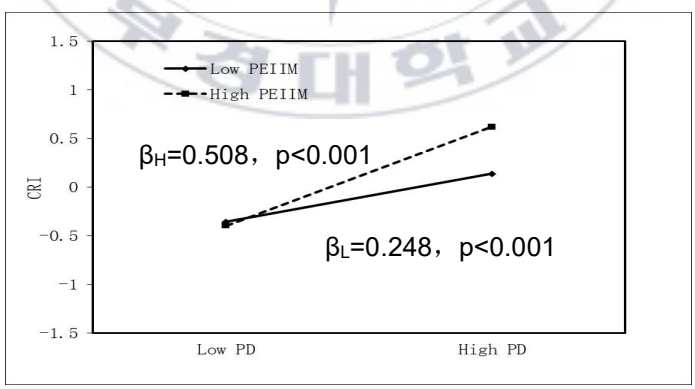
Variable	Model 1			Model 2		
	β	t	VIF	β	t	VIF
Gender	0.023	0.563	1.016	0.036	0.95	1.019
Age	0.016	0.389	1.015	0.019	0.487	1.019
Highest education level	-0.022	-0.52	1.051	-0.022	-0.576	1.064
Monthly income	0.016	0.376	1.053	0.008	0.207	1.055
Home products No.	0.015	0.372	1.006	0.029	0.77	1.008
Smart home products No.	0.019	0.463	1.015	0.02	0.516	1.022

PD		0.378	9.620***	1.084
PEIIM		0.11	2.823**	1.069
PDxPEIIM		0.13	3.282**	1.105
F	0.187		12.195	
R2	0.002		0.156	
ΔR2	0.002		0.154	

*p<0.05; **p<0.01; ***p<0.001

From the moderating line chart below (Figure 4-5), it can be seen that when the perceived effectiveness of IoT institutional mechanisms is at a low level, the positive impact of product diversity on customer repurchase intention is 0.248; when the perceived effectiveness of IoT institutional mechanisms is at a high level, product diversity has a positive effect on customer repurchase intention at 0.508, which is greater than the low level perceived effectiveness of IoT institutional mechanisms. It shows that the perceived effectiveness of IoT institutional mechanisms will increase the positive effect of product diversity on customer repurchase intention.

<Figure 4-5> Moderating line chart (PD-CRI)



As shown in the Table 4-26, the independent variable customer satisfaction had a significant positive impact on customer repurchase intention (T=10.309, p<0.001), and

the perceived effectiveness of IoT institutional mechanisms had a significant positive impact on customer repurchase intention (T= 2.103, p<0.05), and the interactive item of customer satisfaction x the perceived effectiveness of IoT institutional mechanisms also had a significant impact on customer repurchase intention (T=2.483, p<0.05), indicating that the perceived effectiveness of IoT institutional mechanisms has a moderating effect between customer satisfaction and customer repurchase intention.

<Table 4-26> The moderating role of PEIIM in CS to CRI

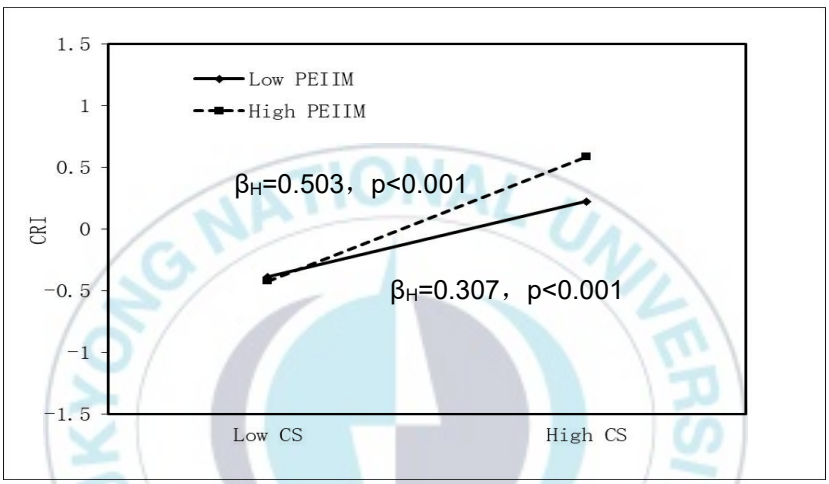
Variable	Model 1			Model 2		
	β	t	VIF	β	t	VIF
Gender	0.023	0.563	1.016	0.017	0.461	1.02
Age	0.016	0.389	1.015	0.012	0.318	1.019
Highest education level	-0.022	-0.52	1.051	-0.019	-0.486	1.07
Monthly income	0.016	0.376	1.053	0.01	0.258	1.055
Home products No.	0.015	0.372	1.006	0.029	0.78	1.008
Smart home products No.	0.019	0.463	1.015	0.023	0.609	1.023
CS				0.405	10.309***	1.101
PEIIM				0.082	2.103*	1.079
CSxPEIIM				0.098	2.483*	1.109
F		0.187			13.6	
R2		0.002			0.171	
ΔR2		0.002			0.169	

*p<0.05; **p<0.01; ***p<0.001

From the moderating line chart below (Figure 4-6), it can be seen that when the perceived effectiveness of IoT institutional mechanisms is at a low level, the positive effect of customer satisfaction on customer repurchase intention is 0.307; when the perceived effectiveness of IoT institutional mechanisms is at a high level, the positive effect of customer satisfaction on customer repurchase intention is 0.503, which is

greater than the low-level perceived effectiveness of IoT institutional mechanisms. It shows that the perceived effectiveness of IoT institutional mechanisms will increase the positive effect of customer satisfaction on customer repurchase intention.

<Figure-4-6> Moderating line chart (CS-CRI)



4.7 Results of data analysis

This paper used SPSS 24.0 and AMOS 24.0 software to analyze the data. First of all, in the part of questionnaire design, the measurement scale of nine variables, namely switching cost, price perception, service effectiveness, domestic brand, foreign industry leader brand, product innovation, product diversity, customer satisfaction and customer repurchase intention were obtained by referring to review literature. Furthermore, the measurement scale of the perceived effectiveness of IoT institutional mechanisms was determined according to expert interviews and a literature review. According to the characteristics and research purposes of smart home products, a preliminary questionnaire was formed. It was distributed through a network

questionnaire. Then, 200 questionnaires were distributed, and 176 valid questionnaires were collected for a pilot study. Reliability analysis and validity analysis of the questionnaire were discussed. Among them, all eight constructs in the questionnaire had a Cronbach's α greater than 0.80. However, the two constructs of service effectiveness and product innovation failed to reach 0.80, because the CITC value of service effectiveness 3 and product innovation 2 were smaller than the others and less than 0.50. The modified Cronbach's α coefficient was larger than the original Cronbach's α coefficient for these two factors, which indicates that the two items are not highly relevant to the other items and needed to be deleted in order to improve the final Cronbach's α coefficient. Considering the two questions again, it was found that service effectiveness 3 and product innovation 2 have a small range of issues. Considering the potential confusion about the subject of this paper that might occur, the author deleted service effectiveness 3 and product innovation 2. There was a second reliability analysis after deleting these two questions. The result was that ten constructs of the Cronbach's α coefficient were greater than 0.80. It indicated that the revised questionnaire was reliable. This paper used exploratory factor analysis to study the revised questionnaire in the pilot study. The KMO test and Bartlett's Test of Sphericity were determined and met the requirements, it indicates that the data suitable for exploratory factor analysis. Next, 176 questionnaires were analyzed by exploratory factor analysis. Principal component analysis was used to extract the number of factors with an eigenvalue greater than 1, ten common independent factors were extracted. In addition, it was shows that each measurement item is well included

in the respective factors after using the rotation analysis method. The reliability and validity of the pilot study were determined to correct the questionnaire. The overall reliability and validity of the final questionnaire were improved. Secondly, 602 formal questionnaires were discussed. In descriptive statistical analysis, it mainly determined the proportion of basic population data such as gender and age, thus indicating that the questionnaire data is valid and reliable; furthermore, with regard to highest education level, diploma or undergraduate and master's degree are the main force for purchasing smart home products. The problem of the population of doctors is relatively small, and it also accounts for a small share in statistics. According to statistics, it can be considered that consumers who buy smart home products generally have higher education level. Regarding the item of monthly income, a monthly income of $701-$1900 is the main purchasing force of smart home products. This is trustworthy, because the prices of smart home products are generally high and need to have a certain economic foundation. The number of home products accounted for a large proportion; also, more than five smart home products is the majority, which proves that the current penetration rate of smart home products is relatively high and the market prospects are relatively good. By analyzing the data form of the sample, it was determined that the data form belongs to the normal distribution, and structural equation model analysis could be carried out.

After completing the descriptive statistical analysis, this paper conducted another reliability and validity analysis of the formal questionnaire. In the reliability analysis, the Cronbach's α coefficients of all constructs were greater than 0.80, which proves

that the questionnaire has reliability; in the validity analysis in this paper, the author first conducted a content validity analysis by asking experts or professors to ensure that the content of the questionnaire is well structured; second, the paper adopted confirmatory factor analysis to conduct convergent validity and discriminant validity analysis, respectively. It proved that the questionnaire has good aggregation and discrimination validity, and the review confirmed that the questionnaire is rigorous and well structured.

In the structural equation model analysis, this paper used AMOS24.0 software to create the path of the model. Then AMOS 24.0 software was used to perform a fitting analysis on the model. The fitting results showed that the comprehensive absolute fitting index, value-added fitting index and parsimonious fitting index are all up to the standard. It can be seen that the structural equation model and data in this paper are at a perfect level, and the external quality of the model is perfect. Model path testing can be performed. In addition, in the AMOS 24.0 software, each path was analyzed through the P value to test whether the model hypothesis had reached statistical significance. The results show that in the initial model, the P value of foreign industry leader brand to customer satisfaction was 0.94, which is greater than 0.05. This hypothesis did not pass, indicating that foreign industry leader brand has no positive impact on customer satisfaction. The P value of product innovation on customer satisfaction was 0.404, which is greater than 0.05, so this hypothesis did not pass, indicating that product innovation fails to have a positive significant impact on customer satisfaction. Therefore, the model needed to be adjusted. Based on the

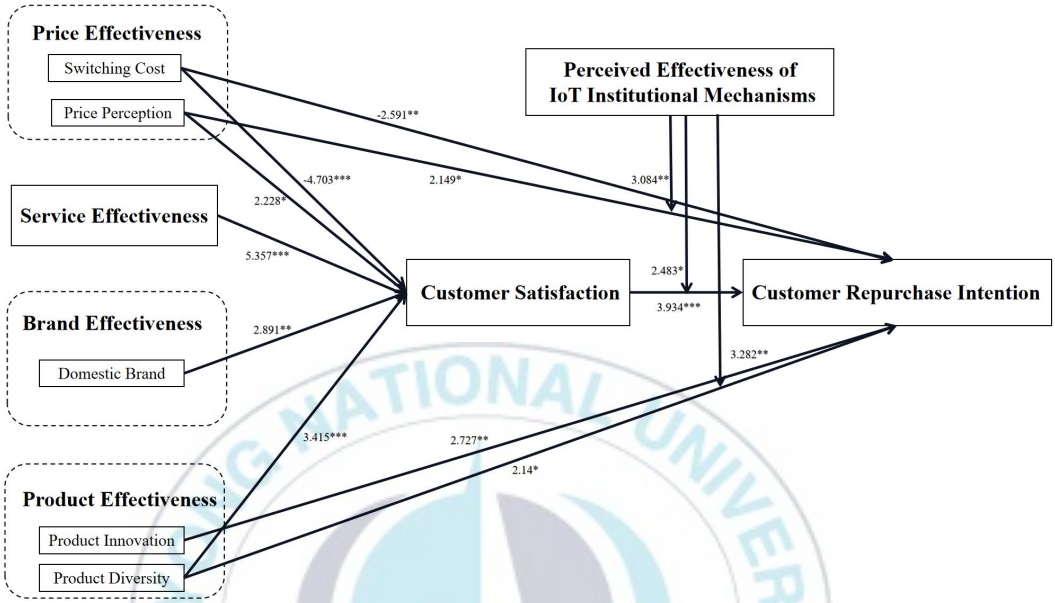
hypothetical results, the author revised the model. After deleting the failed hypothetical path, a second fitting analysis and T value test were performed. The results show that the revised fitting coefficients were improved, in addition, the revised model path passed all hypotheses. Furthermore, the mediating role of customer satisfaction was tested by using bootstrap. The five mediation paths are all significant, because with 95% confidence, zero is not within this interval. SPSS 24.0 was used to analyze the moderating effect of the moderating variables. There are five moderating hypotheses about the perceived effectiveness of IoT institutional mechanisms (PEIIM). Among them, the perceived effectiveness of IoT institutional mechanisms has no moderating effect between switching cost and product innovation on customer repurchase intention. Fortunately, the perceived effectiveness of IoT institutional mechanisms has a positive moderating effect on price perception, product diversity and customer satisfaction on customer repurchase intention. Based on the above analysis, the final hypotheses were determined as shown in the Table 4-27.

<Table 4-27> Final hypotheses results

Hypothesis	Hypothesis content	Test results
H1a	Price effectiveness (switching cost) has a significant negative effect on customer satisfaction	Support
H1b	Price effectiveness (price perception) has a significant positive effect on customer satisfaction	Support
H2	Service effectiveness has a significant positive effect on customer satisfaction	Support
H3a	Brand effectiveness (domestic brand) has a significant positive effect on customer satisfaction	Support
H3b	Brand effectiveness (foreign industry leader brand) has a significant positive effect on customer satisfaction	No support

H4a	Product effectiveness (product innovation) has a significant positive effect on customer satisfaction	No support
H4b	Product effectiveness (product diversity) has a significant positive effect on customer satisfaction	Support
H5	Customer satisfaction has a significant positive effect on customer repurchase intention	Support
H6a	Price effectiveness (switching cost) has a significant negative effect on customer repurchase intention	Support
H6b	Price effectiveness (price perception) has a significant positive effect on customer repurchase intention	Support
H7a	Product effectiveness (product innovation) has a significant positive effect on customer repurchase intention	Support
H7b	Product effectiveness (product diversity) has a significant positive effect on customer repurchase intention	Support
H8a	The perceived effectiveness of IoT institutional mechanisms positively moderates the relationship between price effectiveness (switching cost) and customer repurchase intention	No support
H8b	The perceived effectiveness of IoT institutional mechanisms positively moderates the relationship between price effectiveness (price perception) and customer repurchase intention	Support
H9a	The perceived effectiveness of IoT institutional mechanisms positively moderates the relationship between product effectiveness (product innovation) and customer repurchase intention	No support
H9b	The perceived effectiveness of IoT institutional mechanisms positively moderates the relationship between product effectiveness (product diversity) and customer repurchase intention	Support
H10	The perceived effectiveness of IoT institutional mechanisms positively moderates the relationship between customer satisfaction and customer repurchase intention	Support

<Figure 4-7> Final model



Ⅴ. Conclusion

5.1 Summary

Based on a previous related literature analysis, this paper took customers who have purchased smart home products as the survey object, and the paper focused on the moderating role of the perceived effectiveness of IoT institutional mechanisms (PEIIM). In addition, this paper studied the influence of customer satisfaction on the customer repurchase intention with four antecedent factors: price effectiveness, service effectiveness, brand effectiveness, and product effectiveness. It put forward ten research hypotheses, with relevant and reliable data from a questionnaire survey obtained to test them. After the final questionnaire was formed, it was distributed to obtain the survey data. A total of 602 valid questionnaires were received. The data in the questionnaire were sorted out, and the hypotheses in the paper were tested by descriptive statistical analysis, reliability and validity analysis, SEM analysis, mediating analysis and moderating analysis step by step.

According to this paper's analysis, a certain penetration rate of smart home products is positive. People are willing to accept smart home products based on their economic conditions. Due to the modern lifestyle, it is believed that smart home products are time efficient by both single parents and two-parent families. In addition, three family members and above think that smart home products are convenient. This is consistent with the results of acceptance studies on smart homes conducted by Kim et al. (2017). Through data analysis, highly educated and well-paid customers were

found to be the main purchasing power of smart home products. Shin et al. (2018) studied the influence of the relationship between attitude and intention, and it was found that education level reduces the impact of attitudes on intentions. However, Baudier et al. (2020) found that educational effects did not mitigate the intention to use smart home products. As with Baudier and other scholars, this paper argues that those with higher education level are more likely to repurchase smart home products, because customers who are highly educated may have more information and can effectively identify or perceive the development of IoT institutional mechanisms, as well as believe in the reliability of smart home products. Also, high-income consumers have the higher buying power to be the majority that requires a certain economic base. In this paper, consumers aged 25-45 are the majority. This group of consumers is thought to have some economic power and acceptance of new technologies. Consistent with a study by Kim et al. (2017) that suggested consumers over the age of 30 account for the major purchasing power of smart home products, it is considered that this group has the ability to make major decisions for the family. Pattinson et al. (2015) found that older users had better information security behaviors. These findings suggest that the impact of age is not specific to the use of IoT products and is more widely involved in information security. From this point of view, the IoT institutional mechanisms for smart home products need to consider security more in the future. Fortunately, the development of blockchain technology can optimize and enhance the security institutional mechanisms of the IoT (Ma, 2020).

By 2025, the global IoT market will reach $1.56 trillion. One of the most popular

IoT services is smart home products, with ICT to achieve interoperability of household products (Peine, 2008). Big IT companies worldwide, such as Google, Amazon, Apple and Samsung, are active in the smart home market (Dean, 2017). Moreover, the smart product companies such as LG and HUAWEI, XIAOMI and other enterprises also occupy a large share of the market because the companies have a diverse range of products. Other participants, such as telecommunications service providers, have also expressed interest in the smart home product market. For example, in Korea, service providers have launched the smart home services IoT @home and Giga IoT Home, and they bundle and sell a variety of smart home products to customers such as smart plugs, gas locks and monthly communications services (Hong et al., 2020). Many studies have discussed the adoption of IoT technology by consumers in the past. Therefore, analyzing the moderating role of perceived effectiveness of IoT institutional mechanisms (PEIIM) is essential; furthermore, it is reasonable to believe that the market prospects of smart home products are worthy of discussion in the aspect of price, service, brand and product, with influencing factors on repurchase intention of smart home products via the mediating effect of customer satisfaction.

5.2 Theoretical contributions

This paper analyzed the influencing factors of consumer repurchase intention on smart home products by focusing on the moderating role of the perceived effectiveness of IoT institutional mechanisms (PEIIM). By establishing PEIIM as a key moderator of the relationship between customer satisfaction and customer repurchase intention, this paper advances existing IoT institutional mechanism

research on the effect of customer repurchase intention. Furthermore, it found that institutional mechanisms remain important in smart home products repurchase intention by examining how the experience-based evaluation of the past purchase process such as through customer satisfaction is strengthened by PEIIM. Moreover, this paper provided empirical evidence based on the sample in the smart home product repurchase context. The finding adds to the understanding of IoT institutional mechanisms by defining the construct PEIIM and in terms of its articulated focus on general perception and risk mitigation. This paper's examination of its role in relationships involving smart home product customer satisfaction, price effectiveness, product effectiveness and smart home product customer repurchase intention reveals several important research findings.

First and foremost, this paper confirms that PEIIM positively moderates the relationship between customer satisfaction and customer repurchase intention. It shows that the positive effect of smart home product customer satisfaction in smart home product customer repurchase intention is stronger when PEIIM is higher. People may be more likely to apply their past positive experiences with smart home products to form their expectations of a brand's future function if there are higher perceived effective institutional mechanisms in place (Oliver, 1999; Fang et al., 2014). This result adds to the smart home product literature by identifying an important effect for the relationship between customer satisfaction and customer repurchase intention. This finding is an important contribution to the scholarly understanding of how satisfaction is evaluated in existing smart home product repurchase relationships. Generally

speaking, positive performance of prior trade would enhance the customer's perceptions of the enterprise (Mayer et al., 1995; Fang et al., 2014), and in particular, customers satisfied with prior purchase processes with an enterprise will be more likely to trust and repurchase it (Kim et al., 2004; Ribbink et al., 2004). This paper addresses this theory in the smart home product literature by theorizing and empirically verifying the important role of the IoT institutional infrastructure in affecting experience-based evaluations of the past purchase process (customer satisfaction) in repurchase intention.

Furthermore, when the effect of switching cost and price perception on smart home product customer repurchase intention was considered, this paper found that PEIIM had no moderate effect on the relationship between switching cost and customer repurchase intention. With this new insight, the result of this paper provides a plausible explanation for the finding that switching cost should be redetermined, although it is still an important effect on customer retention in some studies (Lee et al., 2001; Colgate & Lang, 2001; Kim & Kankanhalli, 2009). Compared with the switching cost, the result of this paper shows that PEIIM positively moderates the relationship between price perception and customer repurchase intention. It suggests that people are aware of the time savings and simple operation of a smart home product even the price is expensive, and are positive about it (Ram & Sheth, 1989; Yang et al., 2017). Taking these two key findings together, this paper reveals an interesting paradoxical effect of IoT institutional mechanisms on the importance and evaluation of price effectiveness in smart home product customer repurchase intention.

On the one hand, a positive (high level) perception of IoT institutional mechanisms can encourage people to repurchase a smart home product even if they are expensive, while on the other hand, it diminishes the importance of switching cost in repurchase intention situations. This paradoxical result helps reveal the conditions in which price effectiveness in an enterprise can be qualified as a source of genuine competitive advantage in the smart home product context.

Furthermore, when the effect of product innovation and product diversity on smart home product customer repurchase intention was considered, the finding in this paper suggested that PEIIM has no moderate effect on the relationship between product innovation and customer repurchase intention. This is because people take time to adapt to an innovative smart home product function (Hong et al., 2020; Han et al., 2021). Fortunately, PEIIM positively moderates the relationship between product diversity and customer repurchase intention. It is claimed that the IoT and product diversity exist together because the technology needs various products and diverse combinations of products need IoT technology to connect them. According to above findings, this paper found that IoT institutional mechanisms had an effect on the importance and evaluation of product effectiveness in smart home product customer repurchase intention. It shows that a positive (high level) perception of IoT institutional mechanisms can enhance the effectiveness of product diversity and fully demonstrate the advantages of product diversity.

Numerous studies have discussed customer satisfaction's mediating effects on customer repurchase intention, with few studies recognizing that different sources of

customer satisfaction could complement each other. This paper analyzed the antecedents of customer satisfaction and studied the influence of these factors on customer repurchase intention through the mediating effect of customer satisfaction. The results are as follows:

When the effect of customer satisfaction on repurchase intention was considered, this paper concluded that customer satisfaction has a significant positive impact on consumer repurchase intention. It was shown that customer satisfaction is important. By doing that, the analysis concluded that a customer's perception of prices and services, domestic brands and product diversity have a positive impact on repurchase intentions through customer satisfaction. It is believed that when the customer is satisfied after using a product or service, it positively affects the customer's continuous repurchase intentions. This is not limited to the smart home product industry, but also applies to almost all industries. The main purpose of customer satisfaction management is to strengthen the factors of customer satisfaction, and eliminate or weaken the factors that make customers dissatisfied. The purpose is to promote consumer repurchase intentions (Cardozo, 1965; Oliver, 1999).

This paper measured price effectiveness on switching cost and price perception. The result of this paper shows that high switching costs reduce customer satisfaction, leading to a low repurchase intention because the incompatibility of mobile phones and products cause customers to consider configuration issues before selecting smart home products. Switching operating software reduces use efficiency. The analysis of price perception factors in this paper shows that they have a positive impact on

customer satisfaction and thus on customer repurchase intention. Research by Hong et al. (2020) pointed out that maintenance and installation costs become a burden for consumers to use smart home products. However, with the development of the economy and technology, people have a more fixed income, and they are aware that the time savings and simple operation of a smart home product does not come with low price, and are positive about it; most people affirm the quality of IoT technology and smart home products.

The effect of service effectiveness on customer satisfaction was considered. Based on this paper, service effectiveness can improve smart home product customer satisfaction and affect repurchase intention. A large number of studies showed that service affects customer satisfaction. Liu and Lee (2016) believed that consumer repurchase intentions is combined with their perception of service. This paper's results were the same as those studies.

This paper analyzed the influence of domestic brands and foreign industry leader brands on customer satisfaction and repurchase intention of smart home products. The results showed that domestic brands have a positive impact on customer satisfaction with smart home products. Wang and Chen (2004) studied the positive effects of consumer ethnocentrism on consumers' domestic purchase preferences. Cultural identity and consumer ethnocentrism have different concerns and feelings for domestic and foreign brands (He & Wang, 2015). According to their study, consumer recognition of their own country will help develop local brands in the domestic market. The hypothesis on customer satisfaction with foreign industry leader brands for smart

home products did not pass because customers have certain concerns about the domestic operation of foreign brands.

Product innovation has always been considered important for high-tech products. In this paper, the hypothesis that product innovation had a positive impact of on customer satisfaction with smart home products did not pass. This paper argued that the possible reason is that there is no universal standard for consumers' understanding of innovation, instead of a gradual innovation model. The failure to have updated technological stimuli is an important reason why consumers fail to perceive the product innovation mechanism effectively (Szymanski et al., 2007). Apart from that, product diversity was also discussed in this paper. Companies are more inclined to provide more choices for consumers (Broniarczyk et al., 1998). It is believed that product diversity is important for smart home product companies, because smart home products need connectivity to operate. With the development of IoT institutional mechanisms and mobile phone operating system technology, controlling one device with the same software has been improved.

To sum up, this paper also makes an empirical contribution. McKnight et al. (1998) claimed that the effect of institutional mechanisms on intention and behavior would not hold in the existing trade process (Fang et al., 2014), for instance smart home product repurchase, because the first-hand information accumulated through past trade experiences with the enterprise would mask the impact of institutional mechanism factors. However, according to the data analysis of this paper, it was found that there is a significant relationship between customer satisfaction, price perception,

product diversity and customer repurchase intention via the moderating impact of PEIIM. This empirical result provides a new point of view on research of institutional mechanisms. Furthermore, this paper validates the research on the mediating effect of satisfaction through empirical analysis, and affirms the positively significant impact of customer satisfaction on customer repurchase intention. Moreover, this paper analyzed the antecedents of customer satisfaction with smart home products through empirical data, and the results make an important theoretical contribution to the smart home product satisfaction management of specific customer segments. In essence, the findings in this paper add to the existing literature by demonstrating that a technology-based satisfaction lever (PEIIM) and a process-based satisfaction lever (customer satisfaction) can interact to produce an additional influence on customers' intentions to repurchase smart home products.

5.3 Practical contributions

Smart home products are an important part of the consumer IoT market (Li et al., 2018). Because of connectivity, maneuverability and security under IoT institutional mechanisms, IoT is widely used in the smart home product industry. Smart home products in the past were designed to be personified. The mode of operation prescribed kept smart home products inflexible according to their external factors, so that the traditional ones could no longer meet people's needs. Thanks to the particularity of the IoT, new smart home products have connectivity between things. Therefore, users can control smart home products safely and effectively with

smartphones or computers. With the development of IoT institutional mechanisms, the smart home industry has also been expanded (Yang et al., 2017).

The innovation in this paper is that it took the perceived effectiveness of IoT institutional mechanisms (PEIIM) as a regulating variable to study the moderating impact of customer repurchase intention. Although the focus of this paper, IoT institutional mechanisms, is not new to the institutional mechanism literature, prior related research has only examined the role of institutional mechanisms in the context of initial purchase (McKnight et al., 2002; Pavlou & Gefen, 2004). Relevant studies in the context of repurchase intention are rare since institutional mechanisms, as a second-hand source of the purchase process, are not presumed to be relevant when customers obtain first-hand information about products (McKnight et al., 1998; Fang et al., 2014). This paper examined its role in relationships involving customer satisfaction, price effectiveness, product effectiveness and customer repurchase intention and revealed several important research findings. First of all, it affirmed the completeness of IoT institutional mechanisms, proposed in 2018 as the world's first "Common Criteria" that conforms to the international information security standard institution. This regulation covers the communication, device and control safety requirements of the IoT smart home products. It means that smart home products "have laws to follow" in the field of information security. The connectivity, real-time operability and security of IoT technology are used as the measurement factors to measure the perceived effectiveness of IoT institutional mechanisms. With the development of 5G, the connection mechanism and real-time operation mechanism of

the IoT will be improved, and problems such as connection timeout or connection failure of smart home products that people are worried about will be solved. It belongs to the IoT network mechanism the smart home product itself is expected to establish, and a more efficient and stable connection system institutional mechanism will exist. To be specific, connectivity and real-time operability are proposed and discussed as the basic characteristics of the IoT institutional mechanisms. For security, in a study by Kim et al. (2017), personal privacy was raised. The study thought that IoT technology needed to be connected by fixed terminals in the short term and faced the risk of hacking or changing terminals at any time. In this paper, the security of the IoT was determined. With the development of blockchain and other technologies, the security and authenticity of information are expected to be solved. In addition, with the improvement of software system technology, the traditional one-terminal control of all smart home product models has been slowly changed to multiple software combination control, and fixed terminal problems have accordingly been alleviated. Security is discussed in the perceived effectiveness of the IoT institutional mechanisms because as the technology matures, it is hoped to verify that people believe more in applying this technology.

First of all, this paper studied the switching cost affecting customer satisfaction and then affecting customer repurchase intention. The conclusion is that the higher the switching cost, the lower the customer repurchase intention. Second, this paper introduced the perceived effectiveness of IoT institutional mechanisms as a moderating variable try to reduce the negative impact of the switching cost on the

customer's repurchase intention through the security, operability and connectivity of the IoT institutional mechanisms. However, the final results show that the moderating hypothesis is not pass. It is more certain that high switching costs have an impact on the customer repurchase intention. In the future, smart home product companies need to pay more attention to compatibility design to avoid high switching costs and losing customers. Third, the perceived effectiveness of IoT institutional mechanisms also does not moderate product innovation and customer repurchase intention. The author believes that, as mentioned earlier, product innovation has no positive effect on customer satisfaction. This shows that the consumer's innovation perception of smart home products is not obvious. The smart features used by users tend to add convenience to their lives. Users agree that the function of smart home products is very valuable from the point of view of security and convenience. However, consumers say it takes time to adapt to an innovative smart home product function. They require products that are easily accessible and routinely operated. The lack of sufficient use instructions for innovative smart home products leads to low use and unsatisfactory user feedback. In other words, the satisfaction obtained through smart innovation is not successfully passed on to the end user (Hong et al., 2020). Combined with two hypotheses, product innovation is not effectively perceived by consumers, and smart home product enterprises need to provide more obvious performance improvement between new and old products and with the latest technology.

In the moderating hypothesis of price perception and customer repurchase intention, the perceived effectiveness of IoT institutional mechanisms can adjust the

price to improve customer repurchase intention, which is worth discussing. At present, although the pricing of smart home products is high due to their wide connectivity, real-time operability and mature security, customers think that IoT institutional mechanisms are worth the money. Similarly, the moderating relationship between product diversity and customer repurchase intention is established. Because product diversity needs more stable IoT institutional mechanisms to support it, with the expansion of the product chain, the requirements of IoT institutional mechanisms become higher, and the affirmed IoT institutional mechanisms can effectively improve the customers' intentions to repurchase smart home products. Finally, the moderating role between customer satisfaction and customer repurchase intention is also true. Satisfaction is an important factor in repurchase intention (Oliver, 1999), which is also analyzed by different models in many pieces of literature. With the use of the perceived effectiveness of IoT institutional mechanisms, this paper attempts to improve the impact of customer satisfaction with smart home products on customer repurchase intention. The results show that the IoT institutional mechanisms are the key factors to improve customer repurchase intention.

Furthermore, according to the analysis of the mediating impact of customer satisfaction between the four antecedents and customer repurchase intention, some practical contributions will be discussed.

1): The cost of technology and product performance caused a high-level price in smart home products; research by Hong et al. (2020) suggests that the price is a major barrier for consumers to adopt smart home products. A questionnaire completed by

800 respondents found that 58 percent of people think smart home products are expensive in the USA (Hong et al., 2020). Furthermore, it is widely believed that switching cost consists of learning time and the energy spent to convert a product or service from one brand to another. A relatively famous example of switching costs is Apple's Mac system and Samsung's or other phones' Android system for smart products. Because people are familiar with the operation of a system, the sum of the switching cost requires such effort to adapt to a new system. Some users may complain about the existence of switching costs. Thus, for smart home products, it is necessary to clarify the relationship between switching cost and customer repurchase intention. The finding in this paper showed that high switching costs reduce customer satisfaction, leading to low customer repurchase intention. Uncertainties arising from the application purchase cost, accessory purchase costs and the increased likelihood of additional post-transition payments, and switching costs from changing operating software also increase (Minarti & Segoro, 2014). Therefore, there is a switching cost of connecting to mobile phone operating software under the same brand for smart home products. The switching cost of the same brand software operation will greatly affect the purchase decision of various products with the mobile operating system. This paper showed that customers do not want to have high switching costs. Consistent with Lee et al. (2001), there are many switching costs in the Korean mobile market, which leads to consumers being bound by their service providers. Consumer users prefer a convenient experience by using smart home products. Controls or switches in complex software result in lower user satisfaction (Han et al., 2021).

Analysis of price perception factors in this paper showed a positive impact on customer satisfaction and thus on customer repurchase intention. Ram and Sheth (1989) believed that the higher the cost of innovation, the higher the perceived economic risk. However, the group studied in this paper is based on the group of customers who have purchased smart home products, and who are aware of the initial price perception risk. So as far as the repurchase intention of smart home products is concerned, more value for smart home products will be repeated by making customers feel satisfied.

2): Services have been given much attention by the IoT industry. The emergence of smart home products was initially designed to provide convenient living services for the elderly or the disabled-experts and businesses concerns about whether the IoT institutional mechanism can connect smart home products well. However, consumers pay more attention to the simple use of smart home products. In a study by Demiris et al. (2004) estimating people's attitudes toward smart home technology through focus group interviews, the results showed that customers are worried about the lack of professional training services. Han et al. (2021) concluded a study that said Korean female customers prefer those smart home products that are simple to operate. In this paper, the service effectiveness of smart home products can improve customer satisfaction and affect customer repurchase intention. The convenience mechanism of services provided by smart home products companies, including pre-sale services, distribution services and maintenance services, is important; also, the professional mechanism of services is equally vital, including the connectivity and operability

mechanisms of the services that are required professionally and easily. This suggests that smart home product companies need to develop and design products considering the professionalism and convenience of operating services. Furthermore, specialized training services should be provided in the sales process. This increases customer satisfaction and encourages repurchase intention of smart home products.

3): This paper analyzed the influence of domestic brands and foreign industry leader brands on customer satisfaction and repurchase intention of smart home products. Governments worldwide are working to develop national institutional smart home product standards, preparing for the advent of the IoT. Google and Apple are working with appliance companies to launch smart home products, China's HUAWEI and XIAOMI are committed to developing their smart home product systems. Samsung Electronics, LG Electronics, SK Telecommunications, KT and others have occupied the dominant position in the development track of smart home systems. This paper shows that domestic brands have a positive impact on customer satisfaction with smart home products. Due to its network connectivity mechanism, smart home products need support from the network and mobile operators. Additionally, countries are different in their network institutional development. For everyday appliances, stable networks mechanisms and communications are needed, which is also another major reason for consumer satisfaction with domestic brands. The hypothesis on customer satisfaction with foreign industry leader brands for smart home products did not pass because different countries have different styles of plugs and wall outlets. Therefore, the need for additional equipment to recharge smart home products will

reduce customer satisfaction. In addition, language and other problems exist. Currently, many smart home products have a voice assistant, and in identifying the language system mechanism, consumers may prefer to choose the original language mechanism as the first language. This is a problem worth thinking about for the international development of smart home product enterprises. How to solve the compatibility mechanism of language and charging configuration devices is critical.

4): In this paper, it was concluded that the hypothesis of the positive impact of product innovation on customer satisfaction with smart home products did not pass. This paper believes that smart home products are in a stable innovation period after a stage of rapid innovation. The failure to have updated technological stimuli is an important reason why consumers fail to perceive product innovation mechanism effectively (Szymanski et al., 2007). For instance, XIAOMI launched updated smart home camera products in which only in the pixel function had a certain improvement and other performance remained the same. The hypothesis that product diversity has a positive impact on customer satisfaction with smart home products passed. Consumers are more willing to download one software to control multiple smart home products under the same brand, which is much more convenient than before. XIAOMI's strategy is to build systemic chain products and develop simpler and more convenient software to control them.

To sum up, this paper discussed price, service, brand and product through the impact of smart home product customer satisfaction to improve customer repurchase intention: higher switching costs reduce customer satisfaction and their repurchase

intention. Even though the perceived effectiveness of IoT institutional mechanisms to reduce the role of switching costs on customer repurchase intention has not been successful. Kim and Kankanhalli (2009) tested a model in the new enterprise system implementation environment by integrating the current situation deviation theory, TAM and fair implementation model, and found that the switching cost increases user resistance. Therefore, this paper believes that smart home product enterprises need to avoid fixed operating systems or programs to keep away from high switching costs. Even if the customer has purchased a product, there is no guarantee of continuing the repurchase behavior. Smart home product companies have realized this, and the development of more and more compatibility systems and software has solved this problem from the original need to determine the smart home product brand before building the gateway scheme to modified mobile phone software controlling fixed home equipment, such as safety doors, windows and lighting switches. This is a good way to reduce switching costs. Price perception is considered an effective influencing factor in improving the intention of repurchase of smart home products. People are increasingly affirming the price of smart home products. In addition, through the development of IoT institutional mechanisms, people are more willing to spend more money on smart home products because they can save time and facilitate their lives. Services are considered important, and smart home products need to provide simple and convenient services. Complex services should provide tutorial services. Compare with foreign industry leader brands, most consumers prefer domestic brands because of the network connectivity of smart home products and stable network operation.

Inconsistent international plug-in sockets are also seen as obstacles. Product innovation fail to have an effective impact on the repurchase intention of smart home product customers, even though the perceived effectiveness of IoT institutional mechanisms cannot be improved. Therefore, for different smart home product enterprises, suggestions for R&D innovation are different. Large leading enterprises such as LG, Google, and HUAWEI should invest many R&D funds, create innovative products to improve consumer perception of them, and quickly occupy market share. For small and medium-sized enterprises, this result is worth thinking about when they invest in R&D, because the current smart home product innovation perception is not effectively identified, and it is likely to be beneficial to them to follow the strategy because the degree of innovation needs to be perceived, which will cost more. However, product diversity has proved to be effective in influencing the repurchase intention of smart home product customers. As mentioned earlier, XIAOMI is adopting a product diversity strategy and developing a software control system for all products under one brand. For smart home product enterprises, product diversity development needs to simultaneously complete a convenient operating system. The perceived effectiveness of IoT institutional mechanisms also improves the impact of product diversity on customer repurchase intention of smart home products. IoT technology and product diversity exist together because the technology needs various products, and diverse combinations of products need IoT technology to connect them. Like other ordinary consumer goods markets, the smart home product market will affect the customer's repurchase intention under the connectivity, operability and

security system of IoT technology. Customers with satisfaction are tend to repurchase more.

According to above analysis, smart home product companies should realize that switching costs will negatively affect customer repurchase intention. Even if this paper hopes to adjust it through PEIIM, it still has not succeeded. Therefore, companies should take corresponding measures to reduce switching costs, such as developing compatible products. In addition, this paper shows that customers affirm that the IoT institutional mechanisms can reduce privacy risks, and the connectivity mechanism of smart home products can encourage repurchase intentions even when the price is expensive. Therefore, smart home product companies should invest in promotion of IoT institutional mechanisms. The finding suggests that IoT institutional mechanisms can improve the effect of smart home product diversity on customer repurchase intention, and establishing an enterprise's product diversity is the optimal competitive strategy. The effect of customer satisfaction on repurchase intention becomes stronger when PEIIM is higher. This moderating effect implies that satisfaction can be a more important source of trust production under the condition of high PEIIM. In other words, people will affirm their past positive experiences with smart home products to determine the smart home products' future function if there is a high level of PEIIM. In conclusion, this paper has managerial implications for both smart home product enterprises and public policy makers. First, for policy makers such as the IoT Technology Association and International Information Technology Standards Organization and large-scale smart home product companies, the establishment of

sound IoT institutional mechanisms will be of great significance to the development of the smart home product industry. Second, it is especially important for smart home product enterprises to focus on building satisfaction with customers, and they need to focus on strategically allocating their resources on increasing satisfaction according to the level of existing IoT institutional mechanisms (e.g., real-time monitoring, remote operation, security protection, etc.). Third, smart home products may save maintenance costs by strategically targeting a segment of customers who perceive themselves as residing in a relatively institutional IoT environment. In this environment, building satisfaction with smart home product customers is especially important.

5.4 Limitations and future research

This paper studied the influencing factors of repurchase intention of smart home products by empirical analysis. It provides some achievements for research on the consumer behavior of smart home products. However, there are still some limitations.

1): In this paper, the questionnaire survey was conducted. First, the recall method was be used when the respondents answer the questionnaire, maybe induce memory recall bias. Furthermore, most of the respondents were in China and Korea, a small part of the samples comes from the United Kingdom and the United States. Because the questionnaire is collected by the “snowball” method of personal relationships, a large number of samples come from Chinese and people who close to Chinese. Thus, the sample data has some limitations;

2): Although this paper is based on a mature scale, according to the perceived effectiveness of IoT institutional mechanisms, the specific characteristics of it were obtained by interviews with industry experts. Therefore, it is hoped to make the dimension more rigorous in future studies. For instance, energy-saving mechanisms should be discussed;

3): This paper only discusses the impact of prices, services, products and brands on consumer repurchase intention and on influencing consumer satisfaction. However, consumer trust is equally important for consumer behavior, but was not considered; in addition, more objective measures such as repurchase behavior might be used as additional dependent variables to improve the predictability of the model.

4): From the perspective of marketing, this paper should research a wider range of lifestyles and ages.

In future research, the alternative methods should be considered, such as experiments. Furthermore, the sample range should be expanded and focus on analyzing attitudes about smart home products in different countries; because the different countries have different lifestyles. Smart home products, as auxiliary equipment for people's lives, need to be adjusted according to the family structure and lifestyle. Korea has a great deal of consumer behavior research on smart home products regarding lifestyle, gender and age. Thus, future research also needs to pay attention to the impact of population factors. Moreover, the application of IoT technology to smart home products needs to be continuously discussed. At present, many smart home products studies focus on attracting users through displays of

high-end technology, rather than providing guidance for users to correctly adapt for a sustainable, intelligent life. This paper shows that the benefits of intelligent technology are not effectively provided to consumers due to the lack of a correct perception of product innovation. Therefore, it is necessary to provide more learning studies about technology. Finally, with the development of artificial intelligence and blockchain technology, the operation and safety of smart home products should be continued.

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Appendix

MS / MR:

Hello! Thank you for being so generous with your time to complete this survey! I am a doctoral student at PUKYONG NATIONAL UNIVERSITY of Korea. I am researching the factors affecting the customers' intentions to repurchase smart home products under Internet of things institutional mechanisms. The survey object is customers using smart home products, and the survey is entirely anonymous and confidential. The data collected will only be used for academic research and will not be used commercially. There are no right or wrong answers. Please answer the questions according to your situation. (For research purposes, smart home products were defined as all home electronic devices that use the IoT for management, monitoring and control, such as TVs, air conditioners and electric lights, and all other devices that can be used in the house, such as waterworks, door locks, electricity, heating devices, windows, cameras and so on.)

Basic information

1. What is your gender?

Male ☐ Female ☐

2. What is your age?

Under 25 ☐ 26-35 ☐ 36-45 ☐ Over 46 ☐

3. What is your highest education level?

High school and below ☐ Diploma or undergraduate ☐

Master's ☐ Doctor or above ☐

4. What is your monthly income?

$100-$700 ☐ $701-$1300 ☐ $1301-$1900 ☐ Over $1901 ☐

5. The number of home appliance products in your home (including smart and non-smart home products)

One or none □ 2-5 □ 6-10 □ Over 11 □

6. The number of smart home products in your home

One or none □ 2-5 □ 6-10 □ Over 11 □

The first part: the price effectiveness of the smart home product enterprises you choose

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Sources	Questions
Switching cost	Items adapted and modified from Ping (2003) Kim et al. (2004) Chen (2019)	The cost of renewal or interconnection between smart home products of the same brand is important (vertical switching cost)
		The cost of taking a lot of time and effort to switch to another smart home product providers is important. (horizontal switching cost)
		The cost of learning a new service between different brands of the same home products is important. (horizontal switching cost)

Factors	Sources	Questions
Price perception	Items adapted and modified from Petrick (2002) Yasri et al. (2020)	You can afford the cost of smart home products
		You can afford the cost of use fees for smart home products if you think the price is reasonable
		You think that buying smart home products is worth the money
		Generally speaking, the quality of smart home products is high

The second part: the service effectiveness of the smart home product enterprises you choose.

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Sources	Questions
Service effectiveness	Items adapted and modified from Li et al. (2021)	You think the services provided to you by the smart home products currently selected are easy to use, accessible, and user-friendly
		You think the smart home products currently selected can solve the problem quickly
		You think the service quality of the smart home products you have selected is satisfactory and well supported
		Compared with other smart home product brands, the existing smart home product brand has good service quality

The third part: the brand effectiveness of the smart home product enterprises you choose.

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Sources	Questions
Domestic brand	Items adapted and modified from Verlegh (2007) He & Wang (2015) Diamantopoulos et al. (2019)	Will choose domestic smart home product brands to support and promote domestic economic development
		Will choose domestic smart home product brands because of the convenience of purchase and maintenance, even if you have to pay more
		Will choose domestic smart home product brands because of the network operator effect

Factors	Sources	Questions
Foreign industry leader brand	Items adapted and modified from Balabanis & Diamantopoulos (2016) Diamantopoulos et al. (2019)	Will choose the foreign industry leader brand because of the popularity of the industry leader (more experienced and more resources)
		Will choose the foreign industry leader brand because foreign brands outperform domestic ones
		Will choose the foreign industry leader brand because of trust in it

The fourth part: the product effectiveness of the smart home product enterprises you choose.

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Sources	Questions
Product innovation	Items adapted and modified from Rogers (2003) Fu & Elliott (2013) Zhang et al. (2020)	Product innovation technology is important
		A smart home product is an innovative product
		Smart home products represent a new product category for consumers

Factors	Sources	Questions
Product diversity	Items adapted and modified from Kim (2006) Terblanche & Boshoff (2006)	The product diversity of smart home product enterprises is important
		The software connectivity between smart home products is important (should cater to a wide range of preferences)
		With the development of smart home products, enterprises need to offer customers a satisfactory choice of products

The fifth part: the customer satisfaction with the smart home product enterprises you choose.

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Sources	Questions
Customer satisfaction	Fang et al. (2014) Garbarino & Johnson (1999); Oliver & Swan (1989)	Overall, extremely satisfied
		Overall, extremely pleased
		Your expectations were exceeded
		You would recommend this smart home product enterprise to relatives and friends

The sixth part: the perceived effectiveness of IoT institutional mechanisms.

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Sources	Questions
Perceived effectiveness of IoT institutional mechanisms	New scale developed based on definition, recent literature (e.g., Fang et al., 2014) preliminary qualitative interviews	When using smart home products, you are confident that there are IoT mechanisms in place to protect you against any potential risks (e.g., real-time monitoring, remote operation, security protection, etc.) if something goes wrong with the smart home product
		You have confidence in third parties (such as IoT technology companies that cooperate with smart home product companies) to protect you against potential risks (e.g., real-time monitoring, remote operation, security protection, etc.) if something goes wrong with the smart home product
		You are sure that it is correct because of using smart home products under IoT institutional mechanisms (e.g., real-time monitoring, remote operation, security

		protection, policies and laws, etc.)

The seventh part: the customer's intention to repurchase smart home products from the enterprise you choose.

Please select the score you think is appropriate between disagree very much (1 point) and agree very much (5 points) according to your judgment, and mark the selected option in the box "□").

1 - disagree very much, 2 - disagree, 3 - average, 4 - agree, 5 - agree very much

Factors	Source	Questions
Customer repurchase intention	Fang et al. (2014) Jarvenpaa et al. (2000)	Your likelihood/probability of buying smart home product again from the enterprise you had in mind as you filled out this questionnaire. (In the medium term?)
		Your likelihood/probability of buying smart home product again from the enterprise you had in mind as you filled out this questionnaire. (In the long term?)
		All things considered, and on a scale from 1-5, what is the probability that you will purchase smart home products from the same enterprise again?