

Study on the Influence Mechanism of Virtual Reality on the Marketing Process of High Intervention Products

-- Take Online Real Estate Platforms for Example

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Abstract

This study meticulously examines the influence of virtual reality on the marketing process pertaining to highly interventional goods within online real estate platforms. Virtual reality serves as a simulated environment, affording users the capability to remotely peruse information and engage in real-time interactions. Notably, BEKE, a prominent online real estate platform in China, inaugurated the virtual reality house viewing functionality in 2018, marking its precedence as the first platform to integrate this technology within the e-commerce industry. Leveraging comprehensive data pertaining to housing attributes and transactions, this research employs rigorous analytical techniques such as the survival model, propensity score matching, and the Heckman control function to delve into the impact of virtual reality on the duration of housing marketing and to further explore its pivotal role in shaping consumer decision-making processes.

Keywords

Virtual Reality; High Intervention Goods; Marketing Promotion; Digital Marketing.

1. Introduction

Virtual reality is an emerging vision technology that can use computer-generated 3D virtual environments to simulate the real world. Consumers can interact with the simulated environment through the virtual reality operation interface, and get information and real-time feedback according to their personal needs.

In recent years, non-immersive virtual reality has appeared in real estate platforms and been used for online house viewing. In 2019, Zillow introduced "3D house viewing", a feature that allows consumers to browse internal details online and interact in real time. Shell Net calls this online house viewing function "virtual reality house viewing," which is consistent with Zillow's 3D house viewing, both based on non-immersive virtual reality.

The fact that the real estate industry differs from other industries is that housing is usually seen as a highly interventional product, with high value and high importance to home buyers. The wrong purchase decision will affect the living experience of home buyers and cause serious economic burden. Therefore, it is necessary to explore the role of virtual reality in the marketing process of high intervention products.

2. Hypotheses

This study is devoted to answering the following questions:

- (1) Will the virtual reality have an impact on the housing marketing time?
- (2) What is the function mechanism of virtual reality in the consumer decision-making process?

(3) What is the role of virtual reality in the information collection and alternative scheme evaluation stage?

In view of the above research problems, this paper refers to the relevant literature and theories, including the concept of high intervention products, the theory of consumer decision-making process, the influence of visual elements in the housing marketing process, etc. On this basis, the research hypothesis is proposed, specifically as follows:

Hypothesis 1: Houses using virtual reality will be marketed faster than homes without the technology.

Hypothesis 2: In the information collection stage, the houses using virtual reality will have higher detail page views than those without virtual reality.

Hypothesis 3: After the user evaluates the alternative plan, the houses that support virtual reality are more concerned than those that do not support this feature.

3. Data Description

The housing properties and transaction data in this paper are from BEKE, the largest online real estate information platform in China. The virtual reality house viewing function of the platform was launched at the end of April 2018, so this study focuses on the time node between the function and the comparison of marketing data on the platform. In the end, a total of 226,799 housing transaction records were collected. Table 1 shows the descriptive statistics of housing properties using binary variables and continuous variables. Of the housing data collected, 17% supported the virtual reality housing viewing function, and the average presence time of the housing on the platform is 120.2 days.

Table 1. Descriptive statistics for the binary and continuous variables

Variable name	Description	Sample number	Mean	Standard deviation	Least value	Crest value
Has been sold	Binary variable, indicating whether the home has been sold by the time of data collection.=1 sold; =0 unsold.	226799	0.27	0.45	0	1
Sold time	Continuous variable, the number of days from being sold to being sold.	61613	60.81	70.52	1	422
Existence time	Continuous variable, number of days of housing in the platform.= Time of sale, if the house is sold; = Days of days, if the house is not sold.	226799	120.2	117.7	1	458
Total price	Continuous variable, housing marketing price (in one million yuan).	226799	3.42	3.40	0.01	200
No price adjustment	Binary variable, indicating whether the housing did not change the price in the marketing process.=1 Not changed; =0 price changed.	61613	0.43	0.49	0	1
Area	Continuous variable, house area (square meters).	226799	92.31	46.77	8.54	1388
Building age	Continuous variable, the house has been built for years.	226799	12.83	8.21	0	46
Virtual reality	Binary variable, whether the house supports virtual reality. =1 is supported; =0 is not supported.	226799	0.17	0.37	0	1
Picture	Continuous variable, the number of pictures of the house displayed on the details page	226799	5.97	4.33	1	90
Page access	Continuous variable, the number of visits to the house details page.	53986	1203	2839	1	253387
Follow with interest	Continuous variables, adding the number of users of the house to the concern list.	226799	15.67	43.58	0	9888

4. Measurement Model

The research data in this paper mainly includes housing properties and start marketing and end marketing time. It is a kind of "time-event" type of data. For this type of data, this paper uses two types of survival models: accelerated failure time model and Cox proportional risk model. The two models target individual survival and risk rates, respectively.

4.1. Accelerated Failure Time Model

This paper first uses the accelerated failure time model to identify the impact of virtual reality house viewing on housing marketing time. The accelerated failure time model fits the survival rate S at time t as a function of a series of variable X . The function error term e can have many different functional forms. This paper considers two kinds of distribution: (1) generalized extreme value distribution and (2) normal distribution. When the error term follows the generalized extreme value distribution, the survival function conforms to the exponential distribution $S(t|X_i) = 1/\exp(\exp(-X_i \beta)t)$.

Survival in this paper is the proportion of all homes that were not sold at the time of data collection. The functional form of the accelerated aging time model is as follows:

$$\text{Logs (presence time } i) = \beta_0 + \beta_1(\text{virtual reality}) + \beta_2 \text{Total price } i + \beta_c(\text{controlled variable } i) + \varepsilon_i \quad (1)$$

The value of β_1 indicates the role of virtual reality in the housing marketing time. If the β_1 is significantly negative, it indicates that VR home viewing technology can reduce the existence time of houses to accelerate the marketing process.

4.2. The Cox Proportional Hazards Model

This paper also uses the Cox proportional risk model to explore the impact of virtual reality on housing marketing time. The proportional hazards model was used to explore the role of the variables on the risk rate. The risk rate of the house in this paper λ refers to the probability that the home is sold at time t . The proportional hazards model is presented as follows:

$$\lambda(t | X_i) = \lambda_0(t) \exp(\alpha_0 + \alpha_1 \text{virtual reality } i + \alpha_2 \text{Total price } i + \alpha_c(\text{controlled variable } i)) \quad (2)$$

Where $\lambda(t | X_i)$ Represents that the property of a given house i is X_i , The risk of it being sold at time t . $\lambda_0(t)$ indicates the potential risk rate at time t . The control variable is the same as that controlled by the accelerated failure time model, representing the various properties that may affect the risk of sale. In the proportional hazards model, the parameter α in this paper α_1 For the use of the risk rate of the sale of virtual reality. Thus, if the α_1 significantly positive effect suggests that virtual reality accelerates the marketing process of homes, making them easier to sell.

5. Results

5.1. The Impact of Virtual Reality on Marketing Time

This paper uses the aforementioned survival model: the error term is the accelerated failure model in the exponential form, the error term is the log-normal form, and the Cox proportional hazard model.

As shown in Table 2, the estimated results of the VR coefficients in the accelerated failure model are significantly negative, which means that the application of VR house viewing technology can reduce the survival rate of houses. The Cox proportional hazards model estimated that the

coefficient of virtual reality is significantly positive, which means that virtual reality house viewing technology increases the risk of a house being sold. In conclusion, using virtual reality can speed up the marketing process of housing. Table 2 (4) to (7) shows the estimates of the samples after the orientation).

Table 2. Impact of virtual reality on housing marketing time

(A) Full sample (before matching)				(b) After matching			
	(1) Accelerated failure time (index)	(2) Accelerated failure time (log-linear)	(3) Cox proportional risk	(4) Accelerated failure time (index)	(5) Accelerated failure time (log-linear)	(6) Accelerated failure time (log-linear) & Heckman control function	(7) Cox proportional risk
Virtual reality	-0.626	-0.841	0.571	-0.538	-0.728	-1.012	0.486
Total price	0.037 (0.007)	0.050 (0.0087)	-0.027 (0.0057)	0.063 (0.0147)	0.069 (0.0175)	0.069 (0.0175)	-0.050 (0.0127)
Area	0.008 (0.0004)	0.010 (0.0006)	-0.007 (0.0003)	0.009 (0.0009)	0.012 (0.0011)	0.012 (0.0011)	-0.008 (0.0007)
Building age	0.009 (0.0009)	0.009 (0.0011)	-0.007 (0.0007)	0.010 (0.0014)	0.010 (0.0017)	0.010 (0.0017)	-0.007 (0.0011)
Picture	0.010 (0.0017)	0.003 (0.0020)	0.004 (0.0013)	-0.005 (0.0031)	0.012 (0.0039)	0.012 (0.0039)	-0.000 (0.0025)
Inverse Mills rate						0.177 (0.1522)	
Constant term	4.981 (0.1527)	4.586 (0.1741)		4.533 (0.4418)	3.830 (0.5261)	3.931 (0.5333)	
In(δ)		0.683 (0.0028)			0.658 (0.0045)	0.658 (0.0045)	
Sample capacity	225896	225896	225896	71624	71624	71624	71624
Has been sold	61498	61498	61498	22681	22681	22681	22681
AIC	365617	346617	1373199	132402	126121	126114	461123
BIC	367486	348497	1375058	133843	127572	127574	462463
Category variable	yes	yes	yes	yes	yes	yes	yes
On the shelf month	yes	yes	yes	yes	yes	yes	yes

Note: This paper uses "category variables" to refer to the various properties of houses, including decoration, owner, transaction tax, floor, building materials, building structure, building structure, space structure, community (location fixed effect), etc. Shown in parentheses are the robust standard deviations. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The coefficient of the VR concerned in this paper is -0.728, which is significantly negative. According to this coefficient, calculate the marginal effect of virtual reality house viewing technology, and find that using virtual reality can reduce the housing marketing time of 51.7% ($\exp(-0.728) - 1 = -0.517$). This result shows that virtual reality house viewing technology

can significantly reduce the existence time of housing in the market and accelerate its marketing process. Hypothesis 1 is supported by the empirical results.

The above results show that as a non-immersive VR application, VR house viewing function plays a role in accelerating the marketing process of such high intervention products.

5.2. Impact of Virtual Reality on Consumer Decision-making Process

Consumers will be affected by the relationship between housing price and objective quality in the decision-making process. Objective quality is defined as the unbiased estimation of product quality (Riesz1978) based on product attributes after detailed evaluation, corresponding to the fair value of the commodity. The selling price of the product indicates its market value. The relationship between housing price and objective quality will determine consumer decisions. When the house price is much less than its objective quality, consumers are more willing to buy the house.

As shown in Table 3, column (1), the VR coefficient of 0.545 is significantly positive. The results show that the presence of virtual reality can bring more traffic to the details pages of houses when consumers collect information. The above findings mean that in the user information collection stage, virtual reality as an information clue can enhance the possibility of consumers to conduct detailed evaluation. Hypothesis 2 is supported by the empirical results.

As shown in Table 3, the coefficient of 0.560 is significantly positive. The results show that when consumers evaluate their properties in detail, the houses that support virtual reality viewing function are more included by consumers. Virtual reality can increase consumers' willingness to see houses offline. Hypothesis 3 is supported by the empirical results.

Table 3. Impact of Virtual Reality on consumer decision-making process

	(1) Page access	(2) Follow with interest
Virtual reality	0.545*** (0.0265)	0.560*** (0.0412)
Total price	0.083*** (0.0185)	-0.037* (0.0223)
No price adjustment	-0.335*** (0.0283)	-0.170*** (0.0343)
Area	-0.002* (0.0010)	-0.006*** (0.0014)
Building age	-0.001 (0.0013)	0.000 (0.0030)
Picture		0.067*** (0.0049)
Existence time	0.010*** (0.0002)	0.002*** (0.0002)
Constant term	7.680*** (0.6737)	0.119*** (0.0216)
Sample capacity	19767	19767
False R ²	0.040	0.171
Category variable	yes	yes
On the shelf month	yes	yes

Note: Because both page visits and attention are the amount of accumulation of the house in the whole marketing process, there are time variables that are controlled in the model. Shown in parentheses are the robust standard deviations.*p<0.10, **p<0.05, ***p<0.01.

The above findings reveal the internal mechanism of the acceleration effect of virtual reality house viewing on housing marketing.

6. Conclusion

This paper uses the survival model to study the influence mechanism of virtual reality house viewing function on housing marketing time. Because housing is a typical high-intervention commodity, reducing the uncertainty of housing quality is a crucial thing before consumers make purchase decisions. On this basis, this paper further explores the role of virtual reality in the decision-making process of consumers, and identifies its effects in information collection and alternative evaluation. The research results show that the use of virtual reality house viewing function can effectively accelerate the housing marketing process. When consumers collect information, the emergence of virtual reality can bring more page access to the home details page. During the alternative evaluation phase, homes that support virtual reality home viewing capabilities are more likely to be added to their attention list by consumers. In addition, virtual reality can increase the conversion rate and conversion advantage rate between the information collection and alternative evaluation stages.

The above research results provide empirical support and theoretical explanation for the deep understanding of the action mechanism of visual elements on merchants and users in e-commerce platforms, and provide certain guidance and suggestions for relevant practitioners to better display the visual elements of the page.

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