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Conference Paper

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14th Asia-Pacific Regional Conference of the International Telecommunications Society (ITS): "Mapping ICT into Transformation for the Next Information Society", Kyoto, Japan, 24th-27th June, 2017

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Zhang, Aihua; Lv, Jia; Kong, Ying (2017) : The Effects of the Internet and Mobile Services on Urban Household Expenditures, 14th Asia-Pacific Regional Conference of the International Telecommunications Society (ITS): "Mapping ICT into Transformation for the Next Information Society", Kyoto, Japan, 24th-27th June, 2017, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/168554>

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The Effects of the Internet and Mobile Services on Urban Household Expenditures

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Abstract

In recent years, the economy of China has entered a new normal state and the economic growth rate has decelerated. The telecommunications industry as a national strategic and basic industry, is also facing up with some dilemma. Information consumption is a comprehensive concept including e-commerce, communications, broadband services, online games and so on. On this basis, this paper employs the almost ideal demand system(AIDS) to explore the impact that information consumption has made to residential consumption expenditure and the change of the consumption structure. According to empirical analysis, finally we can draw the following conclusions: The income elasticity of information consumption is greater than 1, which means the income demand is flexible. And the self-price elasticity of information consumption is negative and the absolute value is between 0 and 1. It means that the price of information consumption is not flexible.

Key Words: Information consumption Household consumption expenditure The almost ideal demand system(AIDS) Demand elasticity Information consumption

1. Introduction

Chinese consumers have finally entered the "adult" period. The two carriages, investment and exports, which have stimulated China's economic growth for a long time, have been in a dilemma. However, consumers still remain enthusiastic about personal consumption. At present, individual consumption has become the key driving force of China's economic growth. The actual personal consumption growth in 2015 was 8.4% which was higher than the overall growth of domestic economy. This should be attributed to the sustainable increase of income of consumers, the rapid development of Internet, the increasingly sophisticated consumers and many other elements. Actually, International Telecommunication Union has already discovered that there is a close link between

the development of ICT industry and the income of consumers. The level of expected income went up which implies the consumption habit of Chinese people is going to change dramatically. In the past few decades, the expenditure pattern of Chinese people has transformed gravely. One of the most remarkable point is that the share of expenditure of basic necessities has declined comparing to the past few years. The data from National Bureau of Statistics of China reveals that the average nominal consumer spending ratio of food, beverages, tobacco and other items fell from 37% in 2005 to 30% in 2015. Moreover, this also conforms to the inevitable trend of the international development that with the rise of resident income level, the alternatives of consumer spending will increase. At the same time, the percentage of transportation and communications in the household expenditure has demonstrated upgrade tendency. Great changes have taken place in the information consumption.

Although this reflects the rapid development of information consumption, there has arisen some concern over this issue. The development of communications industry has been lagging behind the growth rate of GDP of China. With the popularity of mobile communication, the market space has peaked gradually. However, the new source of economic growth has not been released till now. Meanwhile, the policy of speeding up and reducing price that is put forward by the government does not control the cost essentially. Instead, it brings large pressure to the operators. And in the process of implementation, this measure does not hit the point of the users. At present, China's telecommunications industry is promoting the reform of supply side and has put forward a series of policies which has no significant effect till now. The pricing for telecom tariffs has become hot topic and focus.

Information consumption not only changes people's lives, but also may bring great impact to other industries. According to "IT Industry Development Report in China (2014-2015)", the penetration of information consumption has enhanced significantly which has driven all walks of life to transformation and innovation. For instance, as for the education industry, the online education has sprung up currently and is changing the existing territory of educational industry. No matter when and where, as long as you can connect to the network, it enables you to listen to the public lesson from all over the world, and enjoy the same teaching resources with the students from world-famous university.

Based on the background mentioned above, the purpose of this paper is to study the effects of the Internet and mobile services on urban household expenditures in China and to explore the pricing strategies of information consumption and the impact that the information consumption brings to other industries. And then put forward some targeted recommendations from the perspective of promoting the national economic development. According to the purpose, we use the ideal demand system (AIDS model) that developed by Deaton and Muellbauer in 1980 and discuss from three aspects including income elasticity, price elasticity.

The study is organized as follows: Chapter two reviews and summarizes the literature in related

fields to understand the trends of research. Chapter three introduces the research methods and models used in this paper. Chapter four describes the process of empirical analysis. Chapter five draws conclusions based on empirical analysis and summarizes the policy implications of the study.

2. Literature review

In contrast, the aggregate approach with time series data has the advantage of long-term observation of structural changes. Using aggregate data, the model of aggregate demand can be used to investigate alternatives and complementarities between telecommunications and other existing commodities. The Almost ideal demand system (AIDS) was developed by Deaton and Muellbauer in 1980, which has attracted considerable attention as a popular model for estimating demand function using aggregate data, and has been widely used to analyze total commodity demand. K.G. Balcombe and J.R. Davis (1996) employed the canonical cointegrating regression (CCR; Park, 1992) procedure in estimating the almost ideal demand system for food consumption in Bulgaria. It suggests that Bulgarian consumers are rationally deciding their preferences subject to a budget constraint in the context of sharply rising nominal prices and declining real incomes. Frank T. Denton and Dean C. Mountain (2002) explore how large the effects of demand elasticities calculated at the micro level are and how they vary with the degree of nonuniformity in the income distribution with models based on a quadratic version of the Almost Ideal Demand System (AIDS). Using income data for seven countries with widely different distributions, they investigate the elasticity differences theoretically and then calibrate the models and generate numerical results. Dawit Diriba Guta (2012) used the linear approximation almost ideal demand system (LA/AIDS) with normalized prices to compute expenditure elasticity and a multinomial logit model (MLM) to examine household fuel use. Dianah Ngui, John Mutua, Hellen Osiolo, Eric Aligula (2011) estimates price and fuel expenditure elasticities of demand by applying the linear Approximate Almost Ideal Demand system (LA-AIDS) to 3665 households sampled across Kenya. Chuanwang Sun and Xiaoling Ouyang (2015) estimate price and expenditure elasticities of residential energy demand using data from China's Residential Energy Consumption Survey (CRECS) that covers households at different income levels and from different regional and social groups. Li, Song, and Witt (2004) apply the Error Correction Model (ECM) LA/AIDS both static and dynamic forms to their studies on tourism demand of Western European countries.

With remarkable advances in the Internet and telecommunications services, some empirical research that studies the relationship between the telecommunication services and other consumption categories has been springing up. Hong (2007) analyzes whether the growth of the Internet complements or substitutes for consumption of existing entertainment goods

by applying a difference-in-differences approach. Sangho Choo, Taihyeong Lee, and Patricia L. Mokhtarian (2010) analyzes relationships between expenditures on transportation and communications with aggregate data from the U.S. Consumer Expenditure Survey for 19 years using the aggregate demand system modeling (in particular, the linear approximate almost ideal demand system). Panagiotis Lazaridis (2003) examines meat consumption patterns of households in Greece using data from family budget surveys employing the linear approximate Almost Ideal Demand System. Sangho Choo, Taihyeong Lee(2006) examine trends with respect to consumer's expenditure patterns in transportation and communications categories and analyze aggregate consumer expenditure data using aggregate demand system modeling (in particular, a linear approximate almost deal demand system, or LA-AIDS), to determine the relationships between expenditures on transportation and those on communications.

As for the information consumption in China, Fan Xuchun (2016) studies the decision mechanism of the upgrading of Chinese residents' consumption structure and how to realize the effective supply of products. In this paper, he studies how the price and income influence all kinds of expenditure categories in Chinese residents including the communications. Zhong Lingling, Xu Chunyan and Wang Zhanping (2016) analyze the role of information consumption in China's economic growth regarding the gross domestic product (GDP) as the dependent variable.

3. Analysis method

3.1 Model variables

Among all the literature about the effect of the information consumption to the economy, most regard the GDP (Gross Domestic Product) as the dependent variable to study the relationship between information consumption and gross domestic product employing Econometric model.

However, one of the most significant sections of the economic development in China is the consumer spending. As a part of the macro economy, household expenditure enables to reveal the influence that information consumption made in stimulating domestic demand.

"The periodic report of information consumption coefficient and information technology development" issued by National Ministry of Industry and Information in 2003 standardized the definitions of the scope of information consumption for the first time. The report pointed out that information consumption is the sum of communication, education and entertainment culture. Although this definition still exists a few unreasonable places, including unable to cover all the categories of information consumption, this definition is the most reasonable method by now.

There are many categories of consumer spending. According to the household consumption expenditure statistics on the National Bureau of Statistics in China, residents spending can be divided

into eight categories, including food, clothing, household facilities and services, health care, transportation and communications, education and entertainment culture, residence, and other goods and services. Among all of them, communication, education and entertainment culture are classified into information consumption. The rest categories are all variables as household expenditure.

3.2 Model building

The Almost Ideal Demand System (AIDS) model was a kind of demand system proposed by Deaton and Muellbauer jointly in 1980 combining the Rotterdam demand model and the logarithmic transformation model. It has become the model of choice for many applied demand analysts. The model is grounded in a well-structured analytical framework, accommodates certain types of aggregation, is apparently easy to estimate, and permits testing of the standard restrictions of classical demand theory.

This model assumed that the behavior of consumer satisfied the Price Independent Generalized Log Preference (PIGLOG). It represents the market demand as if it were the outcome of decisions by a rational representative consumer. These preferences, known as the PIGLOG class, are represented via the cost or expenditure function which defines the minimum expenditure necessary to attain a specific utility level at given prices. We denote this function $c(u,p)$ for utility u and price vector p , and define the PIGLOG class by

$$\log c(u, p) = (1 - u) \log\{a(p)\} + u \log\{b(p)\} \quad (1)$$

where u lies between 0 (subsistence) and 1 (bliss), so that the positive linearly homogeneous functions $a(p)$ and $b(p)$ can be regarded as the cost of subsistence and bliss, respectively.

Next, specific functional forms are taken for $\log\{a(p)\}$ and $\log\{b(p)\}$ as in Eqs. (2) and (3) below. For the resulting cost function to be a flexible functional form, it must possess enough parameters so that at any single point its derivatives can be set equal to those of an arbitrary cost function. We take

$$\log a(p) = a_0 + \sum_k \log p_k + \frac{1}{2} \sum_k \sum_j \gamma_{kj}^* \log p_k \log p_j \quad (2)$$

$$\log b(p) = \log a(p) + \beta_0 \prod_k p_k^{\beta_k} \quad (3)$$

so that the AIDS cost function is written

$$\log c(u, p) = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2} \sum_k \sum_j \gamma_{kj}^* \log p_k \log p_j + \mu \beta_0 \prod_k p_k^{\beta_k} \quad (4)$$

where α_i , β_i , γ_{kj}^* are parameters, p_i is the price of a good i . It can easily be checked that $c(u,p)$ is linearly homogeneous in p .

The demand functions can be derived directly from equation (4). According to Ronald Shephard, it is a fundamental property of the cost function that its price derivatives are the quantities demanded. Then we can find the AIDS demand function can be derived as a function of prices and utility in budget share form as shown in Eq.(5)

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i u \beta_0 \prod_k p_k^{\beta_k} \quad (5)$$

For a utility-maximizing consumer, total expenditure x is equal to $c(u,p)$ and this equality can be inverted to give u as a function of p and x , the indirect utility function. If we do this for (4) and substitute the result into (6), we have the budget shares as a function of p and x ; these are the AIDS demand functions in budget share form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log \left\{ \frac{x}{P} \right\} \quad (6)$$

where P is a price index defined by

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2} \sum_j \sum_k \gamma_{kj}^* \log p_k \log p_j \quad (7)$$

Besides, w_i means the expenditure share of good I , p_j means the price of good I , x means total expenditure of all goods. P is index of price. In order to facilitate estimation, we usually use Stone's price index P as an approximation as Eq.(8). The approximation of the resulting model is also called a linear near-ideal demand system (LA/AIDS).

$$\log P = \sum_i w_i \log p_i \quad (8)$$

The restrictions on the parameters imply restrictions on the parameters of the AIDS equation (6). We take these in three sets:

$$\sum_i \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \quad \sum_i \beta_i = 0 \quad (9)$$

$$\sum_j \gamma_{ij} = 0 \quad (10)$$

$$\gamma_{ij} = \gamma_{ji} \quad (11)$$

Provided all these restrictions, equation (6) represents a system of demand functions which add up to total expenditure ($\sum \omega_i = 1$) are homogeneous of degree zero in prices and total expenditure taken together, and which satisfy Slutsky symmetry. Given these, the AIDS Model can be simply interpreted: in the absence of changes in relative prices and real expenditure, the budget shares are constant and this is the natural starting point for predictions using the model. Changes in relative prices work through the terms γ_{ij} . Changes in real expenditure operate through the β_i coefficients; these add to zero and are positive for luxuries and negative for necessities.

In summary, based on the ideal demand system model, this paper established the model about the effect of the Internet and mobile services on urban household expenditures. The model is as follows:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log \left\{ \frac{x}{P} \right\} \quad (12)$$

Where w_i represents the consumption budget share of each consumption expenditure, p_j represents the adjusted consumer price index of each consumer product, x is the total c

consumption expenditure of the urban household in each year, p is the overall price index.

It can be shown that this model is an equation set composed of seven equations. And on account of the relationship between the various equations,

It is impossible to make regression analysis respectively. Therefore, it is necessary to build a system and apply coefficient constraints to perform regression analysis.

3.3 Model estimation

The LA/AIDS model is not a simple linear relationship, but a simultaneous equation consisting of a series of interrelated equations. There is a relationship between the equations, and exist a parameter constraint for the cross-equation. Therefore, a simple linear estimation cannot satisfy the estimation of the simultaneous equations, and it is necessary for the system estimation. As one of system estimation methods, seemingly unrelated regression (SUR) is widely used to solve this question. There seems no internal relationship between the variables, but the disturbing term are correlated. SUR enables to estimate the interdependence between the shares of different good and services which a single equation is unable to display.

The parameters in this model are estimated by the seemingly unrelated regression method. Once the estimation finished, the following formula can be used to calculate the income elasticity, self-price elasticity. The sign of η_i represents the income elasticity. e_{ii}^M means self-price elasticity. These variables can reflect the substitutes and complementarity between the various consumption items.

$$\text{Income elasticity: } \eta_i = \frac{\beta_i}{w_i} + 1 \quad (13)$$

$$\text{Self-price elasticity: } e_{ii}^M = \frac{1}{w_i} (\gamma_{ii} - \beta_i * w_i) - 1 \quad (14)$$

4. Empirical analysis

4.1 Data processing

The basic data used in this paper are from the National Bureau of Statistics official website of China, and the annual "China Statistical Yearbook." The data include the average annual cash consumption expenditure per year for urban households between 2000 and 2015, the consumption price index (CPI) and household disposable income of various types of consumer goods in each year.

Information consumption is an extremely broad concept. In the era of information explosion, the updating speed of information has been beyond our imagination, and the content of information consumption will change constantly with the updating of information technology and services. At present, the statistics of the urban and rural household expenditure on the National Bureau of Statistics can be divided into eight categories, including food, clothing, household equipment supplies and services, health care, transportation and communications, education, cultural and entertainment

services, residential and miscellaneous goods and services, etc. Moreover, there are many subcategories in each category of urban residents' expenditure. According to the "Information Consumption Coefficient and Information Development Stage Report", the contents of information consumption include communication, education, culture and entertainment. However, transportation and communication are always counted as a whole. This paper aims to study information consumption, and transportation is exclusive of the scope of information consumption. In order to make the results more accurate, we will separate the traffic and communication. As the statistical standards of different years will be different, we will distribute the weights proportionally for the years that are unable to split the transportation and communication.

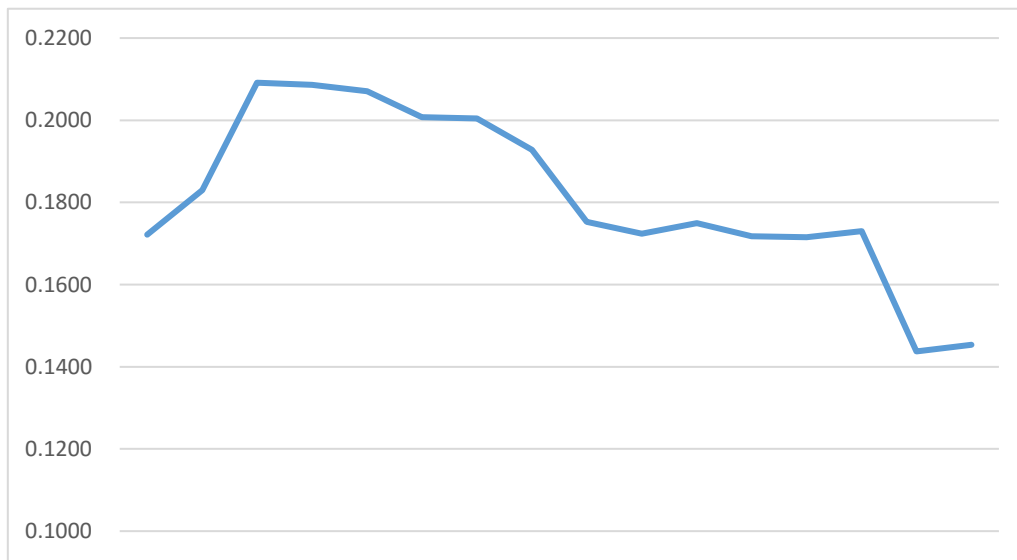


Fig1. Budget shares of monthly household expenditure on telecommunications services (2000-2015)

As is shown in Fig.1, the shares of household expenditure on telecommunications services in China has no significant tendency over years. As we can see, there is a breakpoint in 2002. In 2002, with the separation of China Telecom, the pattern of telecommunications industry was definitely settled. It stimulated the demand for telecommunications services of Chinese residents and the number of fixed telephone and mobile phone users has grown rapidly. At that time, the capacity of China's telecommunications network has leapt to the first one all over the world. In the meanwhile, domestic mobile phones are increasingly recognized by people which boosts the demand for information consumption.

However, China's industrial environment is more complex, the factors that affect the expenditure of telecommunications include not only the demand for telecommunications, but also for the demand for other consumption. In the following years, the estate industry of China has developed rapidly. However, information consumption is still in the top three of household expenditure, which includes food and residents as well.

Since all the data used in this model adopt the relative ratio which can reduce the error due to

the difference of baseline, it is necessary to calculate by the share of the consumer's expenditure on the total expenditure of the consumer which is represented by w1-w7. On the other hand, in order to visualize the process of price change of each consumption category from 2000 to 2015, this paper adjusts the annual consumer price index regarding 1999 as the base period (1999 = 100), and obtains the adjusted price index which represent by p1-p7.

4.2 SUR estimation

The estimated parameters are given in Table 2 below.

Table 1 The estimated parameters of SUR

	Food	Clothing	Resident	Household equipment supplies and services	Health care	Transportation	Information consumption
γ_{1i}	0.0964	-0.1791	0.1065	-0.0232	0.0229	0.0499	-0.0733
γ_{2i}	-0.1791	-0.0775	0.2744	0.0593	0.1275	-0.0469	-0.1578
γ_{3i}	0.1065	0.2744	-0.2170	-0.0003	-0.0208	-0.2028	0.0600
γ_{4i}	-0.0232	0.0593	-0.0003	0.2333	-0.1081	-0.0265	-0.1344
γ_{5i}	0.0229	0.1275	-0.0208	-0.1081	-0.1151	-0.0409	0.1345
γ_{6i}	0.0499	-0.0469	-0.2028	-0.0265	-0.0409	0.2035	0.0637
γ_{7i}	-0.0733	-0.1578	0.0600	-0.1344	0.1345	0.0637	0.1072
β	0.2065	0.0301	-0.1022	0.0120	-0.0557	-0.1121	0.0214
α	1.2422	0.1928	-0.3046	0.1336	-0.1608	-0.4164	0.3132

As is shown in Table 1, the estimation effect of this model is satisfactory, and most of the t-test results of parameters of information consumption are significant. Some of the parameters of the estimated results are not significant. It is possible that it does not meet the principle of maximizing utility to a certain extent.

4.3 Demand elasticity analysis

According to the result of the coefficient estimation, the demand elasticity of information consumption can be obtained, including income elasticity, self-price elasticity.

4.3.1 Income elasticity

The income elasticity of information consumption can reflect the relationship between the demand for information consumption and the total household consumption expenditure. The results are shown in the following table 2.

Table 2 Income elasticity

Year	Income elasticity
2000	1.1241
2001	1.1167
2002	1.1021

2003	1.1024
2004	1.1032
2005	1.1064
2006	1.1066
2007	1.1108
2008	1.1219
2009	1.1239
2010	1.1221
2011	1.1244
2012	1.1245
2013	1.1235
2014	1.1486
2015	1.1470

According to the above results, we can see that the income elasticity of information consumption is greater than 1, which means the income demand is flexible. When the disposable income of the residents increases, the expenditure on information consumption will increase accordingly. However, the developmental level of information consumption in China still remains a certain distance comparing with the international level. On the other hand, the impact of information consumption on the living expenses of residents has been growing. It is foreseeable that with the continuous development of China's economy, the disposable income of our residents will gradually increase. As a potential industry, information consumption will promote the expenditure of residents more and more significantly.

4.3.2 Self-price elasticity

Table 3 Self-price elasticity

Year	Income elasticity
2000	-0.3988
2001	-0.43553
2002	-0.50878
2003	-0.50754
2004	-0.50372
2005	-0.48737
2006	-0.48657
2007	-0.46532
2008	-0.40987
2009	-0.39957

2010	-0.40853
2011	-0.3973
2012	-0.3965
2013	-0.40169
2014	-0.27557
2015	-0.28387

According to the above table, it reveals that the self-price elasticity of information consumption is negative and the absolute value is between 0 and 1. It means that the price of information consumption is not flexible. The scope of information consumption is more extensive, including not only the telecommunications industry, but also the Internet which has developed rapidly and other emerging industries. Although China's telecommunications industry has been promoting the reduction of price and increasing the speed, with the improvement of people's living standards, people's demand for goods and services is not only satisfied with the basic needs of life, but more emphasis on improving the quality of life. Therefore, with the rapid development and penetration of Internet and other industries, more traditional industries turn to integrate with other industries. The demand for information consumption of consumer, especially the quality of information consumption will be more significant. Therefore, to improve the price will help improve the quality of products and services, thereby improving the quality of life of consumers.

5. Conclusion

In this article, we employ the almost ideal demand system(AIDS) developed by Deaton and Muellbauer in 1980. After a series of data preprocessing including logarithmic and smoothness, we use Seemingly Unrelated Regression(SUR) method to estimate the simultaneous equation, and calculate the elasticity of demand including the income elasticity, price elasticity in use of the estimating results. According to empirical analysis, finally we can draw the following conclusions:

(1) The income elasticity of information consumption is greater than 1, which means the income demand is flexible.

(2) The self-price elasticity of information consumption is negative and the absolute value is between 0 and 1. It means that the price of information consumption is not flexible.

Based on the above research, this paper makes recommendations on policy from the structure of information products and infrastructure construction. First of all, we should continue to strengthen the telecommunications infrastructure construction, and actively promote technological progress. Second, it is necessary to further enrich the types and quality of information products and services, and enhance the purchasing power of consumers, thus promoting the demand for information consumption. Third, we should stimulate the integration of information consumption and other industries to form a good atmosphere in the industry. Finally, when we develop the information consumption, the rigid demand of consumers should not be ignored.

Although the results of this paper have been reasonably estimated, the values in this study need to be interpreted cautiously due to the small observation period. In addition, this paper is merely the study of the general situation of China's information consumption, the actual situation is more complex.

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