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Video Game Demand in Japan: A Household Data Analysis—Revised

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Abstract

Various economic studies of the video game industry have focused on intra-industry details. This paper complements the approach by highlighting broader budget allocation by households. Using the "total households" data of the *Family Income and Expenditure Survey*, this paper estimates the demand model for video games. Estimation results show the effects of household income, demographic factors, and prices of goods on the expenditure share of video games. These results indicate the importance of explicitly considering a household's budget allocation, or at least, including information on households.

JEL classification: D12; L82

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I. Introduction

The video game industry is an exceptional one among cultural industries, in which Japanese firms and their products have exhibited a strong international presence for more than 20 years.[1] In the beginning, its presence was established by Nintendo's console "Family Computer (Nintendo Entertainment System)", which was released in the mid 1980s, along with attractive software titles (Sheff, 1993; Sheff and Eddy, 1999). Since then, various game consoles represented by Nintendo's "Game Boy" and "Super Famicon (Super NES)", and Sony Computer Entertainment's "Play Station" and "Play Station 2" have stimulated and developed world markets, especially in Japan, the U.S., and Europe.

The Japanese government has begun to pay attention to the potential importance of "content industry", which is defined as industries creating and distributing content products such as publications (including Japanese cartoons, *manga*), broadcasting and movies (including Japanese animation, *anime*), and video games. In May 2004, the government enacted a fundamental law for the content industry.[2] In parallel, it has begun to plan and implement concrete policy measures for the industry. Video games are regarded as one of the most promising fields.

Since the video game industry has emerged and grown rapidly in just a few decades and has evolved interesting features in the process, it has attracted a number of studies, especially in the area of empirical economics (cf. Shintaku and Ikuine (1999), Matsumura *et al.* (2000), Shintaku *et al.* (eds.) (2003), Shankar and Bayus (2003), and Clements and Ohashi (2005)).[3] However, these empirical studies have focused on intra-industry details and their relationships, such as the number of released software titles, the number of each title's sales, the aggregated

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[1] In this paper, the term "video game" means home video game.

[2] The Law concerning Promotion of Creation, Protection and Exploitation of Content.

[3] See also Aoyama and Izushi (2003), and the Small and Medium Enterprise Agency (2004) Part II, Chapter 1.

software sales for each game console, installed bases of each console, and prices of consoles. While these were detailed analyses, the household side has been almost ignored or been oversimplified, despite the apparent existence of the households as consumers in the market, as well as firms as developers and distributors. Even in the case of those using time-series data, the effects of households' situations and changes in their circumstances have not been sufficiently addressed in these studies.

The objective of this paper is to complement the previous approach by highlighting broader budget allocation by households. Specifically, this paper estimates the demand model for video games, using the "total households" data of the *Family Income and Expenditure Survey* (FIES). The FIES is a representative official survey of households in Japan, and as explained in the next section, the dataset has several advantages for our study. The model for video game demand we apply is the extended version of Deaton and Paxson's (1998) Engel curve, which enables us to examine whether and how household's income and demographic factors, and prices affect the demand. The specification and results are described in Section III and Section IV, respectively.

II. Household Data in Japan

As official statistics on the household sector in Japan, firstly, we can consider *System of National Accounts* (SNA), published by the Economic and Social Research Institute, Cabinet Office. In the supporting tables in the SNA, the composition of final consumption expenditure of households classified by 12 purposes is provided. As one of the 12 divisions, "recreation and culture" exists, and video game expenditure is contained in this division. However, we cannot observe a more detailed account than the division in the SNA.

Next, the *National Survey of Family Income and Expenditure* (NSFIE) by the Statistics Bureau, Ministry of Internal Affairs and Communications (MIC) can be considered as a source

of more specific information. The NSFIE is one of the Designated Statistics,[4] and is a large-scale survey (about 60,000 households) based on a random sample. In the NSFIE, video game expenditure is presented as a sole item in the 1994 (8th) and 1999 (9th, the latest) surveys, and several detailed cross-tabulations of the results are provided. For instance, concerning two-or-more-person households' monthly expenditure, we can see that households having children at elementary school tend to spend more on video games.[5] Moreover, concerning one-person households' monthly expenditure, we can observe that males tend to spend more on video games than females, and younger persons more than older ones, on average.[6]

However, the data of the NSFIE have serious disadvantages for our study. First, the NSFIE is conducted only every five years, and thus, information on years between surveys and years after the latest survey cannot be observed. More importantly, in each survey year, the NSFIE surveys only expenditures from September to November for two-or-more-person households, and from October to November for one-person households. This means that the survey covers only a small part of households' expenditure behaviour in a year, and in particular, does not cover either summer and winter bonus months, the Christmas and New Year season, end of the fiscal year, or the summer holiday in Japan, which are leading seasons for the video game industry. This point seems to be critical for a dataset to examine demand for video games.

In contrast, the FIES, which is also published by the Statistics Bureau, MIC, is surveyed every month, and thus no limitation on either years or months surveyed exists, although its sample size is smaller (about 9,000 households).[7] The FIES is also one of the Designated Statistics and sample households are randomly selected; these mean relatively high credibility

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[4] The surveys for the Designated Statistics under the Statistics Law are the most authorized and official surveys in Japan.

[5] 1999 NSFIE, II Expenditure on Commodities, Two-or-More-Person Households, Japan, Table 5.

[6] 1999 NSFIE, II Expenditure on Commodities, One-Person Households, Table 6.

[7] Of surveyed samples, one-sixth of two-or-more-person households and one-third of one-person households are replaced every month.

for the survey. Further, in recent years, the FIES has been gradually extended, and since 2000, the data incorporating one-person households and households engaged in primary industry have begun to be published as "total households". In particular, the extension to include one-person households seems to be very important to examine demand for video games, because these must represent a large group of video game players.[8] In the total households data of the FIES, since the beginning (i.e., 2000), video game expenditure is provided as a sole item.[9] Considering these advantages, this paper uses the data of the total households of the FIES for analysis.

More specifically, this paper uses the aggregated data from 47 prefectural capital cities in line with Asano's (1997) approach,[10] and annual data for five years from 2000 to 2004. The reason for using annual data is that the FIES total households data are only provided quarterly or annually, and of the quarterly data, expenditure data by item (including video game expenditure) are not published by the 47 prefectural capital cities and cannot be applied in our analysis.

III. Model

In using a demand model for video games, this paper extends Deaton and Paxson's (1998) Engel curve. Deaton and Paxson (1998) examined the nature of a household's food demands in several countries, by estimating a demand model where its share was mainly explained by the logarithm of the total expenditure per capita, the logarithm of household size which shows a household's scale effects, and a household's demographic composition described

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[8] Nearly 30 per cent of total households are a one-person household in Japan.

[9] Here, in the FIES (and in the NSFIE), the minimum division of expenditure is "video games" and its components cannot be distinguished. This is one of the definite limitations of this research.

[10] Asano (1997) estimated the AIDS model under 10 consumption goods groups plus leisure consumption, mainly using 12 years of annual data (1979–1990) from 47 prefectural capital cities in the FIES, although, to be exact, he used the data of two-or-more-person and workers' households excluding those engaged in primary industry.

by the ratios.[11] This paper, as a basis, uses this formula, replacing demand for foods with demand for video games.

That is, this paper basically applies the following model:

$$w_{game} = \alpha + \beta \ln(x/n) + \theta \ln n + \sum_{k=1}^{K-1} \eta_k (n_k /n) + u \tag{1}$$

where x is total expenditure per household, w_{game} is video game's share of x, n is the number of persons per household, n_k is the number of persons in demographic group k segmented by K groups, and u is an error term.

Further, because Deaton and Paxson (1998) used cross-sectional data, the model must be extended to address the time dimension. First, this paper incorporates the effects of prices that households face, considering two types of specifications whose differences are whether individual price effects are described as the logarithm of *level of prices*, or *its relative prices to video games*. Further, following Asano (1997), this paper incorporates yearly fixed effects to control other various fluctuations in each year.

In the result, the final specifications are written as follows:

$$
\begin{aligned}
w_{game,it} &= \alpha + \beta \ln\left((x_{it}/p_{it})/n_{it}\right) + \theta \ln n_{it} + \sum_{k=1}^{K-1} \eta_k (n_{k,it}/n_{it}) \\
&+ \gamma_0 \ln(p_{game,it}) + \sum_{j=1}^{J} \gamma_j \ln(p_{j,it}) + \lambda_t + v_{it}
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
w_{game,it} &= \alpha + \beta \ln\left((x_{it}/p_{it})/n_{it}\right) + \theta \ln n_{it} + \sum_{k=1}^{K-1} \eta_k (n_{k,it}/n_{it}) \\
&+ \sum_{j=1}^{J} \gamma_j \ln(p_{j,it}/p_{game,it}) + \lambda_t + v_{it}
\end{aligned}
\tag{3}
$$

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[11] This model is also applied by Lanjouw and Ravallion (1995) and Deaton (1997, chapter 4).

where p is the general price to deflate the value of x, p_{game} is the price of video games, and p_j is the price of goods j other than video games. Subscripts i and t represent city and time period, respectively. An error term u is divided into the two terms of yearly fixed effect λ_t and other disturbance v_{it}.

This formula is also close to the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980), particularly, the so-called linear-approximate AIDS (LA/AIDS). However, this paper estimates an equation only for video game demand, rather than applying a system equation such as AIDS under a more complicated setting, mainly because our study stresses the simplicity of demand analysis focused on video games, and in practice, the sample size for estimation is not so large.

In the model, when the parameter β is more than zero, the good is a luxury, whereas when β is less than zero, it is a necessity. The total expenditure elasticity is described as $1 + \beta / w_{game}$, and it varies with the value of w_{game}. However, at least in the case of $\beta > 0$, it is guaranteed that the expenditure elasticity is more than one for any value of w_{game} (> 0), and that the good is not only a luxury (i.e., noninferior), but also has positive (in fact, more than one) expenditure elasticity, which means that the demand for the good positively relates to the income factor (i.e., total budget), in all ranges of w_{game}.[12]

For variables x and w_{game}, from the FIES, total living expenditure and video game expenditure's share of it are directly applied. The demographic variables n and n_k are also obtained from the FIES. In particular, as n_k, this paper defines the number of persons under 18 (n_1), persons 18–64 (n_2), and persons 65 or more (n_3); this categorization is detailed as far as possible in the FIES regional data.

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[12] On the other hand, when $\beta < 0$, the expenditure elasticity can take zero or negative value depending on the value of β and w_{game}, which means the income factor does not work or inversely works on demand, respectively.

For prices p, p_{game}, and p_j, the results of the *Consumer Price Index* (CPI) by the Statistics Bureau, MIC, are applied (the base year is 2000). First, for p, this paper uses the "general index, excluding imputed rent" of the CPI, and the reason for excluding imputed rent is that it is not included in the FIES as expenditure. Next, as p_j, this paper applies the price indices of 10 standard consumption goods groups (except for "video games") categorized both in the CPI and FIES; that is, 1. foods, 2. housing (excluding imputed rents), 3. fuel, light, and water, 4. furniture and household utensils, 5. clothing and footwear, 6. medical care, 7. transportation and communication, 8. education, 9. reading and recreation (here, excluding video games), and 10. miscellaneous. These indices for 47 prefectural capital cities can be directly obtained from the CPI data.

However, in the CPI, the most detailed (i.e., by-item) price index including "video games", which has been published separately from "toys" since 1995, is provided only for the whole of Japan and for the Ku-area of Tokyo. This paper complements this with data from the *Retail Price Survey*, which is the base survey for the CPI and surveys retail prices (not price indices, but prices directly) for each item by all prefectural capital cities, but it does not provide the data for the whole of Japan. Thus, this paper obtains the series of p_{game} by multiplying the CPI "video games" of the Ku-area of Tokyo by the ratio of each region to the Ku-area of Tokyo as regards retail prices in the *Retail Price Survey*.[13]

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[13] Here, to be exact, it should be noted that the CPI (and also *the Retail Price Survey*) surveys the price of a representative item in each category, and for the "video games", the price of only a specific game console is surveyed (since July 2000, it is Play Station 2). However, in practice, it is quite difficult to obtain more suitable data for p_{game} than this, especially regional data, and thus this paper applies it as the first step. It would be improved in future if some alternative dataset could be obtained. See also note 16.

IV. Results

The estimation results are presented in Table 1. The result of equation (2) is shown as column I, and equation (3) as column II in the table. They are estimated by weighted least squares, using the distribution of the number of households by region and year as weight. Because the FIES only provides relative values of household distribution compared with the Japan total in each time period, this paper adjusts it by the yearly changes of the total number of households, using the data of the *Labour Force Surve*y. In the table, results of year effects are omitted, which do not show statistically significant results.

Similar results are obtained in I and II. In both cases, the logarithm of the real total expenditure per capita shows a significantly positive effect on the share of video games. The estimated coefficient β indicates the relationship that the increase (decrease) of 10 per cent on real expenditure per capita yields approximately 0.00018 increase (decrease) of the expenditure share of video games. The estimated value of β seems to be credible, considering that the weighted average of w_{game} is 0.00098. Further, a positive β means that the expenditure elasticity of video games is more than one (i.e., the good is a luxury),[14] and further it guarantees that the demand for video games positively relates to the households' income factor in any w_{game}.

For demographic factors, the logarithm of the household's size does not show significant results, whereas a part of household composition, i.e., the proportion of young (under 18) persons in the household, shows significantly positive effects in both cases. The latter result verifies that households with more young persons tend to spend more on video games.[15] The estimated value of η_1 seems to be credible, considering that the weighted averages of n_1/n is 0.1816.

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[14] The total expenditure elasticity is evaluated as about 2.8 on the weighted average of w_{game}.

[15] We should note here that the dependent variable is defined as the expenditure share *per household*. As a result, the specification indirectly means that the total amount of video game demand in the whole economy varies with the total number of households.

For prices of goods, significant results of the logarithm of p_3, p_5, and p_{10} (in column I) or their relative prices to p_{game} (in column II) are shown. The result means that broad price relationships between consumption goods affect the demand for video games through households' budget allocation decisions. However, in particular, no significant results concerning p_{game}, p_9, and p_9/p_{game} are shown. This indicates that, basically, there is no evidence for prices of video games, other recreation goods, or their relative price having an effect on the demand for video games, although the possibility also cannot be denied that the incompleteness of the price series for video games or the high-aggregation of other goods affects the results.[16]

V. Conclusion

This paper estimated the demand model for video games, using the "total households" data of the *Family Income and Expenditure Survey*. The estimation results showed the effects of household income, demographic factors, and prices of goods on its expenditure share. These results indicate the importance of explicitly considering a household's budget allocation problem, or at least, including information on households for the studies on video games. Further, potentially, we may say that it is important to incorporate explicitly the household side for industrial studies more generally, not only as regards video games.

As stated earlier, in recent policy debates, Japanese video games are regarded as one of the most promising fields in the "content industry". However, on the other hand, the domestic market peaked in 1997, and its international competitiveness never seems to allow unqualified optimism for the future compared with the last 20 years. With the rapid progress of high-digital

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[16] Concerning this point, if we further estimate the formula by dropping the term $\ln(p_{game})$ on column I, the results of other terms remain almost the same. The estimation can be considered as the case that additionally assumes that the prices of video games have no regional differences, and in the result the term $\ln(p_{game})$ is included in year effects.

technologies and changes in households' economic and demographic circumstances, further studies of the industry would be valuable.

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Table 1. Estimated Video Game Demand

Dependent Variable: w_{game}

	[I]			[II]		
	coefficient	t-value		coefficient	t-value	
Constant	-0.02643	-3.829	**	-0.02680	-3.995	**
$\ln((x/p)/n)$	0.00179	3.693	**	0.00181	3.806	**
$\ln(n)$	0.00013	0.194		0.00014	0.212	
n_1/n	0.00506	2.431	*	0.00518	2.574	*
n_2/n	0.00190	1.107		0.00197	1.169	
$\ln(p_{game})$	-0.00157	-0.455		-		
$\ln(p_1)$	0.00282	0.583		-		
$\ln(p_2)$	-0.00174	-0.492		-		
$\ln(p_3)$	0.00643	1.984	*	-		
$\ln(p_4)$	-0.00198	-1.173		-		
$\ln(p_5)$	0.00551	3.168	**	-		
$\ln(p_6)$	-0.00514	-1.211		-		
$\ln(p_7)$	0.01626	1.366		-		
$\ln(p_8)$	0.00576	1.169		-		
$\ln(p_9)$	-0.00289	-0.623		-		
$\ln(p_{10})$	-0.01855	-3.031	**	-		
$\ln(p_1/p_{game})$	-			0.00267	0.558	
$\ln(p_2/p_{game})$	-			-0.00221	-0.759	
$\ln(p_3/p_{game})$	-			0.00628	1.979	*
$\ln(p_4/p_{game})$	-			-0.00190	-1.152	
$\ln(p_5/p_{game})$	-			0.00554	3.206	**
$\ln(p_6/p_{game})$	-			-0.00539	-1.313	
$\ln(p_7/p_{game})$	-			0.01406	1.891	
$\ln(p_8/p_{game})$	-			0.00525	1.188	
$\ln(p_9/p_{game})$	-			-0.00369	-1.147	
$\ln(p_{10}/p_{game})$	-			-0.01890	-3.184	**
S. E.	0.00055			0.00055		

Notes: Weighted Least Squares.
   Sample size is 235.
   * Significant at the 5% level.
   ** Significant at the 1% level.