Income Elasticity of Education and Smoking

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Abstract

The relationships among the income (expenditures) level, expenditure for education and tobacco consumption were analyzed based on the data of workers' households reported in Family Income and Expenditure Survey of Japan between 1980 and 1995. For all the observed years, elasticities of tobacco to living expenditure were less than -0.4 and the deviation from zero point had increased (-0.41 in 1980, and -0.95 in 1995). By contrast, elasticities of education to living expenditure were over 1.5 for the observed period. In the case of income elasticity, values of tobacco were negative with the same chronological tendency as in elasticity to living expenditure and those of education were around 1.10. The findings regarding the relationship between income level and tobacco consumption was quite different from most of the studies conducted in western countries, which suggested a positive elasticity between the two. According to the present results, we discussed two strategies in order to reduce the smoking prevalence rate in Japan: education and an increase in the cigarette price by higher cigarette taxes.

Key words: smoking, education, income, elasticity, Japan

Introduction

The positive relationship between the socioeconomic status and health conditions has long been discussed ¹⁻⁶. Economic status may affect one's health through the impact on accessibility to health services. It is also possible that people in the lower social class may tend to have unhealthy behavior, such as smoking, drug abuse, and alcoholism. Some researchers have tried to explain this relationship by the effect of poor education ^{7,8}. For example, Grossman ⁷ has suggested that additional years of schooling make the individual a more efficient producer of health, that is, as a wiser user of medical care, or abstain from cigarette smoking. Fuchs ⁸ has considered both education and healthy behavior as investment, and suggested that individuals with low rates of time discount would invest in many years of schooling and could also invest in health enhancing activities, such as abstinence of smoking.

By contrast, as shown in Table 1, previous studies have reported a positive income elasticity of cigarette consumption ⁹⁻¹², which means that wealthier people consume more cigarettes than poorer people. As the income level usually shows a positive relationship with the educational attainment level, the relationship among income, smoking habit and educational attainment level is not simple. Another important consideration is the cultural background. As most of the previous studies on these topics have been conducted in western countries, it is not always appropriate to rely on such findings in order to interpret factors associated with smoking behavior among the non-western population.

Table 1 Estimates of the income elasticity of demand for cigarettes in previous studies

Study	Estimated income elasticity	Method of estimation	Comments
Hamilton ⁹ (1972)	0.734	Ordinary Least Square regression	Aggregated cross-sectional data
Fujii ¹⁰ (1980)	0.339	Ridge regression	Aggregated time-series data
Lewit and Coate ¹¹ (1982)	0.039	Ordinary Least Square regression	Data of 28,033 individual from the 1976 Health Interview Survey
Godfrey and Maynard ¹² (1988)	0.680	Ordinary Least Square regression	Aggregated time-series data

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Japan is one of the countries with the highest smoking prevalence rate in the world (52.7% of adult males, and 10.6% of adult females)¹³⁾, although the educational attainment level of the general population is very high (over 95% of graduates of junior high school enter into high school, and 45 % of graduates of high school advance to higher education)¹⁴⁾.

It will be useful to know the relationship among economic condition, educational attainment level and smoking status in order to evaluate the effectiveness of anti-smoking strategies such as higher-pricing of cigarette and anti-smoking education. The notion of elasticity has been used for this kind of investigation. The purpose of this study is to evaluate the income/expenditure elasticities of tobacco and education using the results of the Family Income and Expenditure Survey of Japan, and to give a suggestion for its future anti-smoking policy from the viewpoint of health economics.

The Family Income and Expenditure Survey

The Family Income and Expenditure Survey (FIES) is a sample survey carried out annually by the Japanese government as one of the designated statistics issued on the basis of the Statistics Law. The aims of FIES is to provide comprehensive data on incomes and expenditures of consumers in Japan. The data are used in various fields such as policy making and econometric analysis. The survey covers all the consumer households in Japan except for those engaged in agriculture, forestry or fishery and one-person households. About 8,000 households are randomly selected for the survey out of about 29 million appropriate households. The sample households are selected based on the three-stage stratified method, that is, the municipality, survey unit area, and the household. The sample households are requested to keep daily accounts of all the transactions both in money and in kind in the household economy. The account books are collected monthly over period of 12 months.

Material and methods

In FIES data, the volume of all goods and service consumed are stratified by yearly income decile groups. Using these data obtained between 1980 and 1995, we evaluated the expenditure and income elasticity of tobacco (over 99% of tobacco consumed in Japan is cigarettes) and education. The notion of income elasticity is as follows: The income (or expenditure) elasticity of

demand is change in quantity of demand divided by change in income (or expenditure). If elasticity exceeds 1 in absolute value, it signifies that change in demand is greater than the change in income (or expenditure).

The models used in this analysis are:

Model 1: $\ln(Y) = a_0 + a_1 \ln(LE)$

where Y=expenditure of each item to be evaluated, LE= living expenditures,

a_0 = intercept, and a_1 = elasticity of expenditure on each item to living expenditures.

Model 2: $\ln(Y) = a_0 + a_1 \ln(INC)$

where Y=expenditure of each item to be evaluated, INC= yearly income,

a_0 = intercept, and a_1 = income elasticity of each item.

In order to make the studied population relatively homogenous in pattern of revenue and expenditure, the used data were limited to workers household (about 5,000 for each year) in this analysis, according to the suggestion of Tanaka and Mikami¹⁵⁾.

Results

Table 2 presents the yearly average income of workers households by yearly income decile groups in 1980, 1985, 1990 and 1995. The difference in income was around 4.8 times between the highest decile group and the lowest decile group in 1995.

Table 3 shows the yearly average of monthly receipts and disbursement per household by yearly income decile groups in 1980, 1985, 1990 and 1995. Expenditures for tobacco showed a decreasing tendency along with income level. Correlation analyses showed a significantly negative correlation between expenditures for education and those for tobacco (1980: -0.876, 1985: -0.905, 1990: -0.873, 1995: -0.863; $p < 0.01$). Furthermore, according to chronological observation, expenditures for tobacco showed a decreasing tendency in all income groups, and this phenomenon was more apparent in higher income groups. The reduction in percentage between 1980 to 1995 [(value in 1980-value in 1995)/value in 1980] was 57.3% in the highest income class, 18.2% in the lowest income class, and 4.5% in the second lowest class.

Table 4 presents the elasticity to living expenditures and income

Table 2 Chronological changes of yearly income by decile groups between 1980 and 1995 in workers households

Yearly income decile groups	I	II	III	IV	V	VI	VII	VIII	IX	X
1980 YI (10,000 yen)	190	256	296	330	366	407	453	510	602	837
Index (I = 100)	100	135	156	174	193	214	238	268	317	441
1985 YI (10,000 yen)	233	323	376	429	482	538	602	681	793	1106
Index (I = 100)	100	139	161	184	207	231	258	292	340	475
1990 YI (10,000 yen)	278	387	452	513	577	644	716	812	951	1308
Index (I = 100)	100	139	163	185	208	232	258	292	342	471
1995 YI (10,000 yen)	316	444	518	591	665	741	828	939	1094	1524
Index (I = 100)	100	141	164	187	210	234	262	297	346	482

Source: Family Income and Expenditure Survey (1980, 1985, 1990, 1995)

YI: Yearly Income

Table 3 Yearly average of monthly receipts and disbursements per household by yearly income decile groups between 1980 and 1995 in workers' households ; yen)

	Yearly income decile groups	I	II	III	IV	V	VI	VII	VIII	IX	X	Cor Coef Edu-Tobac *
1980	Living expenditures	147,389	177,884	191,573	206,548	220,327	234,752	247,565	277,294	302,587	375,336	$r = -0.876$
	Education	3,458	4,490	5,236	6,524	8,632	8,682	9,269	12,823	12,989	14,267	$r^2 = 0.768$
	Tobacco	1,675	1,583	1,553	1,448	1,274	1,209	1,249	1,131	1,218	1,260	$p < 0.01$
1985	Living expenditures	173,992	210,328	231,007	247,963	261,325	285,172	316,110	336,937	374,430	457,629	$r = -0.905$
	Education	4,068	5,581	7,540	8,492	9,332	12,419	14,422	16,854	20,498	22,362	$r^2 = 0.819$
	Tobacco	1,869	1,745	1,487	1,446	1,381	1,287	1,396	1,039	1,190	998	$p < 0.01$
1990	Living expenditures	199,492	234,754	261,969	280,180	313,543	339,507	351,070	386,877	427,011	521,544	$r = -0.873$
	Education	6,520	7,067	9,559	12,787	14,110	19,731	18,637	24,108	25,608	30,140	$r^2 = 0.762$
	Tobacco	1,589	1,517	1,130	1,192	1,241	1,218	1,111	827	997	849	$p < 0.01$
1995	Living expenditures	213,575	254,133	272,831	307,883	324,886	360,029	371,810	410,802	447,584	533,101	$r = -0.863$
	Education	7,509	8,214	9,359	12,899	16,385	21,410	22,448	26,242	30,954	29,249	$r^2 = 0.744$
	Tobacco	1,371	1,511	1,139	1,050	1,089	1,031	908	1,013	796	538	$p < 0.01$

Source: Family Income and Expenditure Survey (1980, 1985, 1990, 1995)

* Corr Coef Edu - Tobac: Correlation coefficient between education and tobacco expenditures

elasticity of education and tobacco. For all the observed year, elasticities of tobacco to living expenditures were less than -0.4 and the deviation from zero point had increased (-0.41 in 1980, and -0.95 in 1995). By contrast, elasticities of education to living expenditures were over 1.5 for the observed period. In the case of income elasticity, values of tobacco were negative with the same chronological tendency as in elasticity to living expenditures and those of education were around 1.10.

Discussion

There is no doubt that smoking is harmful to one's health. According to our results, people in a lower economic status consume more tobacco than people in a higher economic status in Japan. This finding is different from the results of similar studies conducted in western countries as shown in Table 1⁹⁻¹²⁾. Most of them reported a positive income elasticity of cigarettes. However, as there is a positive correlation between educational attainment level and income, and as there is a negative correlation between educational attainment level and smoking status, it should be reasonable to observe a negative correlation between income and smoking status.

It has been reported that cigarette smoking and educational level are negatively correlated^{7,8)}. Also in the present study, there is a significantly negative correlation between money allocated to education and money allocated to tobacco. It should be noted that money allocated to education in this study is money allocated to the education of children and not to that of adults. However, as the educational attainment level shows a highly positive correlation between parents and children in Japan¹⁵⁾, we have considered that this variable represents the educational characteristics of each household. So far as the mechanism of this relation is concerned, Grossman⁷⁾ has hypothesized that education makes an individual a more efficient producer of his own health. Education could increase knowledge about health effects of risky behavior such as smoking, change preferences, or train a person to better process and act upon information. Besides the direct effect that Grossman has suggested, Fuchs⁸⁾ has reported one or more "third variables" that affect both smoking

and education. He explained the negative correlation between smoking and years of schooling using a concept of time preference (or time discount). The acceptance of a current cost for a future benefit constitutes an investment. It is reasonable to consider education as a form of investment for the future; a decision about cigarette smoking has a similar characteristic for one's future health. In his empirical study, he clarified a significant correlation among smoking, years of schooling, and time preference, and then suggested that individuals with low rates of time discount would invest in many years of schooling and could also invest in health enhancing activities, such as abstinence from smoking. The negative correlation between money allocated to education and that to tobacco observed in our study supports Fuch's hypothesis.

Interestingly, our results have clarified that people in a higher economic class put out more money for the education of their children compared with people in the lower economic class. Thus, children in a higher socio-economic status, may have a better chance of being in a socio-economically well situation in the future. Furthermore, if general education has a regulatory effect on the younger generation to start smoking, children in a

Table 4 Elasticity to living expenditure and income elasticity of tobacco and education between 1980 - 1995 in workers' household

	Elasticity to living expenditure			Income elasticity		
		p-value*	r ² **		p-value*	r ² **
1980						
Education	1.70	< 0.01	0.920	1.08	< 0.01	0.920
Tobacco	-0.41	< 0.01	0.626	-0.26	< 0.01	0.631
1985						
Education	1.93	< 0.01	0.964	1.22	< 0.01	0.962
Tobacco	-0.66	< 0.01	0.863	-0.42	< 0.01	0.877
1990						
Education	1.82	< 0.01	0.941	1.15	< 0.01	0.927
Tobacco	-0.66	< 0.01	0.760	-0.42	< 0.01	0.769
1995						
Education	1.87	< 0.01	0.911	1.11	< 0.01	0.878
Tobacco	-0.95	< 0.01	0.808	-0.58	< 0.01	0.822

* test of significance by F distribution for estimated parameter

** Coefficient of determination of regression equation

lower socio-economic class are more than likely to be smokers and thus to be victims of smoking related illnesses in the future. In order to prevent this kind of social inequality, anti-smoking health education must be integrated into the general education system. If anti-smoking health education is appropriately installed in the primary and secondary education system, some regulatory effect can be expected. Furthermore, social campaign for anti-smoking must be also strengthened in order to make such education be effective. In fact, anti-smoking campaign, such as generalization of smoking-prohibited zone in working places and public places, and distribution of anti-smoking messages through various kind of media, is becoming more and more popular in Japan. Chronological reduction in expenditure for cigarette between 1980 and 1995 observed in Table 3 could be attributed to the effect of recent anti-smoking movement in our society. However, it should be noted that this reduction was less apparent in lower economic classes. This fact indicates that people in lower economic classes are less compliant to such anti-smoking messages. Therefore, we have to prepare some special programs in order to sensitize this sub-population and to reduce the smoking prevalence among them.

As income elasticity of cigarette is negative, higher-pricing of cigarette is an effective strategy to reduce cigarette consumption

among the lower economic class population. However, as cigarette is addictive, such a strategy cannot be very effective for reducing the smoking prevalence among the regular smoker. More important strategy is to reduce the smoking incidence. Previous studies suggested that an increase in the price of cigarettes appears to curtail smoking, particularly the initiation of smoking among teenagers^{10-12, 17-19}. Since teenagers are more sensitive to changes in cigarette prices than adults, the increase of the cigarette tax may be a useful strategy to prevent or delay the onset of smoking in the younger generation, especially among those in lower economic classes. Given the evidence that individuals are considerably less likely to initiate smoking after age twenty-five, it is quite possible that the cohort of the younger generation who never began to smoke as a result of the tax increase would never become regular smoker¹⁷.

Finally, this study was a kind of ecologic study based on macro-level aggregated data, that is, the FIES data are in term of household, rather than individual behavior. This kind of cross-sectional data do not contain information on long term health behavior and attitude. In order to evaluate the validity of our results, we should conduct an individual based investigation on this subject in future research programs.

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