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ALCOHOLIC CONSUMPTION AND
LABOR PRODUCTIVITY IN JAPAN

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Abstract

This paper examines the relationship between labor productivity and alcohol consumption based on research conducted with a limited sample of workers who drink alcohol. Estimation results show that in the case of males, the amount of alcohol consumed significantly raises labor productivity, with an elasticity of approximately 0.13. In females, we cannot reach the firm conclusion. Conversely, the reverse relationship between labor productivity and alcohol consumption cannot be confirmed. Moreover, an awareness of appropriate alcohol consumption supports the sixth strategy of the Health Japan 21 policy, which is to reduce national alcohol consumption by about 20%.

1 Introduction

The study of alcohol consumption is a contentious issue in the research field of addictive behaviors other than smoking. The main problem is in the relationship between labor supply and drinking behavior. There are currently a large number of investigations into this problematic relationship in the United States.

Unfortunately, the results are mixed. That is, problem drinking does not seem to influence employment (Benham and Benham(1982), Kenkel and Ribar(1994), Feng, Zhou, Butler, Booth and French(2001)). Regarding the effect of problem drinking on income, Berger and Leigh(1988), Bryant, Samaranayake and Whilhite(1993), French and Zarkin(1995), and Zarkin, French and Mroz et al.(1998) found that drinkers earned more than non-drinkers. Conversely, Kenkel and Ribar(1994), French and Zarkin(1995), and Mullahy and Sindelar(1993) found that heavy drinkers' wages or income were lower than those of light drinkers.

Moreover, from the macroeconomic perspective, Ruhm(1995) and Freeman(1999) confirmed that alcohol consumption moves pro-cyclically; i.e., it increases during an economic boom. On the other hand, Thomas(2001) concluded that the stress from anxiety over being unemployed in a period of recession raises the levels of alcohol consumption. The different conclusions of these two research projects are probably attributable to the type of data used. That is, the former used macro data and the latter used micro data.

The relationship between labor productivity and drinking is emphasized in the Health Japan 21 health promotion policy in Japan (The Committee for Health Japan 21(2000)). It is similar to Healthy People 2010 in the United States. This policy declares the following targets in a bid to reduce problem drinking:

- a 20% reduction in the number of heavy drinkers,

- the elimination of drinking among minors, and

- the spread of public health knowledge about moderate and appropriate drinking.

This paper evaluates the Health Japan 21 policy from the viewpoint of health economics. Firstly, it checks the reliability of the relationship between labor productivity and drinking. As mentioned above, it has been investigated in many countries, but is yet to be studied in Japan. For our research, we focus on a sample of workers who drink alcohol.

It is a truism to say that labor productivity and drinking are simultaneously determined. That is, alcohol consumption may decrease (or rise) labor productivity *ceteris paribus*, but labor productivity, which is measured by wage or labor income, raises alcohol consumption if it is a normal good. Hence, we have to estimate these relationships by using the simultaneous equation system.

Secondly, this paper checks the effectiveness of the third point emphasized in the policy targets. In other words, we investigate how the diffusion of such knowledge reduces alcohol consumption. It is well known that knowledge of the harm of smoking does not affect the behavior of smokers in Japan (Sato and Ohkusa(2002)). Hence, it may also be the case that knowledge of moderate and appropriate drinking will not affect drinking behavior. Incidentally, Health Japan 21 also declares its intention to spread the knowledge of harm from smoking as a policy target.

2 Data

The data were obtained from a survey conducted in May 2001 in Japan. Of the total 1300 questionnaires distributed, 1024 were completed and returned. Concerning alochol consumtion , the questionnaires ask how much they drink

alochol in average by unit of pure alcohol. Other important information collecting in this survey are as follows.

Knowledge of the harm of alcohol depends on the answer to the following question:

"How many drinks a day do you think is harmful for your health generally with respect to sake? One drink of sake (180ml) is equivalent to a medium bottle of beer (500ml), double shots of whiskey or brandy (60ml), one drink (180ml) of shochu of 35%, or one glass of wine (120ml)."

The level cited as harmful for health in Health Japan 21 is one drink of sake, which is equivalent to 20g pure alcohol (Tsugane, Fahey, Sasaki, et al.(1999), Holman, English, Milne, et al.(1996)).

Two levels of knowledge about the effects of alcohol on health are defined here. The first definition is rigorous; that is, only those who answer exactly one drink of sake have the required knowledge. The second definition is somewhat broad; that is, those who answer less than or equal to one drink of sake have the required knowledge. Hereafter, we call the former definition rigorous and the latter definition broad. The rigorous definition means that those who excessively evaluate the harm of alcohol do not have the required knowledge, although the broad definition includes them together with well-informed persons.

The death cause or morbidity of their parents are dichotomous variables and are defined to be one if they either died from or have liver cancer, hepatitis or cirrhosis, and zero otherwise. Genetic characteristics which are not controlled by individuals may be captured and thus make ideal instruments.

Following Barsky, Juster, Kimball and Shapiro (1997), we construct the variables for time discount factor and risk aversion as follows. The question for time discount factor is: "What amount of money will you gain in ten years that is equivalent to the one million yen you currently get? And the question for risk

aversion is: "What amount of money will you gain with 50% probability and with 50% probability you will not gain that is equivalent to the one million that you get now with certainty?" Let the response for the latter question be x and assume utility function be in the exponential form. In this case, the relationship $100^\alpha = 0.5x^\alpha$ holds, and this indicates $\alpha = \log 2/(\log x - \log 100)$. Thus risk aversion is defined by $-u''(c)c/u'(c) = 1 - \alpha$. Time discount factor is calculated by $100^\alpha = \beta^{10}y^\alpha$ and thus $\beta = (100/y)^{\alpha/10}$ where y is the response for the former question.

3   Estimation Model

Let A_i be the level of alcohol consumption and I_i be the labor productivity which is measured by labor income for the ith individual. X_i denotes independent variables which explain both the alcohol consumption and labor productivity, and Y_i denotes instrument variables for alcohol consumption and that do not explain the labor productivity. Conversely, Z_i denotes instrument variables for labor productivity and that do not affect alcohol consumption. Thus, we estimate

$$
\begin{aligned}
\log A_i &= \alpha + \alpha_X X_i + \alpha_I \log I_i + \alpha_Y Y_i + \varepsilon_i \\
\log I_i &= \beta + \beta_X X_i + \beta_A \log A_i + \beta_Z Z_i + v_i
\end{aligned}
\tag{1}
$$

by using a three stage least square method (hereafter, we refer to it as 3SLS).

In particular, we use the quadratic function of age, income other than labor income, educational attainment, time discount factor, risk aversion rate, and self-assessed health. The quadratic function of age and self-assessed health is often used as an indicator for health condition and implies general human capital and health capital, respectively, in labor productivity. Income other than labor income determines marginal utility of income; i.e., the higher the other income,

the lower the marginal utility of income. This other income captures the pure income effect excluding price effect. Educational attainment implies general human capital in labor productivity and level of knowledge about alcohol consumption. According to the serial health capital research literature (Grossman(2001)), it does imply efficiency in health investment and thus a highly educated person would be expected to be more healthy *ceteris paribus*.

The instrument variables for alcohol consumption are knowledge about the harm of alcohol, cause of death or morbidity in their parents, and the duration of drinking.

According to the Rational Addiction Model (Becker and Murphy(1988)), when the duration of drinking is longer, implying a high accumulation of drinking over time, the marginal utility of drinking rises and the individual needs more alcohol to make price equal the marginal utility of drinking. Hence, the duration of drinking increases alcohol consumption. However, the duration of drinking or drinking behavior may have affected labor productivity in the past, and may affect current labor productivity. In that case, the duration of drinking affects not only current alcohol consumption, but also current labor productivity. In this sense, it is not an ideal instrument. In the following analysis, we perform both cases where the duration of drinking is used and not used as an instrument for assessing alcohol consumption.

Next, the instrument variables for labor productivity are the quadratic function of tenure, the interaction of age and tenure, and employee size. These are very popular variables in the Mincer type wage function applied to the Japanese labor market.

Summary statistics are shown in Table 1. As shown below, the unit of alcohol consumption is one drink of sake, which is equivalent to 20g pure alcohol. It indicates that only 5-6% of respondents have knowledge of the rigorous definition,

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but 18% have knowledge of the broad definition.

4   Estimation Result

The estimation results for drinking and labor productivity in the rigorous defini-
tion are summarized in Tables 2 and 3. Those of the broad definition are shown
in Tables 4 and 5.

Before evaluating the estimators, we must perform the Hausman test under
the null hypothesis that Ordinary Least Square (OLS) is equivalent to Instru-
mental Variable Methods (IV). If this test result is not rejected, alcohol con-
sumption/labor productivity is exogenous and thus we do not need to use IV and
OLS is appropriate because it is more efficient than IV. Conversely, if the result
is rejected, alcohol consumption/labor productivity is endogenous and thus we
have to use IV because OLS is inconsistent. Almost all the test statistics, except
for labor productivity in females under the broad definition, are very low and are
not rejected. Moreover, F statistics in the first step, where the instrument vari-
able regresses on endogenous variables, are lower than 10 except for male labor
productivity. While we relax the criterion to be more than 8, the estimation for
alcohol consumption overcome these condition. In this case, labor productivity
of female does not sufficient strong instruments (Bound, Jaeger and Baker(1995),
Staiger and Stock(1997)). Therefore, these test statistics mean we should refer
the estimation result in OLS for alcohol consumption in both gender and labor
productivity in male, and we do not consider about labor productivity in female
due to lack of appropriate instruments.

Let us evaluate the relationship of most concern, which is between alcohol
consumption and labor productivity. The estimated estimator shows that labor
productivity does not significantly affect alcohol consumption, but the reverse

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relationship is significantly positive except for males under the rigorous definition. Moreover, the estimated elasticity is less than 1 for males, but it is more than 1 for females. However, we have to remember that the female case is characterized by high endogeneity in labor productivity and weak instruments.

In alcohol consumption estimation other than labor productivity, it is an increasing concave function of age, with peaks at 50 years of age for males and 42 years of age for females. Only female medical school graduates practice risk aversion and decrease alcohol consumption. Healthy persons, whose self-assessed health condition is excellent, tend to drink more compared with those who report a fair or bad health condition.

The duration of drinking gradually increases the amount of drinking as the theory predicts. An additional 10 years of drinking experience raises the amount drunk by 22% in males and 12% in females. The cause of death or morbidity in parents is not significant. Conversely, the knowledge in the broad definition significantly reduces drinking. This result supports the strategy of Health Japan 21. Note that this does not imply causality in the rigorous sense. In other words, it is not clear in this estimation whether knowledge exactly reduced drinking or heavy drinkers justify their consumption levels as appropriate.

For estimation of labor productivity for effects other than alcohol consumption, tenure in males and age in females are significant. The reason for insignificance of age in males seems to be long-term employment in Japan and there is thus a high covariance of age and tenure. For males, other labor income is low when other income is high. This pattern appears to reflect part-time work of dependents of more than 20 years age. Low earnings for self-employed and part-time work is a matter of course. Health conditions do not affect labor productivity.

In order to check the robustness of the results obtained, we estimate another specification omitting duration of drinking as instrument variables[2]. The esti-

mation results are summarized in Tables 6 and 7. Though omitting duration of drinking does not affect alcohol consumption, it affects the labor productivity result. Specifically, the estimated elasticity is more than 1 for males, but the Hausman test indicates that OLS is appropriate. For females, alcohol consumption does not significantly affect this specification.

5   Concluding Remarks

For males, OLS results with the Hausman test show the amount of drinking rises labor productivity significantly and its elasticity is about 0.13. Conversely, female case is suffered from weak instruments and thus we cannot reach the form conclusion. The potential reason for this may be the small sample size, which is half that of males, and/or more heterogeneous than male. Thus, we cannot make conclusions about the female case and suggest further research.

Moreover, the knowledge of the harmful effects of alcohol reduces drinking by 20% in males and supports the Health Japan 21 strategy. On the other hand, labor productivity or income does not affect alcohol consumption.

Since this is the first investigation of drinking and labor productivity in Japan, the results obtained allow us to make only tentative conclusions. We need to check the robustness of our research by using other data, methods and instruments.

Footnotes

1) Other than the relationship with labor supply, there is considerable empirical research on alcohol from the viewpoint of health economics. Baughaman, Colin, Dickert-Conlin, Pepper(2001) analyzed the effects of drinking regulations on traffic accidents and found that such a regulation increases the rate of accidents. On the other hand, Pinka and Markowitz(2001) could not establish a robust relationship between mothers' alcohol consumption and their children's behavior.

2) The estimation under another specification is performed in the broadly defined knowledge because it provides more interesting results in the above estimation. There is no substantial difference between the two definitions of knowledge.

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Table 1: Summary Statistics

	Male		Female	
	Average	Std. Dev.	Average	Std. Dev.
Labor Income(log)	6.192261	1.088171	4.820081	1.068712
Alcohol Cons.(log)	.999656	.6083761	.5379219	.43564
Age	43.14043	11.91444	41.12286	12.49203
Age^2	2002.832	1065.795	1846.694	1060.113
Tenure	14.64953	11.2756	7.338192	8.227178
Tenure^2	341.5498	436.1824	121.3382	264.8124
Age·Tenure	707.014	668.5376	356.4082	484.7816
Other Income(log)	2.464473	3.00303	6.044326	1.614122
Education Attainment				
Medical School	.0092879	.0959996	.0028653	.0535288
Other University	.495356	.5003659	.2091691	.4072993
Two Years College	.0263158	.1601967	.2406877	.4281148
Vocational School	.0928793	.2904881	.1232092	.329149
Time Discount Factor	.8859264	.0754176	.8915542	.0760757
Risk Aversion	.1334806	.1545627	.116444	.1411296
Self Assessed Health				
Good	.3051643	.4608377	.3409742	.4747173
Fair	.5117371	.5002538	.5071633	.5006665
Poor	.0985915	.2983464	.1002865	.3008129
Very Poor	.0156495	.1242123	.008596	.0924477
Goverment Employee	.0740741	.2620937	.04	.1962397
Self Employed	.1450617	.3524351	.1228571	.3287431
Part Time Job	.0262346	.1599556	.5657143	.4963724
Firm Size(log)	4.72599	2.28262	3.847275	2.122926
Knowledge Level	.0524691	.2231434	.0628571	.2430533
Knowledge Level(2)	.1805556	.3849467	.1857143	.3894327
Morbidity in Parents	.1033951	.3047094	.0857143	.2803425
Drinking Duration	21.57935	11.10908	16.46285	10.50488

Note:Sample size is 643 in male and 350 in female.

Table 2: Estimation Result in Alcohol Consumption

	3SLS		OLS	
	Male	Female	Male	Female
Labor Income(log)	.0097332	.0456081	.0286383	.0260648
Age	.056246***	.0465336***	.0549352***	.0392732**
Age^2	-.0005727***	-.0005583***	-.0005536***	-.000472***
Other Income(log)	.0046057	-.0207122	.0061013	-.015491
Education Attainment				
Medical School	-.3922111	-.8569118*	-.3857193	-.790234*
Other University	-.0761214	-.0433436	-.0954014*	-.0234935
Two Years College	.059898	-.0273993	.0441416	-.0152943
Vocational School	.0071876	.0276715	.0073094	.0402326
Time Discount Factor	-.0897377	-.2899026	-.0895623	-.2491723
Risk Aversion	.0974137	-.5957341***	.1105082	-.5561271***
Self Assessed Health				
Good	-.1278031	-.0823639	-.1219897	-.0820405
Fair	-.1716826*	-.0779425	-.1627078*	-.0719642
Poor	-.2050657*	-.2593828*	-.1923044*	-.2423169*
Very Poor	-.1296732	-.1225815	-.1273477	-.1113445
Knowledge Level	-.0312078	.0309553	-.0237749	.03618
Morbidity in Parents	-.0157774	.0545959	-.0143534	.0469279
Drinking Duration	.0221136***	.012405***	.0219188***	.0127898***
constant	-.5462771	-.3440808	-.6367792	-.1995851
Hausman Test	7.71	6.63		
p-value	0.73	0.25		
F stat(1st step)	8.24	8.78		
p-value	≤0.0000	≤0.0000		
F stat(2nd step)	13.02	3.58	13.83	3.39
p-value	≤0.0000	≤0.0000	≤0.0000	≤0.0000
$\overline{R}^2$	0.2674	0.1223	0.2757	0.1149

Table 3: Estimation Result in Labor Income

	3SLS		OLS	
	Male	Female	Male	Female
Alcohol Cons.(log)	.4599617	1.33893**	.1339077*	.1273949
Age	.0334321	-.130719**	.062083*	-.0397929
Age^2	-.0004334	.0014811**	-.0006702*	.0004646
Tenure	.0512598*	.0669202	.0538695**	.0439066
Tenure^2	-.000096	.000481	-.0000653	.0003651
Age·Tenure	-.0005259	-.0010649	-.0005863	-.0005719
Other Income(log)	-.0236258*	.0589067	-.0215961	.029733
Education Attainment				
Medical School	-.5278725	1.604901	-.6628151	.6584168
Other University	.3512312***	.0362669	.3287081***	.0089018
Two Years College	.2665785	-.1400049	.2660608	-.1750401
Vocational School	.1716071	.0717846	.1703461	.156441
Time Discount Factor	.2917005	1.134021	.3035178	.8768537
Risk Aversion	-.0318548	.8479043*	.0156771	.1944511
Self Assessed Health				
Good	-.1904141	.1793413	-.2425456	.070973
Fair	-.0311075	.1418404	-.1002714	.0210541
Poor	-.0150414	.5538471	-.0891181	.2070738
Very Poor	.0616582	.7434778	-.0040772	.6167716
Goverment Employee	-.0884288	.36709	-.1064286	.3264826
Self Employed	-.3363858**	-1.149695***	-.2849229**	-1.113089***
Part Time Job	-.7700529***	-1.054122***	-.7598206***	-1.174005***
Firm Size(log)	.0401534	.0124207	.0421536*	.0150725
constant	4.388965***	5.78408***	3.993381***	5.115168***
Hausman Test	4.95	6.63		
p-value	0.9989	0.2496		
F stat(1st step)	14.56	3.53		
p-value	≤0.0000	≤0.0000		
F stat(2nd step)	7.04	6.61	7.45	9.00
p-value	≤0.0000	≤0.0000	≤0.0000	≤0.0000
$\overline{R}^2$	0.1626	0.0862	0.1929	0.3523

Table 4: Estimation Result in Alcohol Consumption under Another Information Definition

	3SLS		OLS	
	Male	Female	Male	Female
Labor Income(log)	-.0024074	.0478219	.024915	.0270465
Age	.055175***	.0454807***	.0529184***	.0380158**
Age^2	-.0005533***	-.0005416***	-.0005244***	-.0004524**
Other Income(log)	.0058485	-.0200375	.0075709	-.0153611
Education Attainment				
Medical School	-.4313849*	-.8079828*	-.4185234*	-.7278953*
Other University	-.083297	-.0462229	-.1047405**	-.0278087
Two Years College	.0337495	-.0292963	.0137051	-.0186063
Vocational School	-.002611	.0307527	-.0032938	.043636
Time Discount Factor	-.1510412	-.269825	-.1550303	-.2203742
Risk Aversion	.1052713	-.5938243***	.1176636	-.5539879***
Self Assessed Health				
Good	-.132076	-.0912049	-.124683	-.0910628
Fair	-.1814609**	-.0865325	-.1724246*	-.0820336
Poor	-.2048198*	-.2548128*	-.1912336*	-.2370446*
Very Poor	-.153765	-.144767	-.1496814	-.1369673
Knowledge Level	-.1524088**	-.0626086	-.1522299**	-.0777138
Morbidity in Parents	-.00885	.0509993	-.0065359	.0452682
Drinking Duration	.0217493***	.0122161***	.0215486***	.0125643***
constant	-.3673267	-.3395605	-.4855488	-.1851095
Hausman Test	7.24	6.18		
p-value	0.7790	0.2889		
F stat(1st step)	8.24	8.78		
p-value	≤0.0000	≤0.0000		
F stat(2nd step)	13.51	3.64	14.37	3.49
p-value	≤0.0000	≤0.0000	≤0.0000	≤0.0000
$\overline{R}^2$	0.2739	0.2748	0.2840	0.1192

Table 5: Estimation Result in Labor Income under Another Information Definition

	3SLS	
	Male	Female
Alcohol Cons.(log)	.6096822*	1.2654**
Age	.0209581	-.1252006**
Age^2	-.0003307	.0014195**
Tenure	.0508204*	.0655234
Tenure^2	-.0000979	.000474
Age·Tenure	-.0005232	-.001035
Other Income(log)	-.0241065*	.0571361
Education Attainment		
Medical School	-.4628512	1.547458
Other University	.3605664***	.0346061
Two Years College	.2670884	-.1421312
Vocational School	.1697773	.0769225
Time Discount Factor	.2996624	1.118413
Risk Aversion	-.0503578	.8082451
Self Assessed Health		
Good	-.1666308	.1727643
Fair	-.0026433	.1345097
Poor	.0178674	.5328008
Very Poor	.0917028	.7357878
Goverment Employee	-.0795142	.3646255
Self Employed	-.3539808**	-1.147473***
Part Time Job	-.7726295***	-1.061398***
Firm Size(log)	.0402156	.0125816
constant	4.539304***	5.743483***
Hausman Test	6.93	51.05
p-value	0.9907	0.0001
F stat(1st step)	15.17	3.63
p-value	$\leq$0.0000	$\leq$0.0000
F stat(2nd step)	6.86	7.45
p-value	$\leq$0.0000	$\leq$0.0000
$\overline{R}^2$	0.1616	0.1929

Table 6: Estimation Result in Alcohol Consumption (excluding Drinking Duration)

	3SLS		OLS	
	Male	Female	Male	Female
Labor Income(log)	-.0409866	.0468702	.0240276	.0380364
Age	.0861011***	.0628476***	.0784957***	.0574183***
Age^2	-.0006918***	-.0006596***	-.0006083***	-.0005905***
Other Income(log)	.002604	-.0262538	.0059179	-.0207335
Medical School	-.5285812**	-.6925939	-.4877068**	-.6271804
Other University	-.0700843	-.0226112	-.1054648**	-.0057627
Two Years College	-.0228453	-.0125181	-.0596032	-.0001838
Vocational School	.0216982	.078558	.0102068	.091081
Time Discount Factor	-.1687941	-.2832074	-.1809854	-.2459426
Risk Aversion	.1329646	-.5299202***	.1384802	-.4923349***
Good	-.1751032*	-.1072791	-.1590201*	-.112374
Fair	-.2149321**	-.1043509	-.2012263**	-.1045483
Poor	-.2197496*	-.2962287**	-.2061258*	-.2825446**
Very Poor	-.213145	-.1748202	-.1983901	-.1765419
Knowledge Level	-.1886683***	-.0692067	-.1785905***	-.0861231
Morbidity in Parents	-.0194316	.0783688	-.0187921	.0719122
constant	-.653976	-.5691712	-.8857697**	-.5025754
Hausman Test	7.38	5.89		
p-value	0.7676	0.3170		
F stat(1st step)	8.24	8.78		
p-value	≤0.0000	≤0.0000		
F stat(2nd step)	12.29	2.77	13.29	2.69
p-value	≤0.0000	0.0004	≤0.0000	0.0005
$\overline{R}^2$	0.2338	0.0864	0.2748	0.0794

Table 7: Estimation Result in Labor Income (excluding Drinking Duration)

| | 3SLS | |
	Male	Female
Alcohol Cons.(log)	1.30437*	1.226542
Age	-.0334041	-.1222843
Age^2	.0001083	.0013868
Tenure	.0495371	.0647853
Tenure^2	-.0000707	.0004703
Age·Tenure	-.0005476	-.0010192
Other Income(log)	-.0227749	.0562004
Medical School	-.1597815	1.517101
Other University	.3981458***	.0337284
Two Years College	.2725888	-.1432549
Vocational School	.1363394	.0796377
Time Discount Factor	.427949	1.110165
Risk Aversion	-.1119825	.7872871
Good	-.0488073	.1692886
Fair	.124932	.1306357
Poor	.1693323	.5216789
Very Poor	.2370051	.731724
Goverment Employee	-.046888	.3633231
Self Employed	-.4186798**	-1.146299***
Part Time Job	-.7743614**	-1.065243***
Firm Size(log)	.0458329	.0126667
constant	5.055997***	5.722029***
Hausman Test	8.13	43.99
p-value	0.9449	0.0003
F stat(1st step)	14.08	2.70
p-value	$\leq$0.0000	0.0007
F stat(2nd step)	5.09	6.72
p-value	$\leq$0.0000	$\leq$0.0000
$\overline{R}^2$	0.1584	0.1333