Assignment Subject

Applied Microeconomics

Assignment Topic

Consumption Function Estimation in China

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Submitted Date

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Consumption function estimate in China
(Post-1978 reform era)

Introduction

Since China's "Reform and Opening up" policy was implemented in 1978,all dominant economic forces are activated to a larger extent.During last three decades,continuous almost 10% growth rate makes China become the second largest economy based on nominal exchange rate.The consumption expenditure has expanded to an unprecedented degree,also consumption structure is vastly changed among Chinese households**(Fig 1,2)**.This paper simply examines the relationship between Consumption expenditure and disposable income(use GDP as its proxy) from 1978-2014**(Fig 3)**.

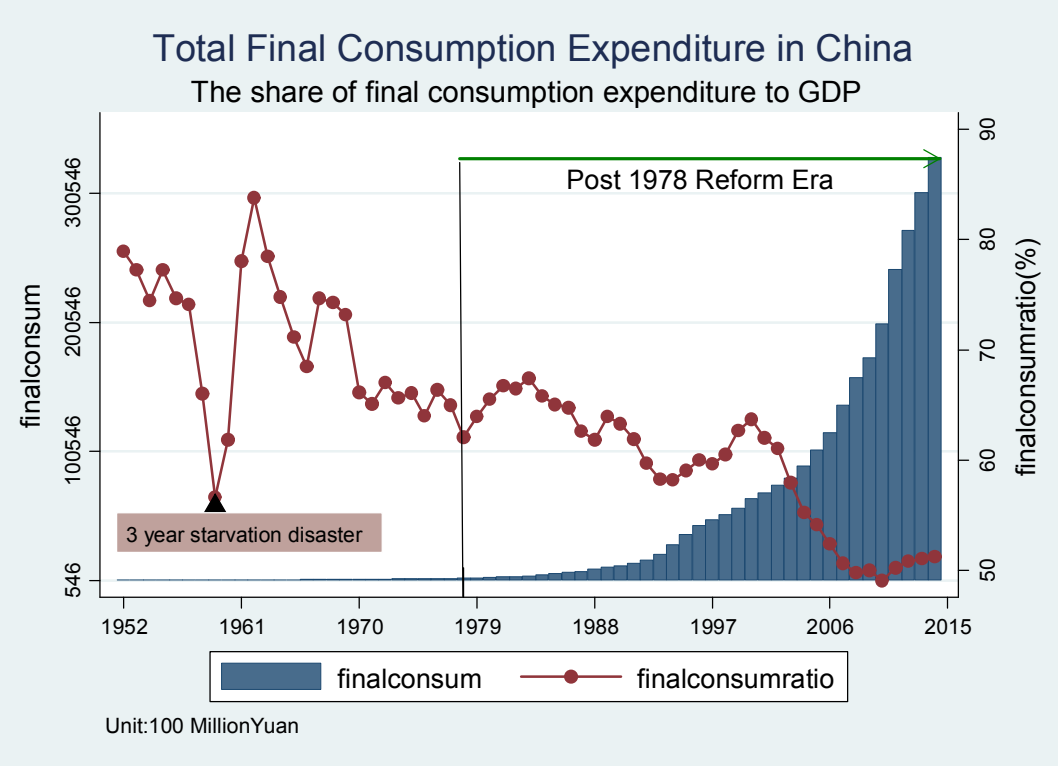

Figure 1[1]

[1] **Note: finalconsum:**Final Consumpetion Expenditure,**finalconsumratio**=Final Consumpetion Expenditure/GDP.

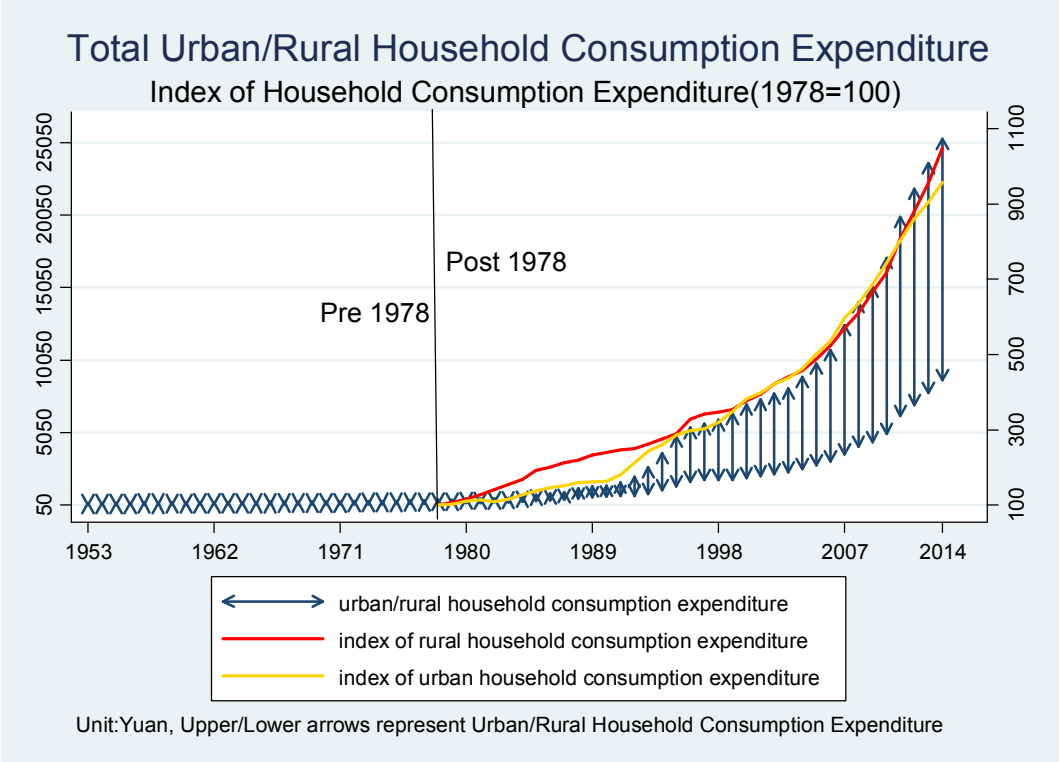

Figure 2

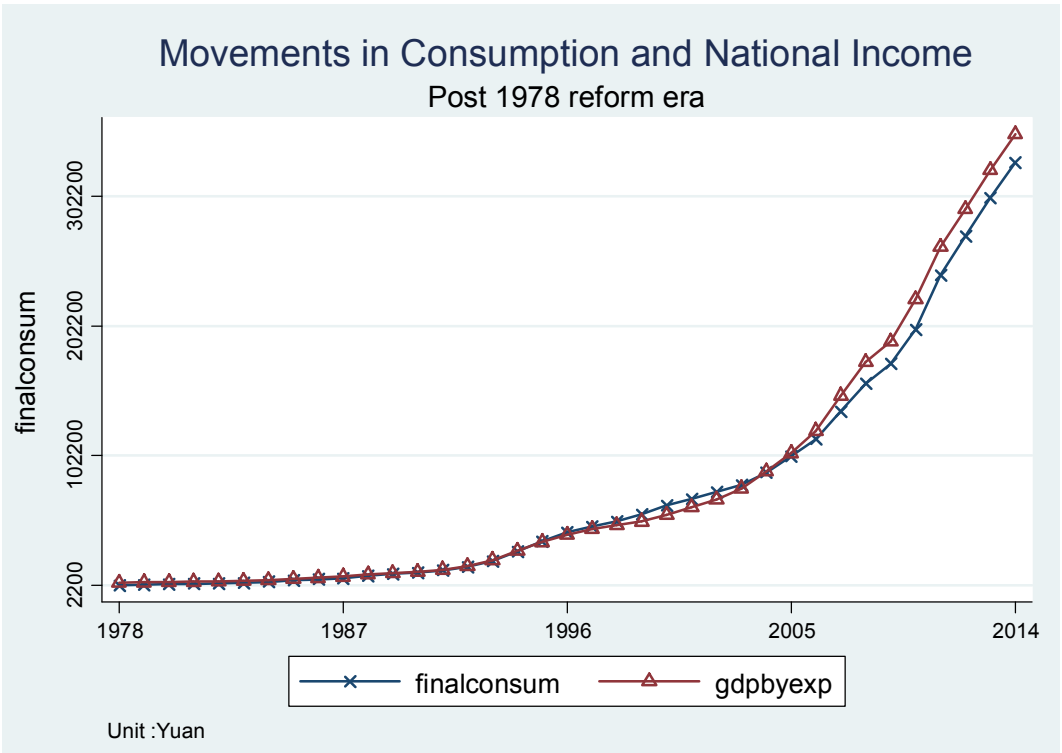

Figure 3

Reference: National Bureau of Statistics,China.

The functional relationship between the aggregate consumption expenditure and aggregate disposable income is known as the aggregate consumption function,all else equal.This can be shown as follows:

$$Y = f(X)$$

Where Y=Total final consumption expenditure,

X=Aggregate disposable income.

The rate of change in consumption expenditure per unit change in disposable income is termed as an mpc.That is mpc=$\frac{\Delta Y}{\Delta X} = \frac{(Y_t - Y_{t-1})}{(X_t - X_{t-1})}$

Where

X_t =Income in current year, X_{t-1} =Income in previous year;

Y_t =Income in current year, Y_{t-1} =Income in previous year.

The numerical value of mpc can be calculated between two points of time.But in the empirical studies the numerical value of mpc is being estimated over a period of time or across the units at a point of time by applying the regression method.

Methodology

1.Linear Consumption Function Estimation

If the relationship between Consumption expenditure and disposable income is linear,then the specification will be as follows:

$$Y = a_0 + a_1 X + e$$

The numerical values of a_0 and a_1 in the equation will be estimated by OLS method under the main assumption that there is one way causation between income and consumption expenditure.If such relationship exists then the consumption expenditure will always be influenced by the disposable income,all else equal,evincing the fact that disposable income will be exogenous.The derivative of Y with respect to X,dY/dX= a_1 is an mpc whose value will be less than unity as the increase in the consumption expenditure will be smaller than the increase in disposable income leaving some margin for savings.The responsiveness of consumption expenditure to the changes in disposable income will be estimated as follows:

$$\eta_{y,x} = \frac{dY/\overline{Y}}{dX/\overline{X}}$$

In the linear regression model,the numerical value of the elasticity will be estimated as follows:

$$\eta_{y,x} = \frac{dY/\overline{Y}}{dX/\overline{X}} = \frac{dY}{dX}\frac{\overline{X}}{\overline{Y}} = a_1\frac{\overline{X}}{\overline{Y}}$$

The value of elasticity of consumption expenditure,would be evaluated at the mean value of Y and X.Hence,it is known as average elasticity.If the numerical value of elasticity of consumption expenditure with respect to disposable income is more than

unity,then MPC will be higher than APC.The proportion of consumption expenditure in disposable income increases with an increase in disposable income.The proportionate change in consumption expenditure will be higher than the proportionate change in disposable income.The growth rate in consumption expenditure will be lower than the growth rate in disposable income.If it is unity,then MPC will be equal to APC,the proportion of consumption expenditure in disposable income.The proportionate change in consumption expenditure will be equal to the proportionate change in disposable income and the growth rate in consumption expenditure will be equal to the growth rate in disposable income.

It is well known that income is sum of consumption expenditure and investment.

X=Y+I

X=Disposable income which is total of Y and I

Y=Total final consumption expenditure

I=Non-Consumption Expenditure(Investment)

This will be specified as follows:

$$X= c_0 + c_1 Y + c_2 I + \upsilon$$

In the above equation if $Y = a_0 + a_1 X + e$ is substituted,then we get the following

$$X= c_0 + c_1 (a_0 + a_1 X) + c_2 I + \upsilon = c_0 + c_1 a_0 + c_1 a_1 X + c_2 I + \upsilon$$

Thus,the co variance between X and error term υ will not be zero.Thus,there will be two way causation between X and Y.Therefore,the numerical value of mpc will be biased.In order to reduce the bias in mpc,both two stage least squares method and indirect least squares method would be used in the empirical studies.

2.Two Stage Least Squares Estimation

At the first stage the income X will be regressed on non consumption expenditure I as shown below:

$$X = m_0 + m_1 I + error$$

The trend values of X will be estimated with the help of the values of m_0 and m_1 estimated by OLS method.

At the second stage,the trend values of income X_e will be considered as the independent variable to regress Y on X_e as follows:

$$Y = h_0 + h_1 X_e + error$$

The co variance between X_e and random variable will be close to zero.Thus,in two stage least squares method the assumption of zero co variance between X_e and random variable will to some extent be satisfied to reduce an upward bias in MPC.

3.Indirect Least Squares Estimation

In the Indirect Least Squares method,the consumption expenditure Y will be regressed on non consumption expenditure(IV) as shown below:

$$Y = g_0 + g_1 I + error$$

Then the income X will be regressed on non consumption expenditure I as shown below:

$$X = k_0 + k_1 I + error$$

Intercept in the consumption function= k_0 / k_1

Slope mpc in the consumption function= $\frac{g_1}{k_1}$

Thus, $\frac{g_1}{k_1}$ will be unbiased mpc in the consumption function.

4.Log Linear Consumption Function Estimation

In empirical studies,the power function is also widely considered to estimate the MPC.The specification of a power model will be as follows:

$$Y = b_0 X_1^{b_1}$$

Where

b_1 is constant elasticity of aggregate consumption expenditure with respect to income as shown below:

dY/dX= $b_1 Y / X$ which will be the mpc and varies with the change in Y and X.The elasticity of consumption expenditure with respect to disposable income will be estimated as follows:

$\eta_{y,x} = \frac{dY}{dX}\frac{X}{Y} = b_1 \frac{Y}{X}\frac{X}{Y} = b_1$ which is known as constant elasticity of aggregate consumption expenditure with respect to disposable income.

5.Distributed Lag Consumption Function

In empirical studies on Consumption Function,the Distributed lag models are used to estimate both the short-run and long-run consumption functions through the partial adjustment mechanism.

The long run/desired level consumption function will be shown below:

$$Y_t^* = b_0 + b_1 X_t + e_t$$

Where

Y_t^* is desired or fully adjusted level of aggregate consumption expenditure which is not observable.Therefore,the above equation will be estimated through the partial adjustment mechanism as shown following:

$$Y_t - Y_{t-1} = \delta[Y_t^* - Y_{t-1}] \Rightarrow Y_t = \delta[Y_t^* - Y_{t-1}] + Y_{t-1} \Rightarrow Y_t = \delta b_0 + \delta b_1 X_t + (1-\delta)Y_{t-1} + \delta e_t$$

Where

$Y_t - Y_{t-1}$ =actual change in consumption expenditure,

$Y_t^* - Y_{t-1}$ =desired change in consumption expenditure.

δ is the coefficient of adjustment whose values will be between zero and one.If it is 1,then the actual change in consumption expenditure will be equal to desired change in consumption expenditure.If it is zero,then there will be no change in actual consumption expenditure since the actual consumption expenditure in time t will be equal to consumption expenditure observed in the previous period t-1.If it is less than 1,then the adjustment to the desired level of consumption expenditure is likely to be uncompleted because of friction,rigidities.

Data Collection

Data on Final Consumption Expenditure,GDP,Non-Consumption Expenditure and Log Final Consumption Expenditure,Log GDP from 1978-2014[2]

year	finalc~m	gdpbyexp	noncon~m	lfinal~m	lgdpby~p
1978	2239.1	3605.6	1366.5	7.71383	8.190244
1979	2586.5	4045.4	1458.9	7.858061	8.305336
1980	2974.3	4539.3	1565	7.997764	8.420528
1981	3282.3	4919.6	1637.3	8.0963	8.500982
1982	3580.7	5385.9	1805.2	8.183313	8.591539
1983	4068.6	6033.4	1964.8	8.311054	8.705066
1984	4797.3	7293.7	2496.4	8.475808	8.894766
1985	5931.1	9121.5	3190.4	8.687965	9.118389
1986	6739.5	10406.2	3666.7	8.815741	9.250157
1987	7649	12221.8	4572.8	8.94233	9.410976
1988	9433.8	15252.9	5819.101	9.152054	9.632524
1989	11043	17270.1	6227.1	9.309552	9.756732
1990	12011.1	18968.4	6957.301	9.393586	9.85053
1991	13628.6	22014.1	8385.5	9.519926	9.999438
1992	16246.1	27208	10961.9	9.695608	10.21127
1993	20826.9	35751.2	14924.3	9.944	10.48434
1994	28305.9	48644.9	20339	10.25083	10.7923
1995	36225.7	61328.9	25103.2	10.49752	11.02401
1996	43117.6	71861.2	28743.6	10.67169	11.18249
1997	47556.7	79739.2	32182.5	10.76968	11.28652
1998	51509.8	85174.4	33664.6	10.84953	11.35246
1999	56681.9	90447.3	33765.4	10.94521	11.41252
2000	63729.2	100080	36350.9	11.0624	11.51373
2001	68617.2	110657	42040.2	11.1363	11.61419
2002	74171.7	121577	47405	11.21414	11.7083
2003	79641.5	137457	57815.8	11.28529	11.83107
2004	89224.8	161616	72391.61	11.39891	11.99298
2005	101604	187767	86163	11.52884	12.14296
2006	114895	219425	104529.7	11.65177	12.29876
2007	136439	269486	133047.7	11.82363	12.50427
2008	157746	317172	159425.7	11.96874	12.6672
2009	173093	346431	173338.1	12.06158	12.75544
2010	199508	406581	207072.5	12.20361	12.91554
2011	241579	480861	239281.6	12.39495	13.08333
2012	271719	534745	263026	12.51252	13.18954
2013	301008	589737	288728.8	12.61489	13.28743
2014	328311	640796	312485.2	12.70172	13.37047

Reference: All time series data displayed in the table above is from National Burea of Statistics.

[2] **Note: finalc~m:**final consumption expenditure, g**dpbyexp:**GDP by expenditure approach, **noncon~m:**non-consumption expenditure, **lfinal~m:** logarithmic form of final consumption expenditure, **lgdpbyexp:** logarithmic form of GDP by expenditure approach.

Empricial Findings

Table 1: Results of Linear Consumption Function

Source	SS	df	MS	Number of obs =	37
				F(1, 35) =	15086.05
Model	2.9818e+11	1	2.9818e+11	Prob > F =	0.0000
Residual	691780886	35	19765168.2	R-squared =	0.9977
				Adj R-squared =	0.9976
Total	2.9887e+11	36	8.3019e+09	Root MSE =	4445.8

finalconsum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdpbyexp	.5011527	.0040802	122.83	0.000	.4928695	.509436
_cons	4130.861	933.4735	4.43	0.000	2235.809	6025.913

The results of the linear consumption function show that the regression coefficient of income,which is known as constant mpc,is significantly positive and less than unity.According to this value one can infer that if income increases by one unit one unit,then consumption expenditure would increase by 0.5011527 units.The sign of the intercept is positive showing the presence of positive consumption expenditure in the absece of income.Further ic can be inferred that the probable value of elasticity of consumption expenditure would be less than unity as the sign of the intercept in the linear consumption function is positive.The value of elasticity of consumption expenditure estimated at the mean values of Y and X:0.5011527*(142314.1 /75451.96)=0 .9452517 showing that one percent increase in income leads to increase the consumption expenditure by 0.9452517 percent per annum,all else equal.

The presence of two way relationship between consumption expenditure and income creates a bias in mpc.In order to reduce the extent of bias the two stage least squares

method with an instrumental variable “non consumption expenditure” is adopted to estimate the aggregate consumption function.

Table 2: Results of Linear Consumption Function by 2SLS

Source	SS	df	MS	Number of obs =	37
				F(1, 35) =	3736.66
Model	2.9610e+11	1	2.9610e+11	Prob > F =	0.0000
Residual	2.7734e+09	35	79240934.7	R-squared =	0.9907
				Adj R-squared =	0.9905
Total	2.9887e+11	36	8.3019e+09	Root MSE =	8901.7

finalconsum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pgdpbyexp	.4999847	.0081793	61.13	0.000	.4833799	.5165895
_cons	4297.092	1869.921	2.30	0.028	500.9514	8093.233

The results of the consumption expenditure function based on the two stage least squares method show that the value of mpc,0.4999847,is marginally smaller than the mpc estimated by OLS method.In estimating an mpc by 2SLS,first the trend values of income have been estimated by regression the income on non consumption expenditure,which is an exogenous variable.The the consumption expenditure is regressed on estimated values of income.

Table 3a: Results of Consumption Expenditure on Non-Consumption Expenditure

Source	SS	df	MS	Number of obs =	37
				F(1, 35) =	3736.66
Model	2.9610e+11	1	2.9610e+11	Prob > F =	0.0000
Residual	2.7734e+09	35	79240935.2	R-squared =	0.9907
				Adj R-squared =	0.9905
Total	2.9887e+11	36	8.3019e+09	Root MSE =	8901.7

finalconsum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
nonconsum	.9999387	.016358	61.13	0.000	.9667301	1.033147
_cons	8593.922	1826.992	4.70	0.000	4884.93	12302.91

Table 3b: Results of Income on Non-Consumption Expenditure

Source	SS	df	MS	Number of obs =	37
				F(1, 35) =	14947.57
Model	1.1845e+12	1	1.1845e+12	Prob > F =	0.0000
Residual	2.7734e+09	35	79240935.2	R-squared =	0.9977
				Adj R-squared =	0.9976
Total	1.1872e+12	36	3.2979e+10	Root MSE =	8901.7

gdpbyexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
nonconsum	1.999939	.016358	122.26	0.000	1.96673	2.033147
_cons	8593.922	1826.992	4.70	0.000	4884.93	12302.91

The results based on indirect least squares method are displayed following two tables.The values of intercept and mpc by ILS are 8593.922/1.999939= 4297.092 and 0.9999387/1.999939= 0.4999846 respectively.

Table 4: Results of Log Linear Consumption Function

Source	SS	df	MS	Number of obs =	37
				F(1, 35) =	37416.26
Model	86.3436781	1	86.3436781	Prob > F =	0.0000
Residual	.080767789	35	.002307651	R-squared =	0.9991
				Adj R-squared =	0.9990
Total	86.4244459	36	2.40067905	Root MSE =	.04804

lfinalconsum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lgdpbyexp	.9461159	.0048912	193.43	0.000	.9361862	.9560455
_cons	.0544121	.0536274	1.01	0.317	-.0544573	.1632815

The results of the log linear consumption function based on the data,show that the regression coefficient of log income is significantly positive and its value is 0.9461159.This is constant elasticity of consumption expenditure with respect to income and explains that one percent increase in income leads to increase the consumption expenditure by 0.9461159 percent,which is less than unity.The value of mpc is 0.9461159*(30170.27/ 51254.03)= 0.5569234(30170.27 is geometric mean of

finalconsum,51254.03 geometric mean of gdpbyexp) explaining that one unit increase in income leads to increase the consumption expenditure by 0.5569234 units.

Table 5: Results of Linear Distributed Lag Consumption Function

Source	SS	df	MS	Number of obs =	36
				F(2, 33) =	24795.97
Model	2.9317e+11	2	1.4658e+11	Prob > F =	0.0000
Residual	195081698	33	5911566.61	R-squared =	0.9993
				Adj R-squared =	0.9993
Total	2.9336e+11	35	8.3817e+09	Root MSE =	2431.4

finalconsum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdpbyexp	.2425888	.0286615	8.46	0.000	.1842766	.300901
finalconsum L1.	.5793599	.0641351	9.03	0.000	.448876	.7098437
_cons	2382.654	563.4056	4.23	0.000	1236.397	3528.911

The regression results of the distributed lag linear consumption function based on the data show that the regression coefficient of income is significantly positive but its value is low and less than unity.THis could be due to the serious problem of multicollinearity between the independent variables.This can be assessed from following scatterplot matrix**(Fig 4)**.The vlaue of the coefficient of partial adjustment is 1-0.5793599= 0.4206401 showing that every year the discrepancy between actual and desired chage in consumption expenditure can be reduced to the extent of 0.4206401 units.

Scatterplot Matrix for finalconsum gdpbyexp lagfinalconsum

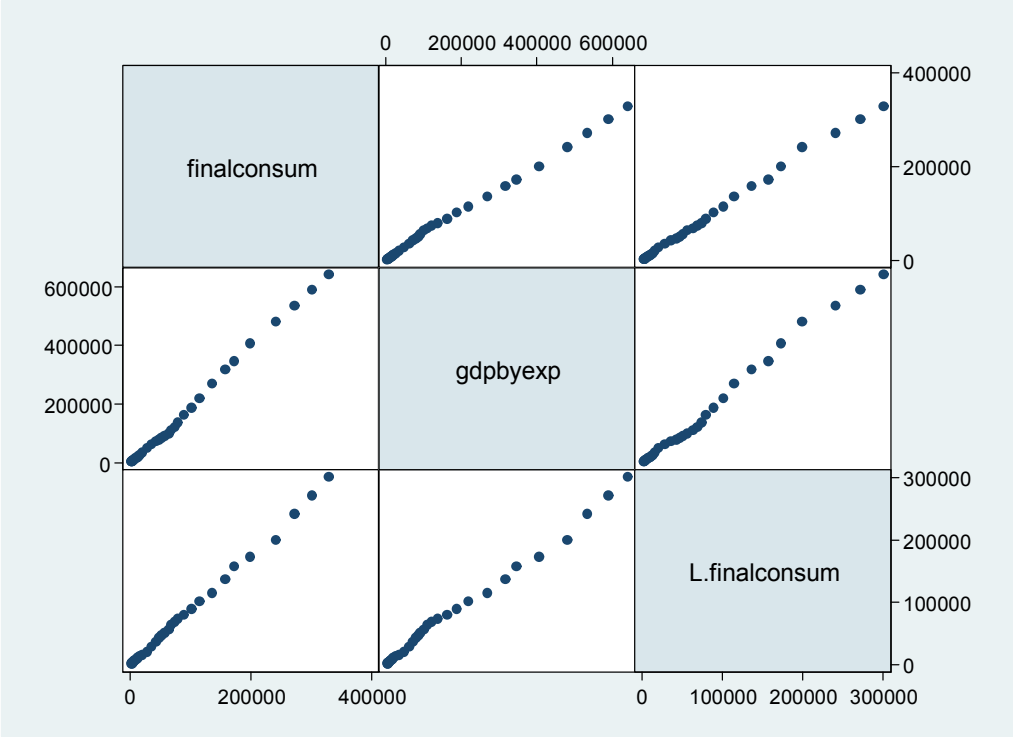

Figure 4

If the distributed lag linear consumption model is not found to be suitable to the data points,then the other form of the distributed lag model such as log linear distributed consumption lag model will be considered.

Table 6: Results of Log Linear Distributed Lag Consumption Function

Source	SS	df	MS
Model	79.4456342	2	39.7228171
Residual	.026849949	33	.000813635
Total	79.4724841	35	2.2706424

Number of obs	= 36
F(2, 33)	=48821.43
Prob > F	= 0.0000
R-squared	= 0.9997
Adj R-squared	= 0.9996
Root MSE	= .02852

lfinalconsum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lgdpbyexp	.530213	.0556281	9.53	0.000	.4170367	.6433893
llagfinalconsum	.4354219	.0585382	7.44	0.000	.3163251	.5545187
_cons	.1355061	.0339508	3.99	0.000	.0664326	.2045796

The results of log linear distributed lag consumption function show that the regression coefficient of log income is 0.530213 showing that one percent increase in income leads to increase the consumption expenditure by 0.530213 percent per annum,all else equal.The coefficient of consumption expenditure lagged by one year is statistically significant showing the presence of significant lag in the adjustment of consumption expenditure to its desired level.The value of the coefficient of partial adjustment or speed of adjustment is 1-0.4354219=0.5645781 implying that about 56% of the discrepancy between actual change and desired change in consumption expenditure can be eliminated in a year,all else euqal.

Conclusion

According to our empirical analyses,we find out that consumption expenditure has strong relation with disposable income among Chinese households.The MPC is around 0.5,and income elasticity of consumption is near to 0.94.It means that when income increases one unit,then consumption expenditure would go up by 0.5 units;when income increases one percent,then consumption expenditure would go up by 0.94 percent.In addition to that,the adjustemnt coefficient of 0.56 tells us that current consumption would get influenced by previous period of consumption.The gap between desired and actual consumption will be narrowed down by 56% within one year.

Reference:

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3.Deaton.A(1987),"Estimation of Own and Cross price Elasticities from Household Survey Data",Journal of Econometrics,Vol.36,P.7.