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Note on a model of Chinese national income determination

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ABSTRACT

A macroeconomic model of Chow (1985) explaining aggregate consumption by the permanent income hypothesis of Robert Hall and aggregate investment by the accelerations principle was found to fit Chinese annual data from 1952 to 1982 well. This note shows that the same model can successfully explain Chinese annual data from 1978 to 2006.

In Chow (1985) I tried to explain the two major components, consumption and investment, of real national income in China in the period 1952 to 1982. This note shows that the same model can explain China's national income from 1978 to 2006.

The model of Chow (1985) starts with the national income identity $Y_t = C_t + I_t$ where Y_t, C_t, and I_t denote respectively national income, consumption and investment in year t in constant prices. X_t = exports − imports is omitted as a component of Y_t because during the sample period 1952–1982 this variable is less than half of 1% of Y, except for 1982 when it equals 1.6%.

Consumption C is determined by the permanent income hypothesis of Hall (1978), namely, as a random walk with drift. To determine investment I assume that desired capital stock K^* equals a constant plus aY, and that actual change in capital stock $K_t - K_{t-1}$ equals a fraction b of the desired change in capital stock or $b(K_t^* - K_{t-1})$. Substituting the linear function of Y for K^* in this equation and solving for K_t give $K_t =$ const. $+ abY_t + (1-b)K_{t-1}$. Since gross investment I_t is defined as $K_t - (1-d)K_{t-1}$ where d is the annual rate of depreciation, we can subtract $(1-d)$ times the equation for K_{t-1} from the above equation for K_t to obtain an equation for investment

$$I_t = K_t - (1-d)K_{t-1} = const. + ab[Y_t - (1-d)Y_{t-1}] + (1-b)I_{t-1}.$$

Given a small rate of depreciation which is equal to about 0.04 for the capital stock in China, investment I_t depends on the rate of change in output Y according to the accelerations principle.

I have estimated this same model using Chinese data from 1978 to 2006. Data on Y = GDP, C, I and X = exports − imports (measured in 100 million RMB) in nominal terms are presented in Table 1. To obtain these variables in constant prices I have divided them by a price index. The price index, also presented in Table 1, is the ratio of Y in nominal terms to Y in real terms. The consumption and investment equations are estimated by the method of two-stage least squares. In the first stage Y_t is estimated by a regression on C_{t-1}, I_{t-1}, X_t and X_{t-1} to yield, with X assumed to be exogenous,

$$Y_t^* = 140.8(116.4) + .8841(.0604)C_{t-1} + 1.4254(.0951)I_{t-1} - .4815(.2616)X_t + 1.4073(.2883)X_{t-1} \quad R^2 = 0.9996; s = 273.4. \tag{1}$$

The number in parentheses after each coefficient is its standard error. The variables are measured in 100 million RMB in 1978 prices, with the price index in 2006 equal to 4.598 as shown in Table 1.

In the second stage of two-stage least squares I have estimated the consumption function

$$C_t = 218.86 + 1.067(.074)C_{t-1} - 0.0051(.0371)Y_t^* \quad R^2 = 0.9985; s = 271.24. \tag{2}$$

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Table 1
Data on China's national income and its determinants.
Sources: Y = GDP, C, I and X = exports − imports in nominal terms, measured in 100 million RMB, are found in Tables 3–15 of *China Statistical Yearbook 2007*. The price index p is the ratio of Y in nominal terms and Y in real terms, the latter given in Tables 3–4 of *China Statistical Yearbook 2007*.

Year	Y	C	I	X	p
1978	3605.6	2239.1	1377.9	−11.4	1
1979	4092.6	2633.7	1478.9	−20	1.054896
1980	4592.9	3007.9	1599.7	−14.7	1.098124
1981	5008.8	3361.5	1630.2	17.1	1.137733
1982	5590	3714.8	1784.2	91	1.164813
1983	6216.2	4126.4	2039	50.8	1.168049
1984	7362.7	4846.3	2515.1	1.3	1.201187
1985	9076.7	5986.3	3457.5	−367.1	1.305023
1986	10,508.5	6821.8	3941.9	−255.2	1.387854
1987	12,277.4	7804.6	4462	10.8	1.453304
1988	15,388.6	9839.5	5700.2	−151.1	1.63712
1989	17,311.3	11,164.2	6332.7	−185.6	1.769711
1990	19,347.8	12,090.5	6747	510.3	1.904878
1991	22,577.4	14,091.9	7868	617.5	2.035682
1992	27,565.2	17,203.3	10,086.3	275.6	2.175614
1993	36,938.1	21,899.9	15,717.7	−679.5	2.558603
1994	50,217.4	29,242.2	20,341.1	634.1	3.075886
1995	63,216.9	36,748.2	25,470.1	998.6	3.490539
1996	74,163.6	43,919.5	28,784.9	1459.2	3.722223
1997	81,658.5	48,140.6	29,968	3549.9	3.750238
1998	86,531.6	51,588.2	31,314.2	3629.2	3.685385
1999	91,125	55,636.9	32,951.5	2536.6	3.605819
2000	98,749	61,516	34,842.8	2390.2	3.604115
2001	108,972.4	66,878.3	39,769.4	2324.7	3.672308
2002	120,350.3	71,691.2	45,565	3094.1	3.717834
2003	136,398.8	77,449.5	55,963	2986.3	3.829693
2004	160,280.4	87,032.9	69,168.4	4079.1	4.088025
2005	188,692.1	97,822.7	80,646.3	10,223.1	4.358183
2006	221,170.5	110,413.2	94,103.2	16,654.1	4.598263

This result confirms the permanent income hypothesis of Hall perfectly since the coefficient of C_{t-1} is almost exactly 1 and the coefficient of income Y is almost equal to zero. Given the result (Eq. (2)) I have dropped the variable Y_t^* and reestimated the consumption function to obtain

$$C_t = 226.05(91.78) + 1.0570(.0079)C_{t-1} \quad R^2 = 0.9985; s = 266.08. \tag{2a}$$

The investment function is

$$I_t = -399.04(139.79) + 2.4149(.6470)Y_t^* - 2.2861(.6281)Y_{t-1} + .2233(.2369)I_{t-1} \quad R^2 = .9968; s = 327.4. \tag{3}$$

Note that the coefficient of Y_{t-1} is opposite in sign and slightly less in magnitude (because of the rate of depreciation) to the coefficient of Y_t^*. This confirms the accelerations principle that investment depends on the rate of change in income.

Given the coefficients of Y_t^* and Y_{t-1} in Eq. (3) to be almost equal in magnitude I replace these variables by the variable $(Y_t^* - Y_{t-1})$ to obtain the investment function

$$I_t = -186.23(120.84) + 1.7782(.6513)(Y_t^* - Y_{t-1}) + .6866(.1589)I_{t-1} \quad R^2 = .9960; s = 359.28. \tag{3a}$$

In Chow (1985) I reported results similar to Eqs. (2a) and (3a) obtained by using Chinese annual data from 1952 to 1982. In the consumption function the coefficient of lagged consumption was almost equal to one and the coefficient of income was zero. In the investment equation the coefficient of Y_{t-1} was negative and slightly less in magnitude than the coefficient of Y and I replaced these variables by their difference as in Eq. (3a). The results showed that the coefficient of this difference in the investment equation was smaller than 1.7782 possibly because the ratio a of capital stock to output was smaller and the adjustment coefficient b for capital stock to reach equilibrium was also smaller before 1978.

In conclusion I have found that the permanent income hypothesis of Hall (1978) to explain consumption and the accelerations principle to explain investment are well supported by Chinese macro data for the periods 1952–1982 and 1987–2006 as well. This is one example of the applicability of economic theory to the Chinese economy. Other examples can be found in Chow (2007).

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