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Lessons from studying a simple macroeconomic model for China

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ABSTRACT

Updating Chow (1985, 2010), this note finds that (1) the consumption equation continues to hold but the investment equation fails; (2) the investment equation holds if investment data for 2008 and 2009 are revised downward to reflect government expenditures as a part of the stimulus package during the world economic downturn; (3) small errors in one or two observations can reverse the sign of a significant regression coefficient in econometric practice.

In Chow (1985, 2010) I found that aggregate consumption in China can be explained well by the permanent income hypothesis of Hall (1978) and aggregate investment by the accelerations principle, using annual data from 1952 to 1982 and from 1978 to 2006 respectively. Updating Chow (2010) by including data from 2007 to 2009, this note finds that (1) while the consumption equation continues to hold the investment equation fails badly; (2) the investment equation continues to hold if data on investment for 2008 and 2009 are revised downward to reflect government expenditures as a part of the stimulus package during the world economic downturn; (3) small errors in one or two observations can reverse the sign of a significant regression coefficient in econometric practice.

I extend the data set of Chow (2010) by including observations from 2007 to 2009. Since the official data have been revised, the same method is used to obtain data from 1978 to 2009, as shown in Table 1. Note the differences between the data in Table 1 of Chow (2010) and Table 1 of this paper after revision.

First, I re-estimate the model using the revised data from 1987 to 2006 to find out whether data revision has changed the findings of Chow (2010). The estimated consumption and investment equations are shown in equations (1)–(4) of Table 2. The method of estimation is two-stage least squares as before, Y^* being the estimated regression of real GDP Y on Y_{-1}, C_{-1}, I_{-1} and X obtained in the first stage. In the consumption equation (2) the insignificant Y^* is dropped. In investment equation (4), $(Y^* - Y_{-1})$ has replaced the two separate explanatory variables. The results show that the conclusions of Chow (2010) remain valid except that the support for the accelerations principle using the revised data is weaker. The standard errors of the coefficients of both Y^* and Y_{-1} in the investment equation (3) are large although these coefficients still have the correct signs and expected orders of magnitude. The coefficient of $(Y^* - Y_{-1})$ in equation (4) has the correct sign but is insignificant. Using official data from 1978 to 2006 before revision, the investment equation (3) in Chow (2010) has estimated the coefficients of Y^* and Y_{-1} to be respectively 2.4149 and 2.2861 with standard errors of 0.6470 and 0.6281, providing stronger support for the accelerations principle.

Second, using data up to 2009 I find the consumption function to remain valid as shown in equations (5) and (6) of Table 2. However, the investment equation, as shown in equation (7) of Table 2, fails to hold. In fact the coefficients of both Y^* and Y_{-1} have the wrong sign and are significant. I then check the failure by adding observations for one year at a time. The results are given in equations (8) and (9) that include observations up to 2007 and up to 2008 respectively. Beginning in 2008 the signs of the coefficients of Y^* and Y_{-1} are wrong, as shown in equations (9) and (7). Thus the accelerations principle fails for the years 2008 and 2009.

Third, I advance the following hypothesis to explain the failure of the investment equation. Note that 2008 was a special year when the Chinese government began applying a stimulus package to compensate for the slow growth in exports, and accordingly, the amount of investment recorded in official data is overestimated. The official data for C and I do not separate out government

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Table 1
Data on China's national income and its determinant sources: Y = GDP; C = consumption; I = investment; X = exports−imports, all in current prices, measured in 100 million RMB and P is the GNP deflator constructed as the ratio of nominal GNP to GNP in constant prices given in the China Statistical Yearbook, 2010.

Year	Y	C	I	X	P
1978	3605.6	2239.1	1377.9	−11.4	1.000000
1979	4092.6	2633.7	1478.9	−20.0	1.054896
1980	4592.9	3007.9	1599.7	−14.7	1.098047
1981	5008.8	3361.5	1630.2	17.1	1.137821
1982	5590.0	3714.8	1784.2	91.0	1.164392
1983	6216.2	4126.4	2039.0	50.8	1.168060
1984	7362.7	4846.3	2515.1	1.3	1.201199
1985	9076.7	5986.3	3457.5	−367.1	1.305087
1986	10508.5	6821.8	3941.9	−255.2	1.388156
1987	12277.4	7804.6	4462.0	10.8	1.453466
1988	15388.6	9839.5	5700.2	−151.1	1.637111
1989	17311.3	11164.2	6332.7	−185.6	1.769748
1990	19347.8	12090.5	6747.0	510.3	1.904815
1991	22577.4	14091.9	7868.0	617.5	2.035899
1992	27565.2	17203.3	10086.3	275.6	2.175818
1993	36938.1	21899.9	15717.7	−679.5	2.558392
1994	50217.4	29242.2	20341.1	634.1	3.075802
1995	63216.9	36748.2	25470.1	998.6	3.490664
1996	74163.6	43919.5	28784.9	1459.2	3.722539
1997	81658.5	48140.6	29968.0	3549.9	3.750088
1998	86531.6	51588.2	31314.2	3629.2	3.685206
1999	91125.0	55636.9	32951.5	2536.6	3.606054
2000	98749.0	61516.0	34842.8	2390.2	3.603901
2001	109028.0	66933.9	39769.4	2324.7	3.674079
2002	120475.6	71816.5	45565.0	3094.1	3.721827
2003	136634.8	77685.5	55963.0	2986.3	3.836414
2004	160800.1	87552.6	69168.4	4079.1	4.101306
2005	187131.2	99051.3	77856.8	10223.1	4.287930
2006	222240.0	112631.9	92954.1	16654.0	4.519499
2007	265833.9	131510.1	110943.2	23380.6	4.735386
2008	314901.3	152346.6	138325.3	24229.4	5.116483
2009	345023.6	165526.8	164463.5	15033.3	5.137704

Table 2
Estimated consumption and investment equations including data from 2007 to 2009.

Dependent variable	Y^*	Y_{-1}	$(Y^* - Y_{-1})$	C_{-1}	I_{-1}	Const.	Sample ending in	R^2/s
(1) C	0.0418 (0.0359)			0.9829 (0.0720)		−228.18 (102.79)	2006	0.9987/259.71
(2) C				1.0661 (0.0077)		168.89 (89.82)	2006	0.9986/261.45
(3) I	1.0057 (0.6804)	−0.8676 (0.6268)			0.5224 (0.3528)	−222.35 (156.87)	2006	0.9950/407.93
(4) I			0.2664 (0.5224)		1.0523 (0.1392)	−74.11 (131.77)	2006	0.9945/421.12
(5) C	0.0454 (0.0233)			0.9764 (0.0514)		232.67 (112.93)	2009	0.9990/290.88
(6) C				1.0758 (0.0068)		101.22 (94.90)	2009	0.9988/304.63
(7) I	−0.7512 (0.2099)	0.7074 (0.2180)			1.4467 (0.1305)	−130.34 (139.48)	2009	0.9979/392.59
(8) I	0.5159 (0.3210)	−0.4125 (0.2872)			0.7327 (0.2398)	−176.29 (145.84)	2007	0.9961/405.74
(9) I	−0.8703 (0.3993)	0.8092 (0.3650)			1.5213 (0.2464)	−117.77 (146.35)	2008	0.9971/399.88
(10) I	1.0201 (0.3086)	−0.8802 (0.2764)			0.5138 (0.2325)	−222.72 (143.41)	2007	0.9964/399.01
(11) I	1.4891 (0.3105)	−1.3328 (0.3040)			0.3502 (0.1719)	−239.35 (145.25)	2008	0.9970/403.67
(12) I	1.5572 (0.2799)	−1.3995 (0.2755)			0.3374 (0.1598)	−283.59 (143.19)	2009	0.9976/397.36

expenditures in these variables. The model is valid insofar as the determination of government expenditures as parts of C and I follows the same theoretical explanations as are given in Chow (1985). Equations (9) and (7) show that this was not the case when a large stimulus package was introduced in 2008.

Fourth, I ask what investment figures for the two years 2008 and 2009 would need to be for the investment equation (3) estimated using data up to 2006 to remain valid. In this exercise I allow myself to move a part of I to the exogenous variable X in such a way that the official data for Y and C in the identity $Y = C + I + X$ remain unchanged. I have constructed artificial investment data for 2007–2009 by using the estimated investment equation (3) based on data up to 2006. In this construction the variable Y in the investment equation (3) means actual Y and not Y^*, as the latter serves to indicate the 2SLS method used to estimate this equation. Then I adjusted the variable X accordingly since the values of X are needed to perform the first stage of 2SLS in order to estimate equations (10)–(12) of Table 2 using data up to 2007 to 2009 respectively. These three equations uphold the accelerations principle since the coefficients of Y^* and Y_{-1} have the correct signs and correct relative orders of magnitude and are all statistically significant.

The artificially constructed values of investment for years 2007 to 2009 are 115142.6, 131342.9 and 140395.7 (100 million RMB) as compared with the official data of 110943.2, 138325.3 and 164463.5 (100 million RMB) respectively. The 2007 figures are almost the same since the official investment data up to 2007 still support the accelerations principle as shown in equation (8). The constructed investment figure for 2008 is about 700 billion RMB less than the official figure. The constructed investment figure for

2009 is about 2400 billion RMB less than the official figure. These constructed investment figures are very reasonable as compared with the size of the government stimulus package of about 4 trillion RMB. Hence our hypothesis provides a satisfactory explanation of the failure of the estimated investment equation by using official investment data. We can thus accept the conclusion that the accelerations principle remains valid provided that the investment data are reasonably adjusted.

Finally, the above calculations provide an interesting example for showing that small changes in the dependent variable for one or two observations in a sample of size 32 can change a regression coefficient from being significantly positive to being significantly negative.

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