A Model of Inflation in Taiwan

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Abstract: The model of Chow (1987) for inflation in China is applied to explain inflation in Taiwan. A cointegration relation linear in the log of a price index and the log of the ratio of money supply to output is estimated. Inflation is explained by the change in this log ratio, lagged inflation and the lagged residual of the cointegration relation as an error correction. The model explains Taiwan's inflation well except during the oil crises of 1973 and 1979-80.

JEL Classification: E31

Key words: inflation, Taiwan, error correction

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The purpose of this paper is to examine the empirical validity of an equation to explain inflation which was first published in Chow (1987) and re-estimated in Chow and Wang (2010) using data for China. The present study applies the same equation to explain inflation in Taiwan from 1961 to 2010, while Chow (1987) used data from 1952 to 1984 and Chow and Wang used data from 1952 to 2008.

The first study was commissioned by Premier Zhao Ziyang of the People's Republic of China in June 1985 because he was concerned about possible inflation after currency in circulation in China had increased by 50 percent in 1984. I used data from 1952 to 1984 to estimate the equation and reported the result to the Premier in July 1985, saying that the rate of inflation in 1985 would most likely be below 9 percent (partly because of the inertia built into the equation). Chow and Wang (2010) applied the same equation to explain inflation in China and found that the Chow test using 1979 as the breakpoint supported strongly the stability of its parameters before and after economic reform was introduced in 1978 towards a market oriented economy in China. In other words the same equation for inflation had applied during the period when central economic planning was practiced.

The present paper examines this equation using data for Taiwan from 1961 to 2010. It finds the equation remains valid but the residual for 1974 and 1980 were about 4.5 and 2.2 times the size of its standard error. These large residuals are explained by the oil crises of 1973-4 and 1979-80. The variables employed in the equation are a general price index P, money supply M and real GDP Y as presented in Table 1. P is measured by P1, the consumer price index or P2, the GDP deflator. M is measured by M2 or M1. Section 1 presents the estimation of the cointegration relation between log P and log (M/Y). Section 2 presents the equation explaining inflation by $\Delta\log(M/Y)$, lagged inflation and the residual of the cointegration relation of the preceding period. When the equations for Taiwan are presented, the corresponding equations for China will be shown for comparison when appropriate. Section 3 examines the large regression residuals in 1974 and 1980 and attributes the poor fits of the equation in these years to the oil crises of 1973-4 and 1979-80. Section 4 concludes.

1. Estimation of a cointegration relation

The first step is to estimate a cointegration relation linear in logP and log(M/Y). Inflation ΔlogP is explained by Δlog(M/Y), ΔlogP(t-1) and the lagged residual of the cointegration relation.

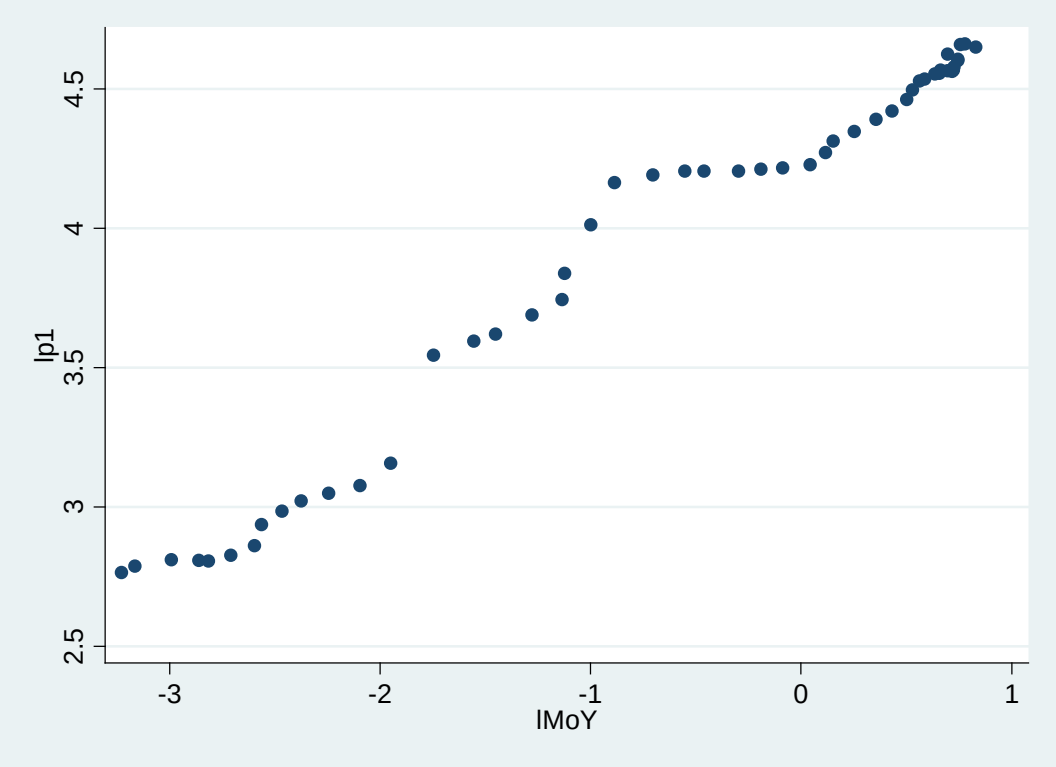
Regressing logP1 on log(M2/Y) I obtain

(1) $\ln P1_t = 4.2697(.0166) + .4918(.011)\ \ln(M2_t/Y_t)$ $\qquad R^2 = .9765$; s= .10544

By comparison the corresponding regression based on data for China from 1952 to 2008 explaining the retail price index in Chow and Wang (2010) is very similar:

$\log P_t = -0{:}7017 + 0{:}3688 \log (M2_t / Y_t)$ $\qquad R^2 = 0.9726$; s = 0:0952:

Figure 1 Relation between lnP1 and ln(M2/Y)



Regressing log P1 on logM2 and logY separately I find the coefficients to be of opposite sign and about the same order of magnitude, thus confirming the hypothesis that log(M2/Y) is an appropriate variable for the cointegration relation. The null hypothesis that the coefficient of logY is the negative of the coefficient of logM2 cannot be rejected at the 10 percent level. The result is shown in equation (2).

(2) $\ln P1_t = 7.155(1.593) + .6354(.08)\ \ln M2_t - .8212(.1822)\ \ln Y_t$ $\qquad R^2 = .978$; s= .10302

2. Estimation of the equation to explain inflation

I next estimate the error correction equation to explain inflation. As shown in equation (3), all coefficients are of correct sign and statistically significant.

(3) $\Delta \log P1_t = -.0019(.0141) + .343(.1462)\ \Delta \log(M2_t/Y_t) + .3148(.1500)\ \Delta \log P1_{t-1} - .2029(.0860)\ u_{t-1}$

$R^2 = .2596$; s= .0559

By comparison the corresponding equation to explain inflation in China in Chow and Wang (2010) is

$\Delta \log P_t = 0.0006(0.0055) + 0.1550(0.0396)\Delta \log(M2_t/Y_t) + 0.5324(0.0872)\Delta \log P_{t-1} - 0.1545(0.0471)u_{t-1}$

$R^2 = 0.6293$; s = 0.0325

which gave an F(4,47) statistic with rejection probability of 0.5098 for the Chow test of parameter stability using 1979 as the break point, showing that the parameters remained constant for the two sample periods.

Equation (3) for Taiwan has a much lower R^2 and larger standard error of regression. Its residual to explain inflation for the year 1974 and 1980 are 0.264 and 0.128 respectively, as compared with a standard error of only .0559. This interesting result will be examined later.

In the mean time I examine different choices of M and P to find out how robust equation (3) is. When M2 is replaced by M1 to explain inflation measured by P1, the R^2 is slightly larger but the coefficient of $\Delta \log(M1/Y)$ is not significant. The slight increase in R^2 is associated with a larger partial correlation with u_{t-1}.

$\Delta \log P1_t = .0215(.0113) + .0122(.0856)\ \Delta \log(M1_t/Y_t) + .4246(.1327)\ \Delta \log P1_{t-1} - .2467(.0766)\ u_{t-1}$

$R^2 = .2803$; s= .0551

I next examine whether inflation as measured by the GDP deflator is more easily explained by performing the same analysis for P2, while retaining M2 as the measure of money supply.

Regressing logP2 on log(M2/Y) I obtain the following cointegration equation

(4) $\ln P2_t = 4.336(.0164) + .4823(.0109)\ \ln(M2_t/Y_t)$ $\qquad R^2 = .9763$; s= .10388

The scatter diagram for this regression as displayed in Figure 2 also shows that logP2 is well explained by log(M2/Y). Compared with Figure 1, the step in 1974 is somewhat smaller.

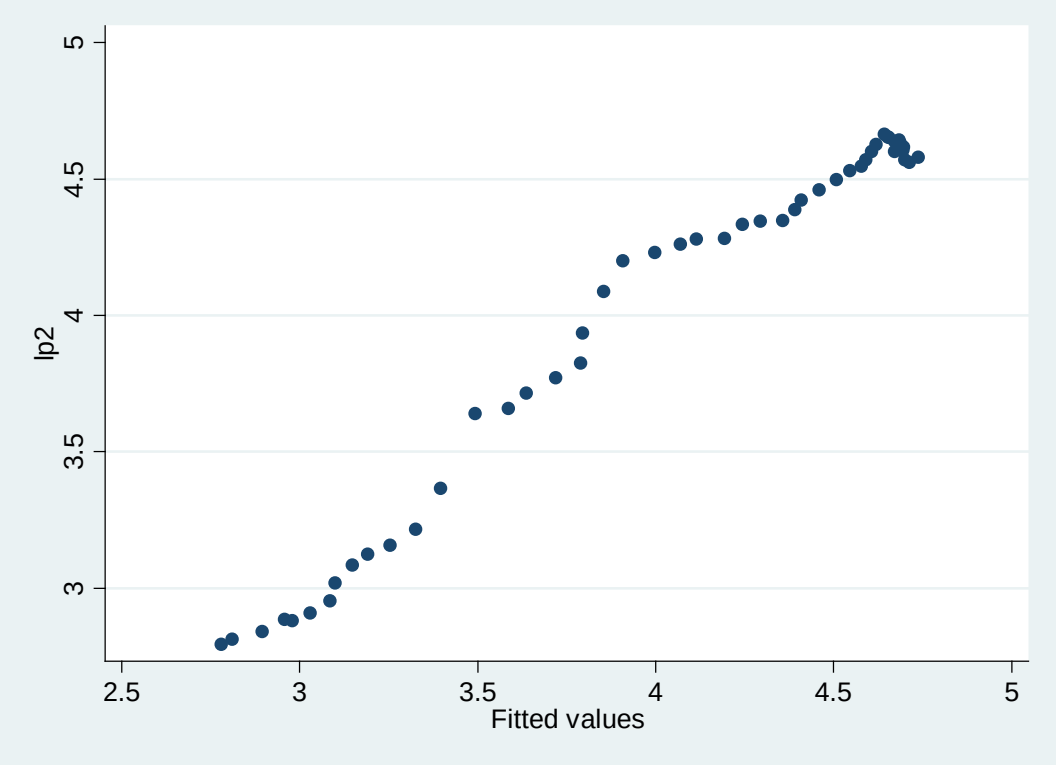
The equation to explain inflation is

(5) $\Delta \log P2_t = -.0033(.0111) + .2821(.1240)\ \Delta\log(M2_t/Y_t) + .4559(.1508)\ \Delta \log P2_{t-1} - .1279(.0722)\ u_{t-1}$

$R^2 = .3687$; s= .0431

All coefficients have the correct sign and are statistically significant. The R^2 of .3687 is larger than .2596 for equation (3) when P1 is used. The standard error of the regression is .0431 as compared with .0559 when P1 is used. The residuals of this regression to predict inflation for 1974, 1979 and 1980 are still large, but not as large as for equation (3). The residual in 1974 is 0.14 as compared with 0.26 when CPI is used.

Figure 2 Relation between lnP2 and ln(M2/Y)



3. Explanation of the large residual errors in 1974 and 1980

The failure of equation (3) to explain inflation in 1974 and in 1980 can be attributed to the two oil crises. Kuo (1999, p. 64) describes the oil crises as follows.

"During 1961-71, the real GDP grew at an average rate of 10.2 percent. Prices were stable, increasing at annual average of 1.6 percent as measured by the wholesale price index, 2.9 percent as measured by the consumer price index…This outstanding performance was interrupted by the 1973 oil crisis. The abrupt 22.9 percent rise in prices in 1973 was a severe shock …In 1974 the inflation rate jumped to 40.6 percent, and the growth rate dropped to 1.1 percent."

"The rise in oil prices in 1979 and 1980 again shocked the Taiwan economy. Prices rose at annual rates of 13.8 percent in 1979 and 21.5 percent in 1980…. Thus the inflation rate during the second oil shock was about half of the first oil shock."

These two oil crises can account for the large residuals in our equation to explain inflation during the corresponding years.

4. Conclusions

First, the model to explain inflation in China as presented in Chow (1987) and updated in Chow and Wang (2000) can also explain inflation in Taiwan from 1961 to 2010. All coefficients are of the correct sign and statistically significant. Second, the goodness of fit for Taiwan is not as good as for China mainly because the model fails to explain the large inflation rates during the oil crises of 1973 and 1979-80.

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Table 1 Price index and its determinants

Year	*P1*	*M2*	*Y*	*P2*	*M1*	*resP1*
1961	15.85	17,350	436,985	16.34	7,699	
1962	16.22	19,965	472,129	16.64	8,086	
1963	16.58	26,119	518,452	17.11	10,355	-0.02882
1964	16.55	33,192	578,462	17.89	13,979	-0.04983
1965	16.53	38,503	641,207	17.83	16,159	-0.02605
1966	16.87	46,541	697,100	18.32	18,147	-0.03023
1967	17.44	57,535	769,666	19.16	23,605	-0.03301
1968	18.81	64,729	838,906	20.48	26,316	0.028705
1969	19.77	77,641	911,591	21.85	30,431	-0.02132
1970	20.48	94,031	1,008,247	22.75	34,985	-0.02468
1971	21.05	120,500	1,133,818	23.51	45,702	-0.04353
1972	21.67	158,217	1,282,919	24.91	61,267	-0.05318
1973	23.45	204,530	1,434,647	28.93	92,155	-0.01141
1974	34.58	254,970	1,461,291	38.07	101,758	0.264318
1975	36.39	325,897	1,540,574	38.79	131,037	-0.10859
1976	37.29	410,477	1,747,790	41.03	163,869	-0.00763
1977	39.92	540,504	1,938,019	43.39	218,861	0.015886
1978	42.22	707,963	2,199,476	45.77	299,867	-0.00355
1979	46.34	772,760	2,375,737	51.16	322,937	0.080002
1980	55.16	939,982	2,549,742	59.61	396,193	0.127942
1981	64.16	1,119,070	2,714,355	66.71	450,513	0.106765
1982	66.05	1,398,336	2,822,229	68.78	516,312	-0.01326
1983	66.95	1,762,328	3,057,050	70.92	611,424	0.008341
1984	66.93	2,110,629	3,341,961	72.24	668,000	0.007666
1985	66.83	2,588,288	3,477,891	72.38	749,504	-0.02335
1986	67.29	3,191,344	3,860,608	76.26	1,134,857	-0.01103
1987	67.64	3,925,486	4,272,887	77.04	1,563,139	-0.02461
1988	68.51	4,722,373	4,510,963	77.33	1,945,181	-0.03456
1989	71.53	5,589,437	4,974,759	80.47	2,062,782	0.003518
1990	74.49	6,201,891	5,316,579	83.33	1,925,647	0.004453
1991	77.18	7,402,961	5,735,769	86.44	2,158,413	-0.01714
1992	80.63	8,813,714	6,169,225	89.71	2,425,843	-0.01034
1993	83	10,170,199	6,584,559	92.79	2,797,140	-0.02087
1994	86.41	11,702,786	7,084,404	94.37	3,139,270	-0.00313
1995	89.58	12,805,365	7,536,283	96.57	3,163,101	0.00392
1996	92.33	13,973,876	7,953,510	99.40	3,426,058	0.002162
1997	93.17	15,094,359	8,389,017	102.21	3,715,252	-0.0111
1998	94.73	16,386,722	8,679,815	106.04	3,854,784	-0.00574
1999	94.9	17,745,013	9,198,098	104.90	4,507,180	-0.01529
2000	96.09	18,897,797	9,731,208	104.69	4,492,072	0.003407
2001	96.08	19,736,946	9,570,584	103.76	5,025,860	-0.029
2002	95.89	20,247,014	10,074,337	103.35	5,491,589	-0.00348
2003	95.62	21,425,529	10,443,993	102.42	6,552,832	-0.01745
2004	97.17	23,001,200	11,090,474	102.48	7,368,000	0.002403
2005	99.41	24,507,974	11,612,093	101.10	7,871,148	0.003079
2006	100	25,798,757	12,243,471	100.00	8,222,626	-0.00647
2007	101.8	26,039,380	12,975,985	99.50	8,219,977	0.028318
2008	105.39	27,863,217	13,070,681	96.55	8,153,704	0.012398
2009	104.47	29,462,914	12,818,935	97.33	10,511,586	-0.04041
2010	105.48	31,036,123	14,213,925	95.71	11,457,126	0.025768