Economics Bulletin

Volume 31, Issue 1

Structural Changes and Regional Disparity in China's Inflation

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Abstract

The inflation problem in China has attracted a great deal of international attention in recent years. This paper examines the time series properties of China's CPI series. It is found that the overall inflation series and the inflation of food, tobacco, clothes, urban transport and urban housing are not persistent. Structural breaks in inflation are found in 2003 and 2004. The degree of rural-urban inflation disparity in China is also investigated. We find evidence that rural residents experience higher inflation than their urban counterparts.

We would like to thank M. Hashem Pesaran, Stephen Hall, Don Dutkowsky, Asha Sundaram and Guiying Wu for their constructive comments and suggestions, Kenny Shui for able research assistance. All errors are ours. Corresponding Author: Terence Chong, Department of Economics and Hong Kong Institute of Asia-Pacific Studies, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong. Email: chong2064@cuhk.edu.hk. Webpage: http://www.cuhk.edu.hk/eco/staff/tlchong/tlchong3.htm.
Citation: Terence Tai-Leung Chong and Ning Zhang and Qu Feng, (2011) "Structural Changes and Regional Disparity in China's Inflation", *Economics Bulletin*, Vol. 31 no.1 pp. 572-583.
Submitted: Jul 07 2010. **Published:** February 15, 2011.

1. Introduction

The time series property of inflation has been an increasingly important research topic over the past two decades. A pioneering study is Rose (1988), who rejects the unit root hypothesis in the inflation series of 18 OECD countries. Ball *et al*. (1990) and Fuhrer and Moore (1995) show that the inflation rate series are persistent. More recently, Mishkin (2007) finds that the persistence of inflation has shifted over time.[2] Most of these earlier studies, however, focus on the inflation problem in developed countries. Studies on the stochastic properties of inflation series in developing countries are rare. In this paper, we examine the time series properties as well as the rural-urban inflation disparity of the inflation series in China. The case of China is of interest because of its rising role in the world economy. Since the open-door policy in 1978, China has experienced inflation upsurges in 1980, 1985, 1988, 1994 and 2004 (Brandt and Zhu, 2000, 2001). Two episodes of deflation are also observed, one from early 1998 to early 2000 and the other from the end of 2001 to the end of 2002. Since 2004, the economic growth of China has accelerated, which causes another wave of inflation from 2005 to 2008.[3] As the second largest economy in the world, as well as the biggest exporter to the US and Europe, the inflation problem in China has important implications on the price levels of other economies. Our results show that, in general, the inflation rates of food, tobacco and clothes in China contain a unit root. Structural breaks in the inflation series are detected. Supporting evidence for the disparity in inflation between Chinese rural and urban areas is also found.

2. The Models

To examine the persistence of the inflation series in China, we first conduct a simple ADF unit root test (Dickey and Fuller, 1979) for the following regression:

$$\Delta\pi_t = \mu + \beta t + \alpha\pi_{t-1} + \sum_{i=1}^{k} c_i \Delta\pi_{t-i} + \varepsilon_t , \qquad (1)$$

where π_t is the inflation rate at time *t*. The lag order k is determined by SIC. We test the hypothesis $H_0 : \alpha = 0$. Since the unit root test is biased towards the null hypothesis in the presence of structural breaks (Perron, 1989), we also estimate the following model of Zivot and Andrews (1992) to allow for an endogenous break:

$$\Delta\pi_t = \mu + \beta t + \alpha\pi_{t-1} + \theta DU_t + \gamma DT_t + \sum_{i=1}^{k} c_i \Delta\pi_{t-i} + \varepsilon_t , \qquad (2)$$

where DU_t is the dummy variable for a mean shift at time TB, and DT_t is the trend shift dummy at time TB, where $DU_t = 1$ if $t > TB$, 0 otherwise, and $DT_t = t - TB$ if $t > TB$, 0

[2] Other studies include Culver and Papell (1997) and Henry and Shields (2004).
[3] The CPI hits a record high of 8.7% in February 2008.

otherwise. In Equation (2), if DT_t is omitted, the resulting model is referred to as Model A, and if DU_t is omitted, it is referred to as Model B. The estimated break point is defined as the date when the t statistic of θ or γ achieves the maximum. The alternative hypothesis is that the series is trend stationary with a mean shift (Model A) or a trend break (Model B) or both (Model C). To allow for two breaks, we also estimate the following model of Lumsdaine and Papell (1997):

$$\Delta\pi_t = \mu + \beta t + \alpha\pi_{t-1} + \theta_1 DU1_t + \theta_2 DU2_t + \gamma_1 DT1_t + \gamma_2 DT2_t + \sum_{i=1}^{k} c_i \Delta\pi_{t-i} + \varepsilon_t . \qquad (3)$$

In Equation (3), $DU1_t$ and $DU2_t$ are the dummy variables for a mean shift at times TB1 and TB2 respectively, with $DU1_t$ and $DU2_t$ being the corresponding trend shift dummies, where $DUi_t = 1$ if $t > TBi$, and equals 0 otherwise. $DTi_t = t - TBi$ if $t > TBi$, and equals 0 otherwise (for $i = 1, 2$). Following Lumsdaine and Papell (1997), the model in (3) is referred to as Model CC. If $DT1_t$ and $DT2_t$ are omitted, we name it Model AA.

3. Data and Results

Monthly data of the Consumer Price Index for the national, urban and rural series from 2001:01 to 2007:04 are obtained from the National Bureau of Statistics of China. The monthly inflation rate is defined as the annualized growth of monthly CPI. The overall CPI is the weighted sum of the CPI indices of eight components, including Food (foods), Tobacco (tobacco, liquor and articles), Clothes (clothes), Home (home equipment & services), Medical (medical treatment, health care & individual articles), Transport (transport & communication), Education (recreation, education, cultural articles & services), and Housing (housing). The summary statistics of the national, urban and rural series are reported in Table Ia and the inflation series are plotted in Figure 1. All series are from January of 2001 to April of 2007. The number of observations for all series is 76. N, U and R denote the national, urban and rural series respectively.

Table Ia: Summary Statistics for China's Inflation (Jan 2001 to April 2007)

Variable	Mean			Std. Dev.			Min			Max		
	N	U	R	N	U	R	N	U	R	N	U	R
Overall	1.46	1.26	1.83	1.60	1.51	1.80	-1.30	-1.70	-0.70	5.30	4.90	6.40
Food	3.20	3.13	3.34	4.05	3.77	4.66	-3.30	-3.50	-2.70	1.60	14.00	15.70
Tobacco	0.36	0.37	0.35	0.68	0.71	0.68	-0.60	-0.70	-0.90	1.80	1.90	1.80
Clothes	-1.61	-1.84	-1.09	0.80	0.92	0.65	-2.90	-3.40	-2.10	0.50	0.40	0.80
Home	-1.09	-1.31	-0.57	1.61	1.74	1.34	-2.90	-3.20	-2.40	2.20	2.20	2.30
Medical	0.15	-0.44	1.07	1.07	1.15	1.11	-1.50	-2.30	-0.60	2.20	1.30	3.70
Transport	-1.22	-1.60	-0.42	0.86	0.83	1.37	-2.70	-3.10	-4.70	0.40	0.00	2.30
Education	1.78	1.49	2.23	2.80	2.94	2.89	-2.30	-1.70	-3.40	9.60	10.30	8.40
Housing	3.06	3.19	2.89	2.17	2.11	2.52	-0.50	-1.10	-1.80	6.80	6.60	7.70

Among the CPI components, the inflation rates in Food, Tobacco, Education and Housing are generally positive, while clothes, home and transport have negative inflation rates since 1998. Comparing the urban and rural series, the average overall inflation rate of the urban and rural series are 1.26 and 1.83 respectively during the 76 months from January of 2001 to April of 2007. Most CPI components of the rural series, except tobacco and housing, have higher inflation rates than those of the urban and the national series, indicating that rural residents experience higher inflation than their urban counterparts. For the models (1), (2) and (3) considered in this paper, this urban-rural disparity could be due to different intercept μ , or different trend β or autocorrelation parameters c_i . However, Figure 1 shows that most urban and rural inflation series follow the same pattern. Thus, to test for the regional disparity of China's inflation, it is informative to simply look at whether the intercept μ is the same for urban and rural inflation series. The null hypothesis is

H_0: $\mu^U - \mu^R = 0$

and the alternative hypothesis is

H_1: $\mu^U - \mu^R < 0$

where μ^U is the intercept for urban inflation series and μ^R for rural inflation series respectively. The null is equivalent to zero mean of $\pi_t^U - \pi_t^R$. The alternative is that the mean of $\pi_t^U - \pi_t^R$ is negative. Superscript *U* is for urban series and *R* for rural series.

The second column of Table Ib below presents the p-values of the test, showing that for the Overall series and components Clothes, Home, Medical, Transport, Education and Housing, the null hypothesis is rejected in favor of the alternative at 5% level. In 3rd column we also report the p-values of the test H_0: $mean(\pi_t^U) - mean(\pi_t^R) = 0$ (H_1: $mean(\pi_t^U) - mean(\pi_t^R) < 0$). The result is similar except that we cannot reject the null for Housing component.

Table Ib: Testing the Urban-rural disparity of China's inflation

	p-values of test 1	p-values of test 2
Overall	0.000	0.030
Food	0.082	0.416
Tobacco	1.000	0.864
Clothes	0.000	0.000
Home	0.000	0.000
Medical	0.000	0.000
Transport	0.000	0.000
Education	0.000	0.013
Housing	0.007	0.123

Note:

For test 1, H_0: $mean(\pi_t^U - \pi_t^R) = 0$, H_1: $mean(\pi_t^U - \pi_t^R) < 0$.

For test 2, H_0: $mean(\pi_t^U) - mean(\pi_t^R) = 0$, H_1: $mean(\pi_t^U) - mean(\pi_t^R) < 0$.

The urban-rural inflation disparity reflects the difference of market structures in urban and rural areas. The rural-urban divide of Chinese economy and its impact on income inequality, labor and products market distortions have been widely studied in the literature (Yang, 1999; Lin, Wang and Zhao, 2004; Knight and Song, 1999; Zhang and Tan, 2007). Though the institutional barriers resulting in this rural-urban divide are dwindling, rural markets are still relatively less developed than urban markets. For example, the disparities of medical treatment and health care between urban and rural areas are even growing (Blumenthal and Hsiao, 2005; Dummer and Cook, 2007; Wang, 2004). Since early 1980s, China decentralized its public health system and transferred much of the responsibility for funding health care services to local governments. The central government's share of health care spending declined sharply from 36.4% in 1980 to 15.5% in 1998 (Liu, 2004). For this part of health services, rural residents received much less than their urban counterparts, 10.7 *yuan* (approximately 1.6 dollars) on average compared with 130 *yuan* (approximately 19.5 dollars) in 1998 (Wang, 2004). With privatized agricultural economy, the health care safety net for most of rural China was dismantled. Under the market-oriented health care system, the investments in health care flow disproportionately to populated and wealthy urban areas. In 1999, only 7% of rural residents had health insurance, compared to 49% for urban residents (Liu, 2004). In light of this situation, the rural markets of medical treatment and health care are less developed and more vulnerable, and have higher CPI compared to urban markets. Similarly, other components of inflation series, such as education, are also influenced by this rural-urban economic divide. Note that the urban-rural inflation disparity due to economic divide is also reflected by the fact that large urban-rural inflation gap occurs in high inflation periods.

Table II: Unit Root Test of China's Inflation Rate

	National		Urban		Rural	
	Intercept	Both	Intercept	Both	Intercept	Both
Overall	-1.55	-1.97	-1.76	-2.32	-1.28	-1.52
Food	-1.70	-1.84	-1.93	-2.11	-1.86	-1.86
Tobacco	-1.87	-2.59	-1.03	-2.04	-1.23	-1.57
Clothes	-0.81	-2.25	-1.05	-2.43	-0.78	-2.63
Home	3.08	-2.50	1.66	-2.43	2.17	-2.11
Medical	-2.35	-2.88	-2.13	*-3.24**	-2.31	-2.34
Transport	-1.25	*-3.97***	-1.99	-2.14	-0.84	*-7.85****
Education	-2.44	-2.39	*-3.07***	-2.71	-1.26	-1.72
Housing	-0.76	-1.59	-0.93	-2.12	-1.13	-1.38

For all series, the 1%, 5% and 10% critical values of the ADF test with intercept are -3.52, -2.90 and -2.59 respectively. The corresponding critical value of the ADF test with intercept and time trend are respectively -4.09, -3.47 and -3.16.
***, **, and * denote the 1%, 5% and 10% level of significance respectively.
Intercept denotes the ADF test with an intercept only and *Both* denotes the ADF test with an intercept and a time trend. Lag order is determined by the Schwarz Information Criterion.

Table II reports the results for the unit-root test without break. For models with intercept

only, we find little evidence against the unit root hypothesis. For models with intercept and trend, the unit root hypothesis is rejected for the national and rural transport series, and for the urban medical series at the 10% level. We also reject the unit root null for the inflation in urban education series at the 5% level for the case with intercept only. For other series, we fail to reject the unit root hypothesis.

The results for the unit root test with one structural break using the Zivot and Andrews (1992) model are presented in Table III. For the national series, the unit root hypothesis is rejected for the categories of Home, Transport and Education in Model B, as well as for the education series in Models A and C. For the urban series, the null hypotheses for home and education are rejected at the 10% and 1% level respectively in all three models. For the rural series, we reject the unit root null for the transport and clothes series at the 5% and 10% level respectively in Model B, and for the housing series at the 10% level in Models A and C. Thus, the aforementioned series are stationary with one break. For other inflation series, we cannot reject the unit root hypothesis with one structural break. Thus, the rural and urban inflations appear to follow different processes.

Note from Models A and C that the overall and food inflations have the same break in March 2005 after the implementation of macro control policies. Allowing for a break in time trend (Model B), the structural break of overall inflation occurs around the inflation peak in early 2004. For other series, the break points are different. The series of tobacco, medical and housing have break points at around 2003 and 2004 in Models A and C. The test of Lumsdaine and Papell (1997) that allows for two structural breaks is also performed and the results are reported in Table IV.

Table III: Unit Root Test with One Break Point

		Model A		Model B		Model C	
		_	_	_	_	_	_
CPI	N	2005:03	-3.27	2004:05	-2.49	2005:03	-2.96
	U	2005:03	-3.36	2004:06	-2.73	2005:03	-3.15
	R	2005:03	-3.24	2004:02	-2.13	2005:03	-2.67
Food	N	2005:03	-3.71	2003:12	-2.31	2005:03	-3.23
	U	2005:03	-3.89	2004:05	-2.62	2005:03	-3.47
	R	2005:03	-3.86	2003:12	-2.14	2005:03	-3.25
Tobacco	N	2003:10	-3.31	2006:07	-2.66	2003:10	-3.30
	U	2004:11	-2.91	2006:03	-2.19	2004:11	-2.93
	R	2005:04	-3.16	2004:02	-2.39	2003:11	-3.00
Clothes	N	2006:02	-3.26	2002:10	-2.90	2002:06	-3.11
	U	2006:02	-3.17	2002:11	-2.79	2005:02	-2.85
	R	2006:09	-4.09	2004:11	*-4.11**	2004:05	-4.11
Home	N	2002:05	-4.49	2003:03	*-4.60***	2002:11	-4.63
	U	2002:05	*-4.64**	2003:08	*-4.20**	2002:12	*-4.82**
	R	2001:10	-3.05	2002:07	-3.17	2001:12	-3.18
Medical	N	2004:04	-4.53	2005:02	-3.04	2004:04	-4.64
	U	2004:04	-4.26	2002:02	-3.46	2004:04	-4.42
	R	2004:04	-4.44	2005:04	-2.49	2004:04	-4.43
Transport	N	2002:04	-4.28	2003:06	*-4.94****	2003:05	-4.80
	U	2002:04	-4.50	2003:07	-3.94	2002:04	-4.45
	R	2001:09	*-5.12***	2002:02	*-5.48****	2002:01	*-5.41***
Education	N	2001:09	*-6.47****	2001:10	*-4.85***	2001:09	*-6.44****
	U	2001:09	*-12.08****	2001:10	*-6.03****	2001:09	*-12.08****
	R	2001:09	-2.69	2001:10	-2.68	2004:09	-3.05
Housing	N	2003:10	-3.00	2004:11	-3.38	2004:04	-3.77
	U	2003:01	-3.34	2005:04	-3.33	2004:04	-3.59
	R	2003:10	*-4.99***	2004:09	-2.64	2003:10	*-4.99**

Model A is referred to as the trend stationary model with a mean shift. Model B has a trend break and Model C allows for both.
For Model A, the 1%, 5% and 10% critical values are -5.43, -4.80 and -4.58 respectively.
For Model B, the 1%, 5% and 10% critical values are -4.93, -4.42 and -4.11 respectively.
For Model C, the 1%, 5% and 10% critical values are -5.57, -5.08 and -4.82 respectively.

Table IV: Unit Root Test with Two Break Points

		Model AA			Model CC		
		_	_	_	_	_	_
CPI	N	2003:08	2005:07	-3.87	2002:01	2005:02	-4.51
	U	2004:02	2004:08	-3.74	2002:01	2005:02	-4.99
	R	2003:08	2005:06	-4.21	2003:08	2006:05	-3.98
Food	N	2003:06	2005:01	-5.12	2004:02	2005:12	-4.70
	U	2004:02	2005:01	-5.32	2004:02	2005:12	-5.01
	R	2003:08	2005:01	-5.01	2003:08	2006:09	-4.51
Tobacco	N	2003:08	2006:10	*-5.98**	2003:08	2006:10	-5.58
	U	2002:04	2005:07	-4.97	2002:07	2004:09	-5.11
	R	2005:01	2005:11	-4.77	2004:02	2005:11	-5.57
Clothes	N	2002:05	2005:12	-4.63	2003:05	2004:12	-5.85
	U	2002:04	2005:12	-5.12	2002:09	2004:12	-5.49
	R	2002:04	2006:08	-5.10	2005:01	2005:11	-5.17
Home	N	2002:04	2004:12	-4.75	2003:06	2004:09	-5.99
	U	2002:04	2004:11	-5.36	2002:11	2006:04	-5.42
	R	2001:11	2002:02	-4.08	2002:04	2005:09	-4.81
Medical	N	2001:11	2004:02	*-5.97**	2003:02	2004:02	*-11.88****
	U	2001:11	2004:02	-5.90	2003:02	2004:02	*-10.37****
	R	2003:02	2004:02	-5.47	2003:02	2004:02	*-10.46****
Transport	N	2002:02	2003:03	*-7.35****	2001:11	2005:11	*-7.27***
	U	2002:02	2003:03	*-6.09**	2002:02	2004:02	-6.38
	R	2001:12	2002:04	*-10.94****	2001:12	2005:12	*-12.22****
Education	N	2004:06	2006:07	*-9.69****	2004:08	2005:07	*-14.07****
	U	2005:07	2006:09	*-18.51****	2005:01	2006:12	*-22.00****
	R	2002:12	2004:06	-5.75	2004:07	2006:08	-6.26
Housing	N	2002:11	2004:02	-5.17	2002:04	2004:06	*-7.13***
	U	2002:11	2004:02	-5.37	2002:01	2005:02	-6.21
	R	2003:08	2005:06	-5.43	2003:03	2004:09	-6.01

Model AA allows for two breaks in the intercept only, while Model CC considers another two breaks in the trend term.
For Model AA, the 1%, 5% and 10% critical values are -6.94, -6.24 and -5.96 respectively.
For Model CC, the 1%, 5% and 10% critical values are -7.34, -6.82 and -6.49 respectively.

Table IV shows more evidence against the unit root hypothesis. Note that Model AA allows for two breaks in the intercept only, while another two breaks are also allowed in the trend term in Model CC. For the national series, the unit root hypothesis is rejected for tobacco at the 10% level in Model AA, for housing at the 5% level in Model CC and for medical, transport and education at the 10% level in both models. For the urban series, at the 1% level, we reject the null hypothesis for medical in Model CC, for transport in Model AA and for education in both models. For the rural series, the null hypothesis is rejected for the medical series in Model CC and for the transport series in both models. The difference between urban and rural inflation series is non-trivial. The urban education series can be regarded as a segmented trend stationary process, while this is not the case for the rural series. Besides, rural transport inflation and its urban counterpart follow different processes. Note from Table IV that the national tobacco and housing series are segmented trend stationary. However, we fail to reject unit root hypothesis for the urban and rural series. Thus, the national series cannot fully reflect the inflation problem in urban and rural areas. In a nutshell, without structural breaks, we fail to reject unit root hypothesis for most components of the national, urban and rural inflation series, except the national and rural transport, urban medical and urban education series. These inflation series are likely to be trend stationary. In the one-break case, the unit root hypothesis is rejected for the national home, transport, and education series, the urban home and education series, and the rural transport, clothes and housing series. In the two-break case, the unit hypothesis is rejected for the national tobacco, housing, medical, transport and education, the urban medical and education and the rural medical and transport inflation series.

4. Conclusion

This paper examines the persistence of China's inflation rate with a focus on the rural-urban disparity. The time series properties of the components of CPI are explored. We fail to reject the hypothesis that the overall, food, tobacco and clothes series contain a unit root. However, if two breaks are allowed, the medical inflation series is segmented trend stationary. In particular, we find that the properties of the urban and rural series have noticeable differences. For example, the urban education series is stationary, while its rural counterpart seems to follow a unit root process. In addition, the rural transport series is stationary, while the urban series is not when structural breaks are allowed. Our findings provide supporting evidence for the disparity between China's rural and urban economies. Our results also imply that, in the long run, it is easier for the government to control the inflation in the medical and education sectors. However, the price stabilization policies may not be effective (Raj and Slottje, 1994) in the sectors of food, tobacco, clothes, urban transport and urban housing.

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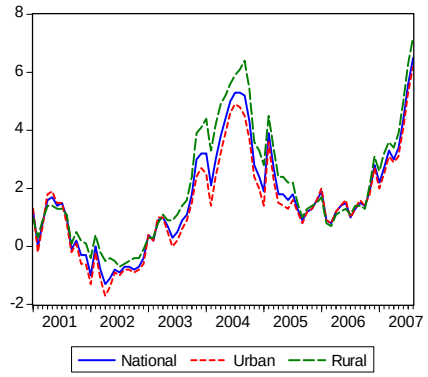
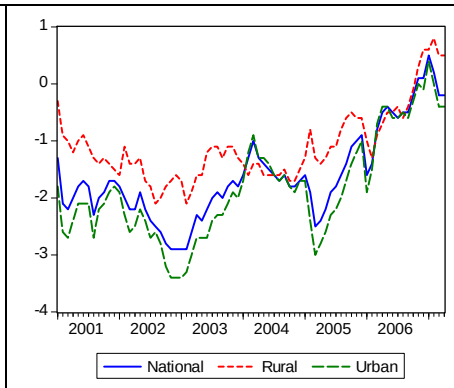
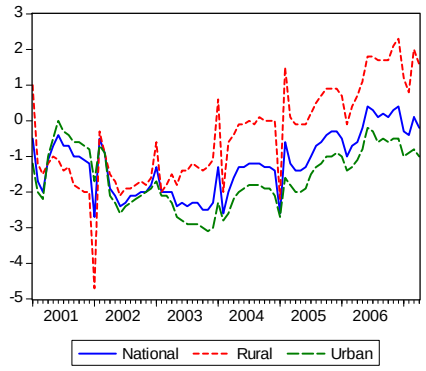
Figure 1: Overall Inflation Rate and its Components



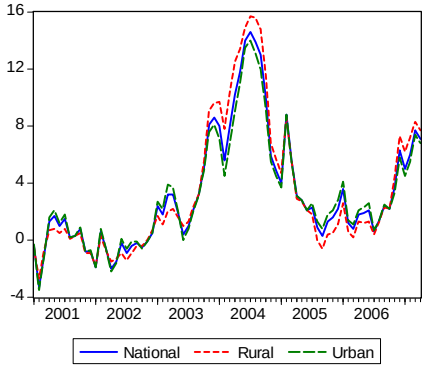
Overall Inflation



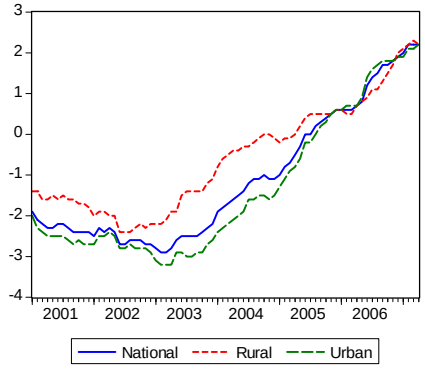
Clothes



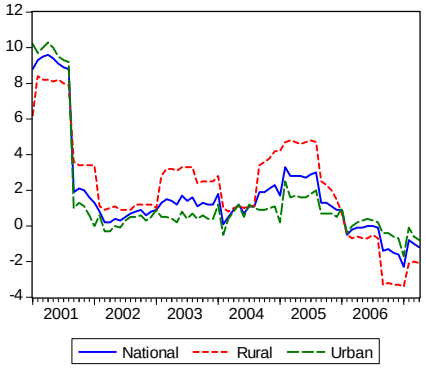
Transport



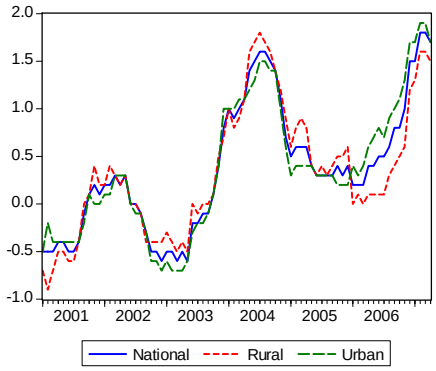
Food



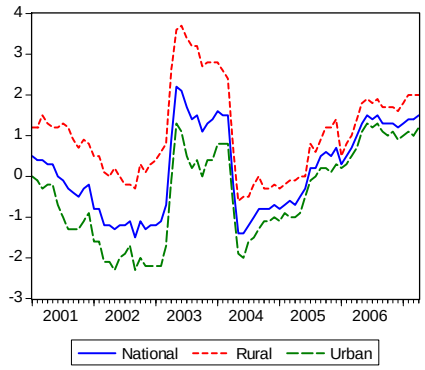
Home



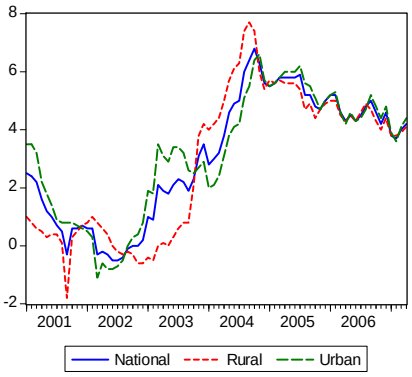
Education



Tobacco



Medical



Housing