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Goods market integration and half-life measurement across Chinese regions

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Abstract

This paper studies the speed of inter-provincial price convergence within China based on half-life measurement. We calculate the point estimates of half-lives and corresponding confidence intervals using the median-unbiased estimation methods, which can correct for downward bias in the least squares estimates. The point estimates of half-lives indicate the fast speed of mean reversion towards convergence between region pairs. However, the confidence intervals for half-lives are so wide that strong conclusion on high degree of internal market unification may not be assured and further research is needed.

Keywords: price convergence, half-lives, median-unbiased estimation method
JEL Codes: C22, R58, O53, P22

1. Introduction

Over the past twenty years, many former planned economies have moved toward market economies. The presumption is that when government intervention is reduced, resource allocation should become more efficient. From 1978 to the present, China has undergone 29 years of market-oriented economic restructuring. Part of this restructuring has been liberalization of internal trade.

Free trade, if it is truly free, must, almost by definition, bring mutual benefits for both trading parties. However, it has been argued that since the Chinese local governments focused on their own economic growth because they have to obtain enough tax revenue to finance their own development, different kinds of local protectionism still found existed. Examples are special charges levied at roadblocks, quotas for shipping in goods from other provinces, local purchasing quotas and administrative trivia etc. All have been used to hamper trade.[1]

Nevertheless, since the Eighth National People Congress in 1993 where the Chinese government stated clearly that its ultimate goal was to develop a "socialist market economy", the government has gradually removed price controls and any forms of state intervention. At present, there are about 90% of products in which the prices determined by market mechanism, simultaneously with a more than 9 percent average growth rate and significant improvement in the living standard.[2] World Bank (1996 and 1997), Wang (1997) and Cai, *et. al.* (2003) have come to realize that China's market-oriented reforms have injected vitality into the economy, raised efficiency, and improved the allocation of resources. Most recently, China has developed legal protection of private property right which will add strength to the market role on China's economy. Those reflect the Government's determination and efforts in shifting the country to be a real market economy.

From the perspective of resource allocation, a less-integrated economy implies that static and dynamic gains achieved by comparative advantage, economies-of-scale, diffusion of technical knowledge, and increasing competition cannot be fully exploited (Xu, 2002). Moreover, local protectionism widens income gaps among different regions. Finally, China's international opening is less effective if free access and free movement of goods do not exist among provinces. The degree of internal market unification in China is controversial and is particularly important, especially after China's entry into the World Trade Organization.

An approach to detecting internal market unification is to assess the extent of inter-provincial price convergence. Recent studies mainly use the concept of mean stationarity and utilize the unit root econometrics methods to evaluate price convergence. The rejection of the unit root hypothesis of the price differential series implies they are stationary and inter-provincial prices will converge. A problem that arises with hypothesis tests in the unit-root context is of low empirical power. Although a panel unit root test can significantly increase the power of the test (Levin, et. al., 2002, and Im, et.al. 2003), Caporale and Cerrato (2006) provides a critical review of the panel tests used in the PPP literature. In this paper, however, we are concerned with estimating the speed of inter-provincial price convergence within China based on the half-life measurement as evidence of internal market unification. The half-life is defined as the number of periods required for a unit shock to dissipate by one half. Lower half-life estimates indicate a faster speed of mean reversion towards convergence. If the half-life is infinite, the convergence never occurs. We

[1] For details, see Young (2000) and Rodrik (2000).
[2] Statistical Yearbook of China,, various issues.

employ median-unbiased estimation methods of Andrews (1993) and Andrews and Chen (1994) for the point and intervals estimates of half-life, which as discussed in detail in Murray and Papell (2002 and 2005), do not suffer from the econometric problems with the least squares estimates. This approach is firstly applied to the China's price data of provincial level for measuring the degree of domestic goods market integration.

The rest of the paper is organized as follows: Section 2 explains the econometric methodologies employed while the data are described in Section 3. Section 4 reports the empirical results. Concluding remarks are shown in the last section.

2. Methodology:

Consider the following AR(1) model for the log price differentials between any region pair in Mainland China, denoted by p_t:

$$p_t = c + \alpha p_{t-1} + e_t, \quad \text{where } e_t \sim IIN(0, \sigma^2) \qquad (1)$$

The formula for point estimate of half-life in equation (1) is simply calculated as $\ln(0.5)/\ln(\alpha)$. Since the least squares estimator of α exhibits downward bias, the least squares estimates of the half-life would be overstated. To correct for downward bias in the least squares estimates, Andrew (1993) introduces a procedure to obtain exactly median-unbiased estimators α_{MU} for α in AR(1) models, where α is allowed to lie in the interval (0,1], which includes the case of a unit root. The condition of median-unbiasedness has the impartiality property that the probability of underestimation equals the probability of overestimation. Because α_{MU} is median-unbiased and median-unbiasedness is preserved under monotonic transformations, the half-life point estimate given by $\ln(0.5)/\ln(\alpha_{MU})$ is also median-unbiased. Moreover, as proposed by Cheung and Lai (2000), the point estimates of half-life need to be supplemented with corresponding confidence intervals as indicators of the variability of estimators. The procedure of Andrews (1993) can also be used to estimate the upper and lower bounds of the exact confidence intervals for α in AR(1) models.

The above exactly median-unbiased estimation methods only apply to first-order AR processes. An extension to higher-order AR models is considered in Andrews and Chen (1994), which suggests an iterative procedure to yield an approximately median-unbiased point and interval estimators for α in the following AR(k+1) model for p_t:

$$p_t = c + \alpha p_{t-1} + \sum_{i=1}^{k} \Psi_i \Delta p_{t-i} + e_t, \qquad (2)$$

The median-unbiased estimators of α are not exact but approximate in equation (2) because the median-unbiased estimation depends upon the true values of Ψ_i which are however unknown. The simulation evidence of Andrews and Chen (1994) shows that the approximation can still produce a substantial reduction in median bias over the least squares estimators.

Half-lives calculated directly from an estimate of α in equation (1) assume that shocks to the series p_t decay monotonically. In the case of a higher-order autoregression, shocks will not decay at a constant rate. Under this circumstance, the point and interval estimates of half-lives are no longer based on α in equation (2), and must be calculated from the relevant impulse response functions (Cheung and Lai 2000). The estimate of half-life refers to the number of periods that gives the impulse responses to a unit shock equal to 0.5.

3. Data

The data series collected from China Monthly Statistics, published by China statistical information and consultancy Service Centre, which consist of the monthly aggregate consumer price indices in China's regions, including Xinjiang, Shaanxi, Shanxi, Hebei, Henan, Hubei, Hunan, Guangdong, Beijing, Anhui, Inner Mongolia, Zhejiang, Yunnan, Tianjin, Sichuan, Jilin, Liaoning, Ningxia, Qinghai, Shandong, Heilongjiang, Jiangsu, Jiangxi, Guangxi, Guizhou, Hainan, Gansu, Fujian and Shanghai. The sample periods span from January 1995 to August 2006. We exclude the series for Tibet and Chongqing due to the lack of consistent data. Shanghai is chosen as a benchmark region. In other words, the data on log price differentials between any region pair refers to the natural log of price data on a region other than Shanghai minus the natural log of price data on Shanghai.

4. Empirical results

We first select the appropriate lag length k in AR models for p_t. Our approach is to start with a maximum lag length of 8 and pare down the model by the significance of usual t-statistic. If k =0, we estimate equation (1) using exactly median-unbiased estimation method and the results are reported in Table 1. While k is larger than zero, we estimate equation (2) via the approximately procedures with the results shown in Table 2.

Combining the results from Tables 1 and 2, we find that the lowest point estimate of half-life is 1.55 months for the price differential between Shanxi and Shanghai, which implies that shocks to the price differentials decay at a rate equal to 36.1% per month. Also, the confidence interval for the half-life is [0.97, 2.19] months. This is equivalent to the statement that we are 95% confident that shocks decay at a monthly rate between 27.1% and 51.1%. On the other hand, the highest point estimate of half-life is 6.23 months for the price differential between Heilongjiang and Shanghai, and the shocks to the price differentials decay at a monthly rate of 10.5%. The 95% confidence interval is [1.92, 10.93], signifying that the shocks decay at a rate between 6.14% and 30.3%. Generally, the point estimates of half-lives are quite low, indicating high degree of domestic goods market integration. However, the confidence intervals for the half-lives are so wide that strong conclusion on internal market unification may not be warranted and further research is required.

5. Conclusion:

From the empirical results, the median-unbiased estimators for α below unity and the point estimates of half-lives for the price differentials between region pairs are low. They provide evidence in favour of high degree of internal market unification within China. However, the point estimates are subject to large variability.

TABLE 1 EXACTLY MEDIAN-UNBIASED HALF-LIVES IN EQUATION (1)

Region	α_{MU}	95%CI	$HL_{\alpha.MU}$	95%CI
Xinjiang	0.82	[0.70,0.91]	3.49	[1.94,7.35]
Shaanxi	0.80	[0.67,0.90]	3.11	[1.73,6.58]
Shanxi	0.64	[0.48,0.76]	1.55	[0.97,2.19]
Hebei	0.74	[0.60,0.85]	2.30	[1.36,4.27]
Henan	0.83	[0.71,0.92]	3.72	[2.02,8.31]
Hubei	0.82	[0.70,0.91]	3.49	[1.94,7.35]
Hunan	0.78	[0.65,0.88]	2.79	[1.61,5.42]
Guangdong	0.72	[0.58,0.83]	2.11	[1.27,3.72]
Beijing	0.79	[0.66,0.89]	2.94	[1.67,5.95]
Anhui	0.79	[0.66,0.89]	2.94	[1.67,5.95]

NOTE:

The point estimates of half-life, $HL_{\alpha.MU}$, is calculated from $\ln(0.5)/\ln(\alpha_{MU})$, and their corresponding 95% bootstrap confidence intervals (CI), are shown in square brackets.

TABLE 2 APPROXIMATELY MEDIAN-UNBIASED HALF-LIVES IN EQUATION (2)

Region	K	α_{MU}	95%CI	$HL_{IRF.MU}$	95%CI
Zhejiang	4	0.77	[0.58,0.90]	2.12	[1.05,5.85]
Yunnan	2	0.88	[0.74,0.97]	4.77	[1.70,19.11]
Tianjin	6	0.68	[0.48,0.80]	1.82	[1.14,6.67]
Sichuan	4	0.81	[0.66,0.91]	4.89	[1.76,8.38]
Jilin	4	0.81	[0.67,0.90]	2.78	[1.77,8.23]
Liaoning	6	0.70	[0.49,0.83]	1.95	[1.39,6.62]
Ningxia	6	0.75	[0.57,0.89]	2.29	[1.54,7.43]
Qinghai	6	0.78	[0.62,0.90]	2.01	[1.23,7.62]
Shandong	6	0.69	[0.48,0.83]	1.82	[1.27,6.38]
Heilongjiang	4	0.83	[0.71,0.92]	6.23	[1.92,10.93]
Jiangsu	4	0.79	[0.61,0.90]	2.83	[1.30,7.68]
Jiangxi	6	0.68	[0.44,0.82]	1.79	[1.25,6.11]
Guangxi	6	0.74	[0.57,0.86]	2.60	[1.56,7.15]
Guizhou	6	0.75	[0.56,0.86]	2.68	[1.75,7.41]
Hainan	5	0.70	[0.52,0.83]	2.48	[0.99,5.67]
Gansu	4	0.81	[0.64,0.92]	2.66	[1.66,6.33]
Fujian	4	0.74	[0.57,0.86]	2.50	[1.66,5.63]

Note:

The point estimates of half-lives, $HL_{IRF.MU}$, is obtained from the impulse response functions.

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