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## 1. INTRODUCTION

Since the Eighth National People's Congress (NPC) 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 other forms of state intervention. As a result, for about 90% of products prices are determined by market mechanism, a phenomenon that has been accompanied by an average growth rate of more than 9 percent and significant improvement in living standards.[1] World Bank (1996 and 1997), Wang (1997) and Cai and Wang (2003) have recognized that China's market-oriented reforms have injected vitality into its economy, raised efficiency and improved allocation of resources. Since 2001, the State Council has issued and brought into force regulations prohibiting local governments and authorities from hindering import of goods and services originating in other parts of China. The ban has been successful in removing crude and obviously illegal means also, such as roadblocks barring entry of products from other parts of the country and even relatively sophisticated ways like local officials hinting to local companies that they should buy only locally made goods. The regulations specify penalties ranging from issuance of notes of criticism to dismissal and criminal prosecution (EIU, 2009). In 2002, China introduced legal protection for private property rights. The 16th Congress of the Communist Party decided to allow private entrepreneurs to enter party ranks, and the NPC adopted a constitutional amendment in 2004 that, for the first time, recognized and protected private property. This transformation in turn has strengthened the market's role in China's economy ( Fung et. al., 2006; EIU, 2009).

[1] For details, see *Statistical Yearbook of China*, various issues.

In theory, free trade increases the welfare of both trading parties, but it does not mean that every region has opened up its economy to other regions. In reality different kinds of local protectionist measures continue to exist in China since local governments largely rely on tax revenues from local industries and have strong incentives to support local companies in competition against non-local enterprises.[2] To support local enterprises, they establish market entry barriers like ad hoc taxes and fees (Ahlstrom and Bruton, 2001; Bai et al., 2004; Lee, 1998; Poncet, 2005; Yeung, 2000). Moreover, local governments impose their own tolls in certain areas to generate revenue and to protect the local economy, a trend that has grown to the extent where toll charges are the biggest cost for trucking companies (Lai et al., 2008; Jiang and Prater, 2002; Hong and Liu, 2007). Other barriers include special charges levied at roadblocks, non-tariff methods such as physical barriers, outright prohibition of trade, low-interest loans and other financial benefits for commercial establishments marketing local goods, fines for commercial establishments marketing non-local goods, local purchasing quotas, and administrative trivia (Young, 2000; Rodrik, 2000; Woo and Lee, 2009).

Since the financial tsunami in 2008, China has faced protectionism in its overseas markets, including to crude and obviously illegal barriers akin to roadblocks and barring products from the outside, besides relatively sophisticated forms of protectionism such as "Buy American" and "British jobs for British workers" campaigns. However, the Chinese government has continued to insist on free trade, though many of China's export-dependent industries have been seriously affected. Senior officials have stressed repeatedly that China will not retaliate against protectionist measures elsewhere. Indeed,

[2] This is a typical example of the "principal-agent" problem (Yin, 2003): when the central government, which makes economic policies for the entire country, behaves as a principal, the local governments who undertake the policies' implementation become the agents. The agents, however, may not act in the interest of the entire country and may instead focus on their own interests.

there are no explicit protectionist provisions in the central government's broad guidelines for various stimulus plans, which include the 4 trillion RMB spending on public infrastructure projects to boost domestic expenditure. On the contrary, the Minister of Commerce, Deming Chen, led a delegation of Chinese entrepreneurs on a highly symbolic shopping tour in Europe.

However, Chinese news reports suggest that the financial tsunami has created an incentive for provincial governments to protect their own firms, especially leading enterprises that are partly owned by the provincial governments. For example, in Anhui, the local government has introduced specific "buy local" policies such that car manufacturers and power plants in Anhui must buy steel and coal from within the province, and construction and home appliance manufacturers must cooperate with local steel giant Ma An Shan Steel. All public infrastructure projects are required to use Anhui-made steel, concrete, doors and windows, glass, electrical wiring and equipment, and so forth.[3] These measures have in turn induced retaliation by other provinces, hampering inter-province trade and worsening the impact of the downturn. For instance, it is difficult to sell a Hubei-built car to taxi companies in Shanghai while it is difficult for Shanghai-based Volkswagen to sell sedans in Wuhan.[4] In addition, in Hangzhou, the municipal government has begun subsidizing purchases of locally made mobile handsets, refrigerators, television sets and washing machines which effectively amounts to an 18% price discount for locally made products. Furthermore, Changchun city, the provincial capital of Jilin, has waived inspection fees for new vehicles made by local carmaker First Auto Works, creating an effective price advantage for the company.

[3] For details, see "China's Provinces Trot out "Buy Local" Campaigns," *JAVNO*, February 18, 2009 [on-line]: http://www.javno.com/en-world/chinas-provinces-trot-out-buy-local-campaigns_235307

[4] For details, see "Martin Zhou in Beijing," *South China Morning Post*, Hong Kong, March 4, 2009.

The provincial government has also required that at least 50% of equipment for large projects be sourced locally by manufacturers with "self-owned brands."

Of the proposed 4 trillion RMB stimulus plan, the central government covers only about 25% of the budget, leaving the rest to local governments and banks. This allows substantial discretion to provincial or city administrations to add protectionist strings to their share of spending in order to safeguard the interests of enterprises in their jurisdictions.It is believed that regional protectionism in China has become much worse since the financial tsunami. Joerg Wuttke, president of the European Chamber of Commerce in China, has gone to the extent of saying that "China should have an *internal WTO*." He says non-tariff barriers in China cost EU companies more than €21.4 billion a year in lost business opportunities. Foreign investors in China are worried that local protectionist tendencies will be reinforced as the economic crisis deepens.[5] However, although most public infrastructure projects must be implemented and partially funded by local officials, this does not mean there has been an overall move toward protectionism on part of provincial governments. In case of consumer goods, urban Chinese customers have become brand-conscious and now deem foreign-made goods synonymous with quality.[6]

On the whole, continuous market reforms and the constantly changing economic situation over the past few decades have sometimes actually deepened liberalization of internal trade among regions, though sometimes reforms or periodic changes in economic situations may have led to increase in the degree of local protectionism. Local protectionism can also damage law enforcement and induce dishonest business behaviors.

[5] For details, see "Martin Zhou in Beijing," *South China Morning Post*, Hong Kong, March 4, 2009.
[6] Ibid.

As a result of increasing pressure from market competition, enterprises may pay too much attention to immediate economic gains and allow moral standards to deteriorate (Wright et al., 2003). Since local governments control local judicial salaries and court finances and make judicial appointments as well, they can interfere in judicial decisions to protect local enterprises or litigants. According to a study undertaken by the Congressional-Executive Commission on China of the US Congress in October 2001, over 68% of surveyed judges identified local protectionism as a major cause of unfairness in judicial decisions.[7] From a resource allocation perspective, 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 across different regions and reduces the effectiveness of monetary policy, as illustrated by the theory of optimal currency area (Mundell, 1961; McKinnon, 1963). The degree of internal market unification in China is therefore particularly important, especially since China's entry into the World Trade Organization, i.e. WTO (Li and Zhai, 2002).

The rest of the paper is organized as follows. Section 2 depicts trade liberalization and its relationship with price convergence. Section 3 explains the econometric methodologies employed to examine the process of price convergence and describes the data. The empirical results and implications are shown in the last section.

## 2. TRADE LIBERALIZATION AND PRICE CONVERGENCE

[7] For details, see "Judicial Independence I in the PRC," under Human Rights and Rule of Law – News and Analysis in Virtual Academy, Congressional-Executive Commission on China [on-line]: http://www.cecc.gov/pages/virtualAcad/gov/judind.php?PHPSESSID=95e72f9fb9c203bb8a8f16cb923d5d41.

Theoretically, if trade is fully liberalized, arbitrage and price convergence is expected to occur. Arbitrage is the practice of taking advantage of a price differential between two or more markets.[8] When the markets are transaction cost free, arbitrage would result in identical goods being traded at the same price across all markets.[9] For example, if a product is traded at different prices, traders may transport this particular product from low price regions to high price regions. This will reduce the supply of the product in the low price region while increasing its supply in the high price region. Consequently, the lower price market's price will increase and the higher price market's price will decrease, resulting in price convergence. This is known as the "Law of One Price" and the concept of purchasing power parity (PPP) is considered to be a multi-products extension of the law. When prices deviate from PPP it implies incomplete relative price adjustments among different regions and inadequate effectiveness of the process of arbitrage. Cecchetti et al. (2002) pointed out that in the case of the United States, tariff and non-tariff effects on movements of relative price indices in different cities are minimal. Additional factors affecting price adjustments across regions include transportation costs, sticky price adjustment effects, and biased technological growth, combined with the presence of non-traded goods.[10] Other studies consider local protectionism as the major obstacle to price convergence (Bai et al., 2004, 2008; Gong and Meng, 2008).

[8] Arbitrage occurs when one of the following three conditions are met: 1. The same asset does not trade at the same price in all markets; 2. Two assets with identical cash flows do not trade at the same price; 3. An asset with a known price in the future does not today trade at its future price discounted at the risk-free interest rate. For details, see Chan et al., 2010.

[9] If an asset is traded at different prices, traders may transport this asset from the low price region to the high price region. This reduces the supply of this asset in the low price region and at the same time, increases the supply in the high price region. Consequently, the lower price market's price will increase and the higher price market's price will be lowered. Price convergence will be the result. For details, see Chan et al., 2010

[10] From Cecchetti et al. (2002), the asymmetric adjustment of large and small deviations is believed to cause slow convergence. The hypothesis is that proportional transportation costs induce a neutral band within which the log relative price between two locations can fluctuate without generating unexploited arbitrage opportunities. This means that when deviations from PPP are sufficiently large to move outside the bands, adjustment will be rapid.

At the global level, countries such as China, Russia, India, the US, the European Union (EU) and Japan have high incentives to protect their juvenile industries or domestic companies, which impedes price convergence. By the same logic, processes of internal trade liberalization will not be smooth if no evidence of intra-national price convergence is found, or if the convergence is slow among different regions. Hence, we believe China's market-oriented economic reform cannot be effective if provinces do not allow free access and movement of goods.

## 3. METHODOLOGY AND DATA

The convergence of an inter-provincial price index within Mainland China can be detected using the following intra-national PPP model:

$$\mathbf{P}_t = \mathbf{c} + \beta \mathbf{P}_t^* + \varepsilon_t , \qquad (1)$$

where the observable variables $\mathbf{P}_t^*$ and $\mathbf{P}_t$ are log-price indices of a benchmark region and another region in Mainland China, respectively. Econometric analysis of intra-national PPP typically involves cointegration tests for inter-provincial price differentials. If $\mathbf{P}_t$ and $\mathbf{P}_t^*$ are cointegrated with cointegrating parameter $\beta$, these different indices will have a tendency to revert to a shared common trend after a shock. Otherwise, $\mathbf{P}_t^*$ and $\mathbf{P}_t$ will never converge towards equilibrium after a shock, and the validity of the intra-national PPP hypothesis will stand rejected. Such conventional cointegration tests implicitly assume that the structural relationship between variables over the study period should remain unchanged. Nevertheless, as mentioned above, the process of price convergence in China has changed from time to time, because of continuous economic reforms and changing economic situations. A test relying on the assumption of structural stability is therefore inappropriate. To tackle this problem, we

could break down the data into several sub-periods and repeat the cointegration tests, but this would rapidly consume degrees of freedom and power due to the low frequency of data.[11] The number of observations is indeed too short for cointegration analysis for different periods in the Mainland. Therefore, we need a measure of convergence that will allow for a dynamic structural change. Such a measure can be estimated by the time-varying coefficient method using the Kalman filter, which computes optimal time-varying estimates of parameters $\beta$ of Equation (1) for each time period. The closer $\beta$ is to one, the closer the two regions are to achieving price index convergence. Thus, we can examine the dynamics of the intra-national PPP coefficient, which indicates the speed and degree of inter-provincial price adjustments within Mainland China before and after the financial tsunami. There is no need to break down the data into two sub-periods; we can consider at the same time the entire period for which data are available. Using Monte Carlo simulation, Bomhoff (1992) found that whether non-stationary series are cointegrated or not, coefficient estimates generated by the Kalman filter outperform coefficient estimates generated by standard ordinary least squares. Hence, in applying the Kalman filter, we need not worry whether the studied time series are cointegrated.

To build a time-varying coefficient model, we must rewrite the intra-national PPP model (1) in a linear state-space form, which consists of observation Equation (2) and the state Equation (3), as follows:

$$\mathbf{P_t} = \mathbf{c} + \beta_{t.}\mathbf{P_t^*} + \mathbf{e}_{.t}, \quad \mathbf{e}_{.t} \sim \mathbf{i.i.d.N(0,H)} \qquad \mathbf{t = 1,2,3,...T} \tag{2}$$

$$\beta_t = \beta_{t-1} + \mathbf{v_t} \qquad \mathbf{v_t} \sim \mathbf{i.i.d.N(0,V)}, \tag{3}$$

[11] For details, see Haldane and Hall (1991); Hall, et al. (1992); Caperale and Pittis (1993); and King and Cuc (1996).

where $\mathbf{e}_t$ and $\mathbf{v}_t$ are the zero-mean Gaussian disturbances with finite time-invariant variances $\mathbf{H}$ and $\mathbf{V}$, respectively. These variances are serially uncorrelated as well as uncorrelated with each other. The dynamics of $\mathbf{P}_t$ are related to a constant $\mathbf{c}$, time-varying parameter $\beta_t$, and $\mathbf{P}_t^*$ through the observation Equation (2). The primary interest is in the time-varying coefficient of the intra-national PPP model $\beta_t$, which is modeled as an unobserved state variable and is assumed to evolve over time as a pure random walk process in the state Equation (3). The advantage of this approach is that it facilitates examination of dynamics of $\beta_t$ over time.

The Kalman filter is a recursive procedure for computing the optimal minimum mean squared error (MSE) estimate of the unobserved state variable $\beta_t$, $\mathbf{t} = \mathbf{1},\mathbf{2},\mathbf{3},...\mathbf{T}$, assuming $\mathbf{c}$, $\mathbf{H}$ and $\mathbf{V}$ are known. Depending upon the information set used, we have filtered and smoothed estimates of $\beta_t$ obtained by using all information up to time t and in the sample through time T, respectively.

The Kalman filter estimation is implemented through the following prediction Equations (4)-(7), and updating Equations (8)-(9):

$$\beta_{t|.t-1} \equiv \mathbf{E}_{t-1}(\beta_t) = \beta_{t-1|.t-1} \tag{4}$$

$$\mathbf{Q}_{t|.t-1} \equiv \mathbf{E}_{t-1}[(\beta_t - \beta_{t|t-1})(\beta_t - \beta_{t|.t-1})'] = \mathbf{Q}_{t-1|.t-1} + \mathbf{V} \tag{5}$$

$$\eta_{t.|.t-1} \equiv \mathbf{P}_t - \mathbf{P}_{t|.t-1} = \mathbf{P}_t - \beta_{t.|.t-1}\mathbf{P}_t^* \tag{6}$$

$$\mathbf{f}_{t.|.t-1} \equiv \mathbf{E}_{t-1}(\eta_{t|.t-1}^2) = \mathbf{P}_t^*\mathbf{Q}_{t.|.t-1}\mathbf{P}_t^{*\prime} + \mathbf{H} \tag{7}$$

$$\beta_{t|.t} = \beta_{t|.t-1} + \mathbf{K}_t(\eta_{t|.t-1}) \tag{8}$$

$$\mathbf{Q}_{t|.t} = \mathbf{Q}_{t|.t-1} - \mathbf{K}_t(\mathbf{P}_t^*\mathbf{Q}_{t|.t-1}), \tag{9}$$

where $\mathbf{K}_t = \mathbf{Q}_{t|.t-1}(\mathbf{P}_t^{*\prime}\mathbf{f}_{t|.t-1}^{-1})$ is the Kalman gain, which determines the weight assigned to new information about $\beta_t$.

Given initial values $\beta_{0|.0}$ and $\mathbf{Q}_{0|.0}$, Equations (4)-(9) can be iterated for $\mathbf{t} = \mathbf{1},\mathbf{2},\mathbf{3},...\mathbf{T}$, and the filtered estimate of the state variable, $\beta_{t|.t}$, is calculated. Nevertheless, smoothing can draw more accurate inference from $\beta_t$ since it uses more information than the filtered estimate. We obtain smoothed estimates of the state variable $\beta_{t|.T}$ and its variance $\mathbf{Q}_{t|.T}$ through the following equations, which we run backward recursively for $\mathbf{t} = \mathbf{T}-\mathbf{1},\mathbf{T}-\mathbf{2},...\mathbf{1}$:

$$\beta_{t|.T} = \beta_{t|.t} + \mathbf{Q}_{t|.t}(\mathbf{Q}_{t+1|.t}^{-1})(\beta_{t+1|.T} - \beta_{t|.t}) \qquad (10)$$

$$\mathbf{Q}_{t|.T} = \mathbf{Q}_{t|.t} + \mathbf{Q}_{t|.t}(\mathbf{Q}_{t+1|.t}^{-1})(\mathbf{Q}_{t+1.|.T} - \mathbf{Q}_{t+1|.t})(\mathbf{Q}_{t+1.|.t}^{-1})'(\mathbf{Q}_{t.|.t})', \qquad (11)$$

where $\beta_{T|.T}$ and $\mathbf{Q}_{T|.T}$ are initial values for smoothing obtained from the last iteration of updating Equations (8) and (9).

The Kalman filter treats the model parameters as known. But parameters $\mathbf{c}$, $\mathbf{H}$ and $\mathbf{V}$ are unknown and need to be estimated. Let $\theta$ represent the unknown parameter vector, which we can estimate by numerically maximizing the log likelihood function:

$$\mathbf{L}(\theta) = -\frac{\mathbf{1}}{\mathbf{2}}\{\sum_{t=1}^{T}\ln(\mathbf{2}\pi\mathbf{f}_{t|.t-1}) + \sum_{t=1}^{T}(\eta_{t|.t-1}^{'}\mathbf{f}_{t|.t-1}^{-1}\eta_{t|.t-1})\} \qquad (12)$$

Given the initial guess of $\theta$, the numerical optimization algorithm searches a new set of $\theta$ such that the log likelihood value from revised estimates will be larger than that from previous estimates. The process is iterated until convergence, when the maximum of the log likelihood function is obtained. Hamilton (1994) and Kim and Nelson (1999) have

documented the time-varying parameter model and the Kalman filter technique in detail.

The data series collected from *China Monthly Statistics*, published by the China Statistical Information and Consultancy Service Centre, consist of monthly aggregate consumer price indices for 29 regions of China; Xinjiang, Shaanxi, Shanxi, Hebei, Henan, Hubei, Hunan, Guangdong, Beijing, Anhui, Chongqing, Zhejiang, Yunnan, Tianjin, Sichuan, Jilin, Liaoning, Ningxia, Qinghai, Shandong, Heilongjiang, Jiangsu, Jiangxi, Guangxi, Guizhou, Hainan, Gansu, Fujian, and Shanghai. Exclusion of series for Tibet and Inner Mongolia is owing to lack of consistent data. The chosen benchmark region is Shanghai. All the price series are seasonally adjusted. Sample periods of estimation span January 2001 to April 2009, and the number of usable observations is 100.

## 4. EMPIRICAL RESULTS AND IMPLICATIONS

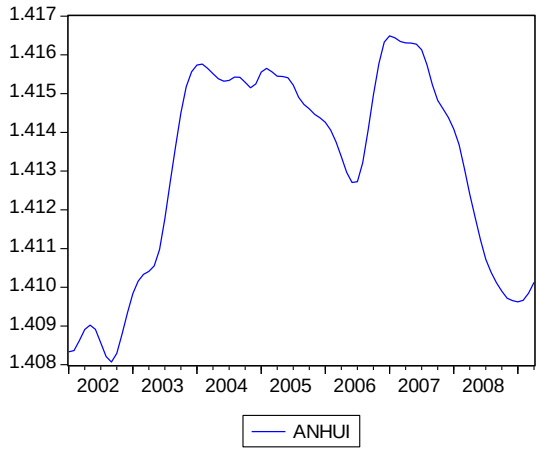
As mentioned above, since the economic reform in 1978, China has undergone more than three decades of market oriented economic reforms. Reforms have included liberalization of internal trade, expected to lead to arbitrage and price convergence. However, we argue that regional protectionism may still be occurring because provincial governments need to maintain tax revenues and are interested in local economic growth and development. Owing to persistent structural changes and an insufficient number of observations, traditional cointegration analysis cannot capture the dynamic patterns of convergence. Therefore, we adopt the time-varying coefficient method to investigate whether the economic downturn has affected price convergence. To do that, we apply Kalman filter and maximum likelihood method to calculate smoothed estimates of time-varying coefficients, $\beta_{t|T}$, of the intra-national PPP model for 28 pairs of regions

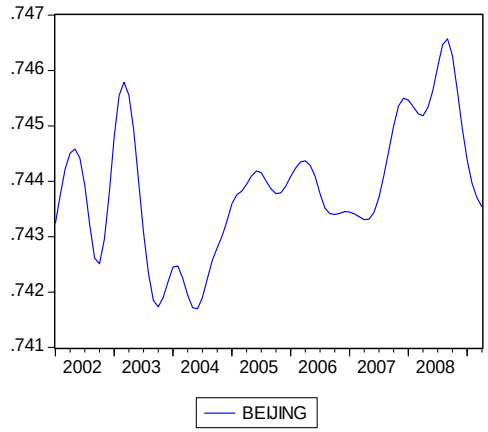
over the whole sample period.[12] Figures 1 through 28 depict graphs of $\beta_{t|T}$ for all regions in the sample from the year 2002 to April 2009.[13] From these figures, all regression coefficients are found to be greater than unity, indicating that the price index of Shanghai moves slower than other regions. The general patterns of the coefficients indicate that they moved farther from unity from year 2002 onwards, the deviation from unity declined during 2007 and then started rising again in mid-2008 when the financial tsunami broke out. In other words, $\mathbf{P}_t$ diverged from $\mathbf{P}_t^*$ initially, and then $\mathbf{P}_t$ moved closer to $\mathbf{P}_t^*$ than before and the convergence was reversed after the financial tsunami occurred.

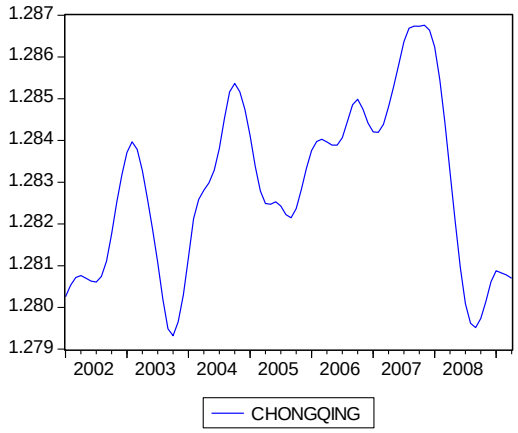
Our findings reveal that the dynamic patterns of the intra-national PPP coefficients in Mainland China have changed from time to time. In addition, we find the financial tsunami to have had an adverse effect on price convergence. This reveals that though the central government has been determined to reduce government intervention and to liberalize internal trade, the economic crisis may have provided an excuse for local governments to pursue regional goals by strengthening trade barriers. Although the 4 trillion RMB stimulus plan was mainly for public infrastructure projects, many of which are expected to reduce transportation costs between regions in the future, local protectionism may increase the monopolistic powers of protected enterprises and lead to higher prices while reducing profits of unprotected enterprises. In the end, this may discourage non-local investment and slow economic growth. This in turn will increase the risk of doing business in China, something that investors in the Mainland should not neglect.

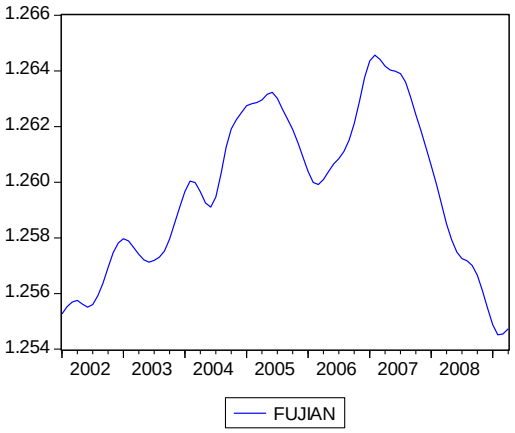
[12] We only report results from smoothed estimates which are more efficient than the filtered ones. Results of filtered estimates are available on request.
[13] Smoothed estimates of the time-varying coefficients are adjusted using Hodrick-Prescott filter.

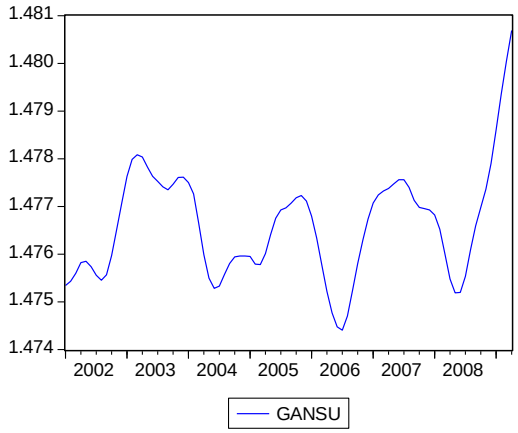
Figures 1 to 28. Smoothed estimates of time-varying coefficients adjusted by the Hodrick-Prescott filter for 28 regions

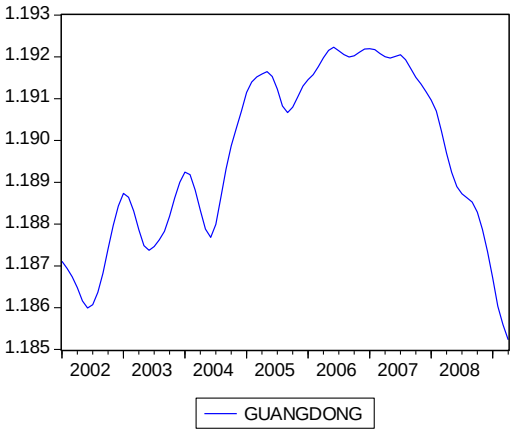


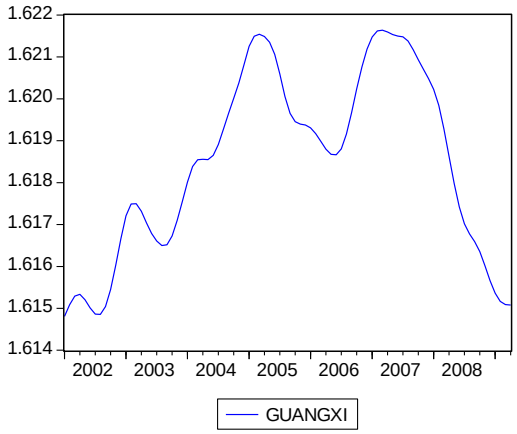

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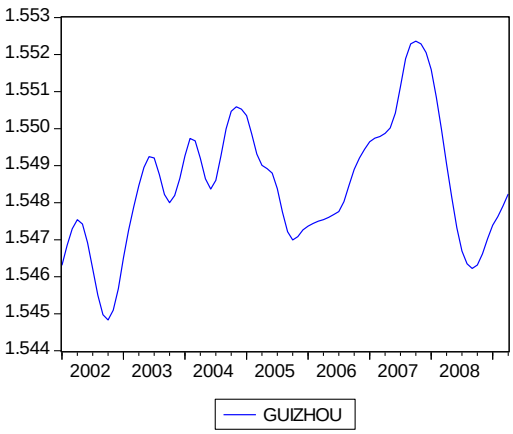
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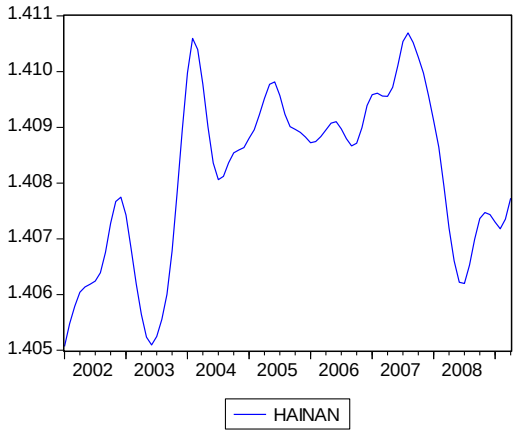
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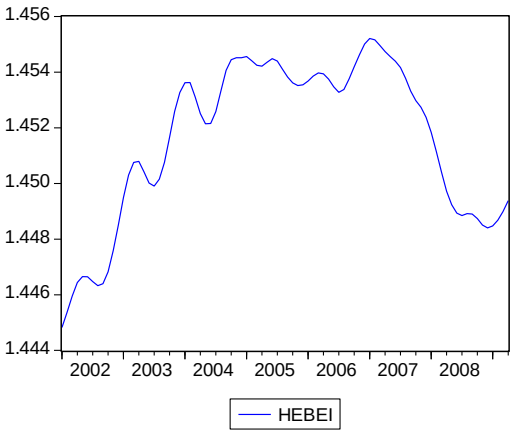
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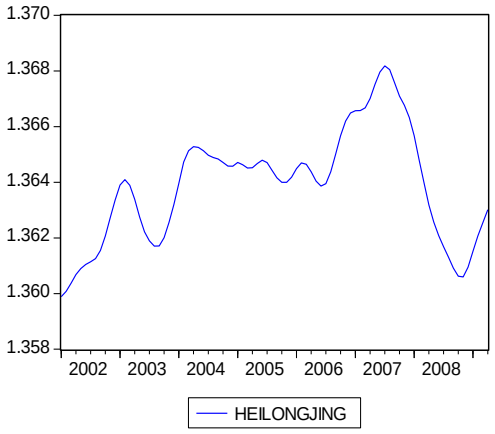
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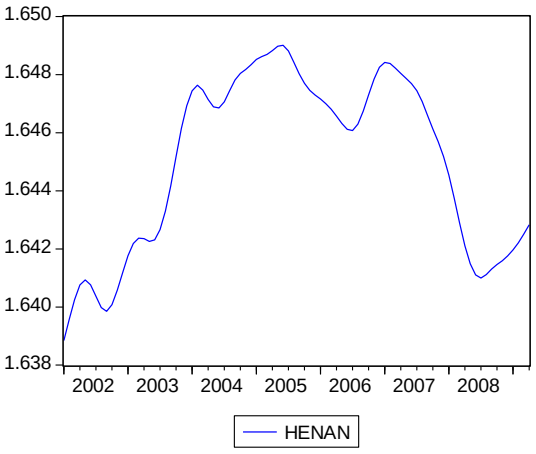
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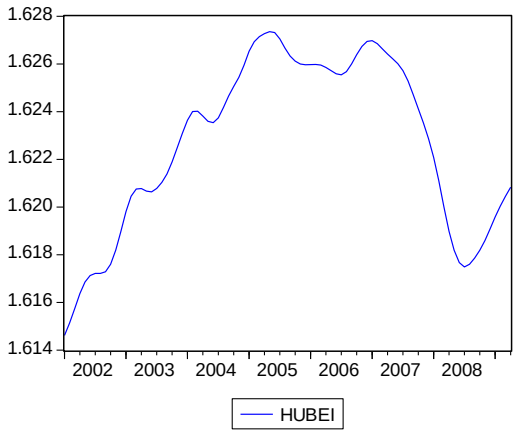
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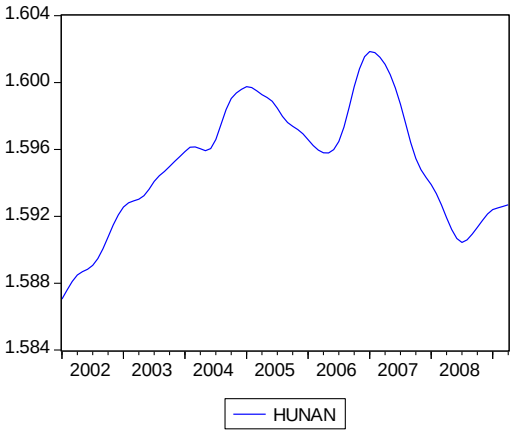
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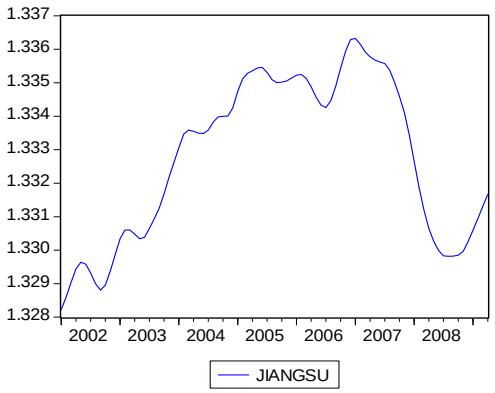
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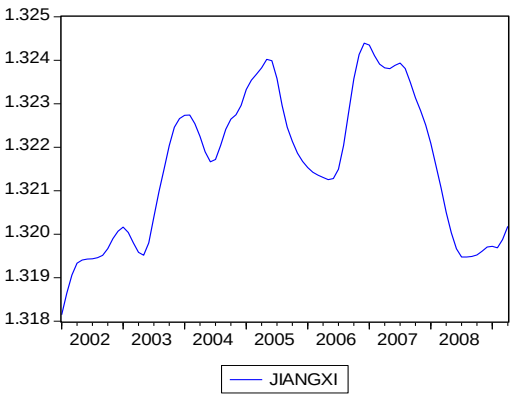
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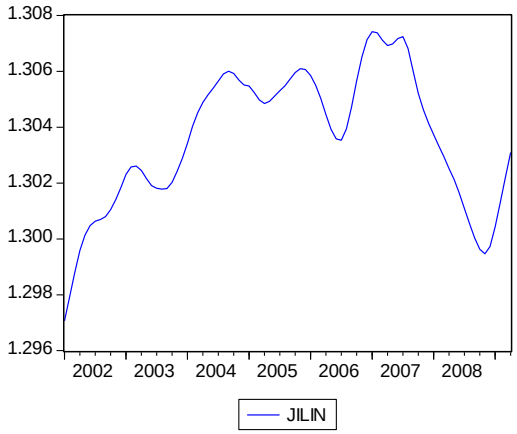
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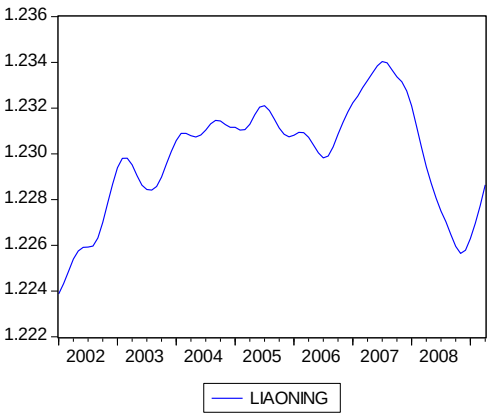
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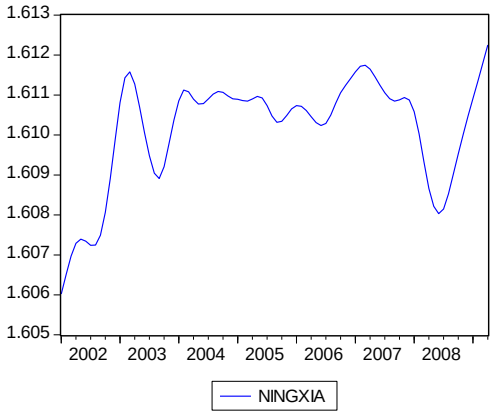
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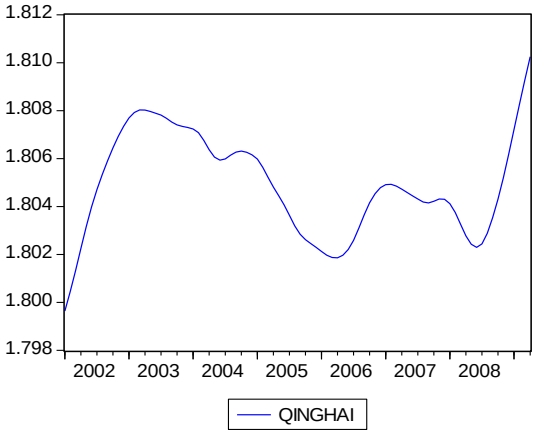
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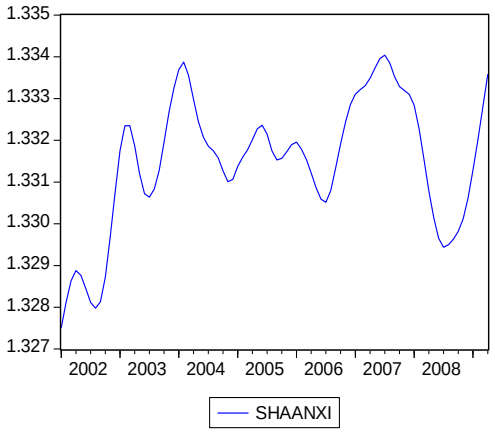
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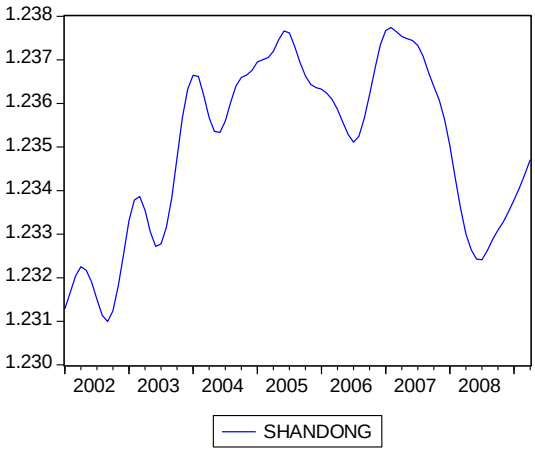
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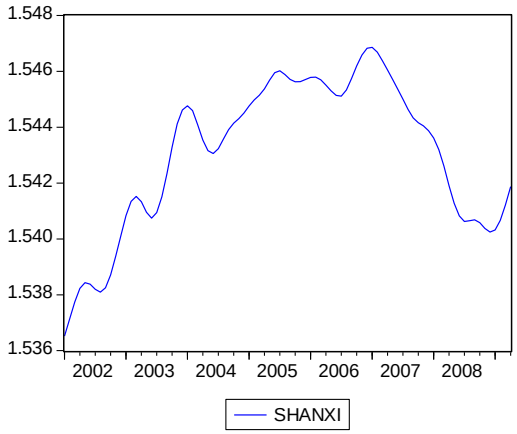
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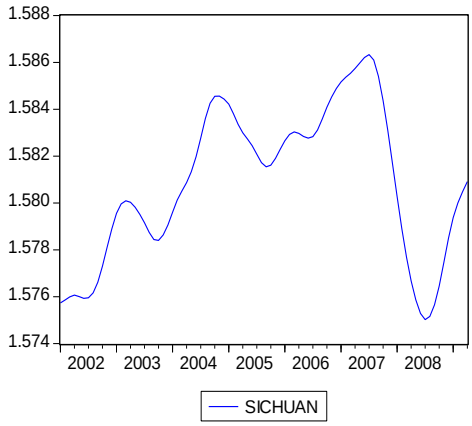
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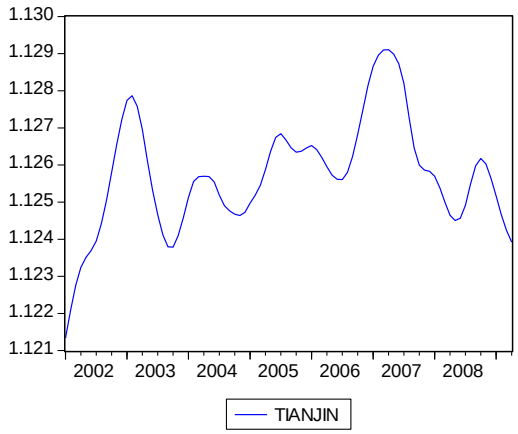
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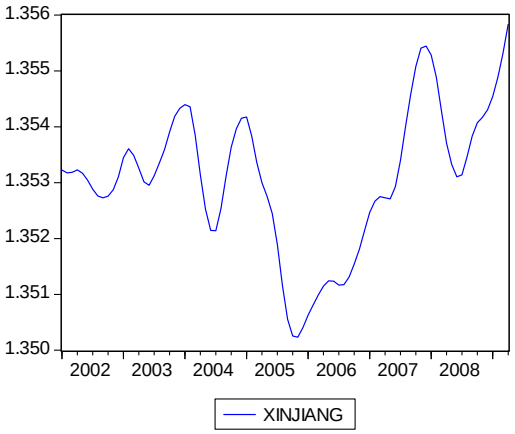
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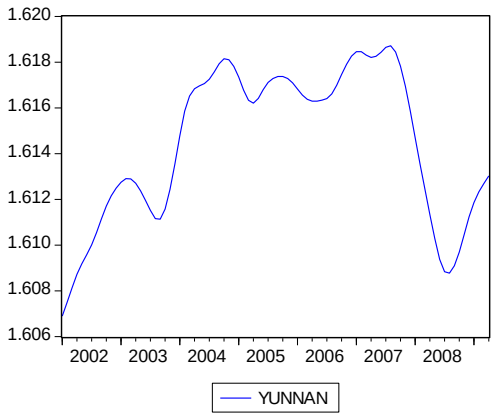
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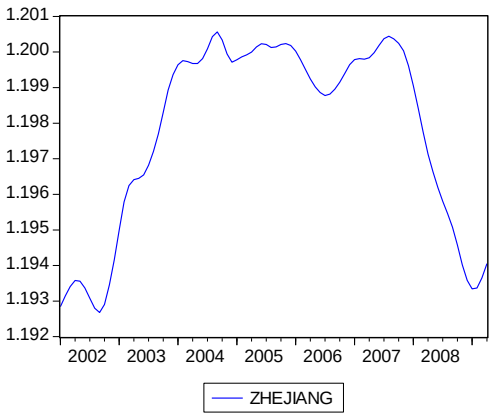
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