Equilibrating ripple effect, disturbing information cascade effect, and regional disparity

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--- a perspective from China's tiered housing markets

Abstract

The current study investigates the role of the tier-one cities of China in affecting regional disparities within and across its five mega-city clusters, through the lens of housing market. For that purpose, an equilibrating ripple effect is differentiated from a disturbing information cascade effect. Evidence suggests that a modest slow-moving equilibrating force originated from Hong Kong has flowed across all tier-one and most tier-two cities in the mainland, indicating a narrowing of regional inequalities between Hong Kong and the mainland cities. On the other hand, a powerful disturbing force emanated from Beijing has affected all other cities, widening the inequality gap in between. The Impulse response functions further suggest that this disturbing force has a permanent impact on regional disparity.

Keywords: Regional disparity, ripple effect, information cascade effect, economic geography, city house price

I. Introduction

A. Motivation, approach, and justification

The current study aims to contribute to the understanding of regional disparity through studying housing markets convergence. The issue of regional inequality has gained increasing importance in the public and political agenda in the EU (Widuto 2019) as well as in China. Increasing inequality is believed to undermine social peace and political stability and to hamper economic growth. Strengthening social, economic and territorial cohesion and reducing regional disparities form a main goal of EU cohesion policy. Such goal is also a key driving force behind the ambitious urbanization process in China, through promoting mega-city clusters. In this study, we aim to gain insight into the efficacy (or otherwise) of China's clustering approach in reducing regional inequality, via examining housing market convergence through a well-known ripple effect. This insight will offer policy guidance for not only China but also other countries keen to reduce their own regional disparities.

It is widely recognized in the relevant literature that housing markets are geographically segmented – the cost of similar sized space varies significantly across different regions, because of the immobility and indivisibility of direct real estate assets. Labour and businesses may move to more prosperous regions in search of better returns, housing assets can't. However, if regional inequality disappears over time, regional house prices (henceforth RHPs) will converge as a result. While there exists a variety of approaches, studying housing markets convergence provides a cost-effective way of understanding regional inequality and the process of economic convergence, given that house prices are usually more accessible than other information, such as technology transfer and productivity growth.

Convergence in housing market through a ripple effect may occur via migrations of mobile production factors. When, for instance, housing in Beijing becomes too expensive, businesses, having to pay higher wages to attract workers, will have to charge higher prices for their end products, making them less competitive in their respective industries. Businesses which are thus made unprofitable may choose to migrate to a less expensive region, driving the house price in that region up and at the same time releasing the upward pressure on the house price in Beijing. Similarly, workers may find their quality of life compromised in Beijing and migrate to, say, Tianjin which offers them a better balance of opportunities and costs, driving house prices down in Beijing and up in Tianjin. When the cost of housing also becomes unaffordable in Tianjin, the migration will "ripple out" further. A ripple effect originated from this relocation of production factors will thus diffuse slowly throughout the country, bearing witness to the gradual disappearance of regional inequality.

However, RHPs may also affect one another via, apart from the long-run equilibrating ripple effect, a disturbing short-run information cascade effect. Thus, separating information cascade from ripple effect is essential if we are to examine the issue of regional inequality through the lens of housing markets convergence. The concept of information cascade effect in finance is made well known by Welch (1992) in a model of IPO under-pricing. The model is further developed by D'Arcy (1997) in the context of insurance policy. According to the model, when a good is sold to a large number of investors sequentially and when the true value of the good is uncertain, later investors may ignore their own signals about the true value and base their investment decisions exclusively on earlier sales. Thus, any misinformation contained in the price will cascade down the transaction chain.

B. Background information on China's mega-city clusters

"The facts of economic geography are surely among the most striking features of real-world economies…" (Krugman 1991). By that, Krugman means that "the bulk of the population resides in a few clusters of metropolitan areas" and these clusters usually pivot on some large well-developed cities which are hubs of economic prosperity (UN-Habitat 2012).

On 16 March 2014, the State Council and the central committee of Chinese Communist Party released the "National New-type Urbanization Plan (2014-2020)," officially launching an ambitious urbanisation program. The prime aim of this program is to narrow down social and regional inequality, a cause of public disquiet. A key part of this plan is creating five mega-city clusters with "national" status: the Pearl River Delta (PRD) cluster, the Bohai Economic Rim (BER) cluster, the Yangtze River Delta (YRD) cluster, the Yangtze River Middle Reaches (YRMR) cluster, and the Chengdu-Chongqing (CC) cluster (Bai 2015). The tier-one cities with population size exceeding ten million are at the heart of this plan, acting as growth engine for their respective clusters and beyond. These tier-one cities include Beijing, Shanghai, Guangzhou, Shenzhen, Tianjin, and Chongqing. For the purpose of this study, Hong Kong is also included and counted as a tier-one city of China.

Tier-one cities are densely populated with huge economic, cultural and political power in China. They have advanced infrastructures and higher than the national average income. Each has its comparative advantages over the others. Beijing for instance, as the political capital, is the place where all important policies concerning the future of the economy originate; while Shanghai is a thriving financial and commercial harbour and has the world's busiest trading port. Guangzhou and Shenzhen, on the other hand, with their proximity to Hong Kong, one of the most influential free port in Southeast Asia, have been the pioneers of economic reform in the country. Chongqing, unlike the other tier-one cities, is located far away from the coastal regions but linked to the bustling YRD area via the Yangzi River, a major inland waterway of the country. Its prominence has risen in recent years, especially since 1997 when the city became the fourth direct-controlled municipality after Beijing, Shanghai and Tianjin.

While this urbanization plan is relatively recent, the conscious practice of economic clustering in China is not new. For example, the area covered by the PRD cluster has been powered by its proximity to Hong Kong into the most economically dynamic region in the country since the launch of China's economic reform in 1979. Although reform came much later in YRD, the urban build-up in the area has given rise to what may be the largest concentration of adjacent metropolitan areas in the world. Both PRD and YRD clusters are the wealthiest regions in the country with high intra-cluster cohesion, but the other three clusters are yet to catch up both in terms of the level of economic prosperity and in intra-cluster cohesion.

C. The concept of ripple effect

The fascination about housing market convergence began in the UK before Hamnett (1988) and was heightened by Meen (1999) in their quest for a ripple effect. A ripple effect may be characterized by four distinctive features: i) regional differentials in house price growth are much greater than can be explained by incomes; ii) this differential is highly cyclical alongside the business cycle; however, iii) the relative house prices of different regions converge to a set of constants in the long-run; and iv) there is an epicentre that always leads the ups and downs of RHP gaps, and which is always more volatile than the rest (Holmans 1990, Meen 1999). The vast number of empirical studies on ripple effect to date, mostly based on the UK regional housing markets, offer mixed evidence.

The theoretical exploration of the ripple effect has attracted less attention than its empirical counterpart, though bits and pieces can be found here and there. Engle and Granger (1987) observe that economic time series may move in a way such that they cannot drift too far apart even though they may wander away from one another temporarily. Econometricians say such series are cointegrated while economists would say that there exists a long-run equilibrium relation among them. Meen (1999) argue that *the existence of a long-run relation exemplified by cointegration is a necessary condition for the existence of a ripple effect.* Thus, the notion of "cointegration" is the statistical base while the concept of "equilibrium" the economic foundation of "ripple effect."

D. Separating ripple effect from information cascade effect

Econometrically, ripple effect may be sliced and diced and then aggregated using records of all contributing variables with a structural model. This approach, while sound conceptually, is difficult to implement in practice. For one, records of these economic variables will be incomplete or inaccessible to the researcher, especially for the less prominent cities; for another, the limited length of the time series in practice will restrict the number of variables that can be included in a model. We can however circumvent this obstacle using time series models of prices alone, because *if markets are at least partially efficient, all information will to certain extent be reflected in prices*. In particular, the ripple effect will be teased out using a vector error correction model (VECM) in this study.

As discussed earlier, RHPs may bear fingerprints of forces other than economic fundamentals. In other words, RHP differentials may fluctuate not only because of a long-run equilibrating ripple effect, but also as a result of information cascade, the latter offers illusory message on regional convergence. Information cascade is also less benign as it helps to build fads and bubbles into house prices when the price processes are *I(1)* and stochastic shocks have permanent effects. In this study, the effect of information cascade is captured by volatility spill-over using residual variance decomposition.

By separating ripple from information cascade effect, we attempt to answer the following questions: i) is there intra-cluster convergence within a given mega-city cluster of China, evidenced by a housing market ripple effect? ii) is there a nationwide ripple effect which runs across different clusters? iii) when convergence is observed, is there a unique epicentre that always leads the ups and downs of RHPs? iv) is there an information cascade effect with distinctive patterns? and v) is ripple or information cascade effect more important and/or far reaching in setting trends in RHPs?

The economic fundamentals of ripple effect imply that it will to a greater extent depend on the economic geography of a country than does an information cascade. Therefore, first, a ripple effect is more likely to occur within each cluster than across different clusters. Our results show that a classical *intra*-cluster ripple effect is only evident within the YRD with Shanghai being the unique epicentre; while an *inter*-cluster ripple effect also exists with Hong Kong being the epicentre, inter-cluster ripple effect is much weaker. Second, information cascade disperses much quicker, within and across the clusters, than a ripple effect arising from slow-moving fundamentals, with the largest shocks coming from Beijing. Furthermore, the impulse response analysis suggest that information cascade had a permanent harmful impact on regional disparities. These results confirm the importance of separating information cascade from ripple effect when examining regional inequalities through housing markets convergence.

II. Literature

Meen (1999) points out that UK housing market may be characterised as a series of interlinked local markets rather than a single national market. He refers to this feature as *spatial dependence*. These interlinked local markets are nevertheless structurally different due to difference in economic condition and households' composition, hence exhibiting *coefficient heterogeneity*. Mean's discussions imply that ripple effect derives from coefficient heterogeneity and spatial dependence, while Alexander and Barrow (1994) attribute ripple effect to inter-regional migration - both views are consistent with the production factor relocation theory the researcher has put forward in section I.A.

For decades, scholars were fascinated whether there is a persistent divide between UK's North and South, or whether any shock to the housing market of London or South East eventually ripples northwards. Hamnett (1988) observes that UK's RHP gaps are highly cyclical, but maintained that the long-run values of these gaps have remained roughly constant. Later studies have mostly focused on the existence or otherwise of a ripple effect in the country.

According to Meen (1999), "… *house prices (in the UK) exhibit a distinct spatial pattern over time, rising first in a cyclical upswing in the south-east and, then, spreading out over the rest of the country. This is known as the ripple effect*." Other authors define ripple effect slightly differently in different context. For instance, Drake (1995) describes ripple effect not only in terms of timing but also speed and magnitude. In their description, *house prices in the South East has the tendency to rise earlier and faster during cyclical upturns;* the price rise then spreads out to other regions with varying time lags. In a cyclical downturn, the South East also leads the way with prices falling earlier and farther than in other regions. More recently, scholars have also examined the ripple effect not only in mean but also in higher moments such as conditional covariance (Willcocks 2010).

The empirical studies are divided in their conclusions as to whether a ripple effect exists in the UK. Using various statistical techniques, Giussani and Hajimatheou (1991) find evidences supporting the view that cross-RHP differentials are the result of a ripple effect, with Greater London and South East leading the house prices in other regions. Using VECM and impulse response functions, MacDonald and Taylor (1993) conclude that RHPs are pulled up in a market upturn and down in a downturn by price increases or falls in the Greater

London area. Alexander and Barrow (1994), employing a variety of testing and modelling techniques (including VECM), conclude that house prices in the south do cause price movements in the north and midlands; and that geographical proximity does appear to be important in the transmission of house prices from region to region; but the Greater London market acts relatively independently of the other southern regions. Meen (1999) tests the stationarity of the ratios of ten regional house price to the national average using ADF and suggests that either these ratios are stationary or are weakly trending. He also grouped the regional house prices into four blocks, the South, Midlands, North and Scotland, then regress the price differentials of these blocks to the national average on various regional and national economic variables in an error correction model (ECM). Meen finds that the coefficient on the error correction term is highly significant for all regions, implying all house prices move in proportion to one another in the long run.

Contrary to the above findings, using cross-spectral analysis, Rosenthal (1986) claim that "The widely presumed simple pattern of house price changes in the South of England being repeated **X** months later in the North may be a much more elusive artefact than generally believed." Employing Kalman filter, Drake (1995) shows that, apart from Greater London and to a lesser degree the South West, no evidence is found to support the existence of an equilibrating force driving the ripple effect from the South East to the rest of the country. Utilizing ECM model and controlling for economic factors, Ashworth and Parker (1997) also reject the ripple effect hypothesis. They argue that the spatial dependence found in early studies could have been due to missing economic variables.

Cook (2003) argues that "the failure of previous analyses to uncover convergence is due to an underlying asymmetry in the adjustment process being ignored." For example, in the presence of asymmetry, standard unit root tests may fail to reject the null of long-run stationarity in regional-national house price ratios (Pippenger and Goering 1993, Xiao and Tan 2006). To account for this possibility, Cook employs a rolling version of the momentum-threshold autoregression (MTAR) unit root test. Among the thirteen UK RHP ratios examined, the null is rejected against the alternative hypothesis of *asymmetric stationarity* at the 5 per cent level in most cases. Following this line of inquiry, Holmes and Grimes (2008) argue that the univariate unit root and multivariate cointegration tests suffer from low test power. To address this issue, they apply first principle component methodology. Their results confirm that all regional-national price differentials are stationary. They further confirm via estimating an ECM model that the regional speeds of adjustment towards long-run equilibrium are inversely related to their distance from London where shocks originate.

Willcocks (2010) is perhaps the first in this strand of literature that examines ripple effect in volatility rather than in mean. He was interested in finding out how regional housing markets link to one another via conditional variances. Willocks confirm that the South East is the trigger for the ripple effect in the mean process, but it is the South West that drives the ripple effect in conditional variances. In a similar spirit, Cook and Watson (2015) examines convergence in price changes rather than in price levels. Their results support the presence of a ripple effect. They also confirm, using subsamples, that comovement between London and the other regions is greater during upturns than during downturns in the market. Tsai (2015) is another study focusing on volatility spill-over in the UK.

Despite its economic importance, research on the cross-regional house price behaviour in China is very patchy. Zhang and Morley (2014) represents one such attempt. They examined 30 cities and 5 municipalities with a quarterly sample covering 1998Q1-2010Q4. Employing Levin-Lin-Chu test, Im-Pesaran-Shin test and ADF test, they fail to reject the null that the regional-national house price ratios contain a unit root, implying non-convergence of regional house prices. They further regress the quarterly differences of house prices of 32 cities on that of Beijing, Shanghai and Guangzhou, and conclude a ripple effect running from the latter group, especially from Beijing, to the former. Their table 3 however presents only one set of results. It is not clear which city that set of results corresponds to. A more clearly explained study was conducted by Chiang (2014) who examines six tier-one cities (Beijing, Tianjin, Shanghai, Chongqing, Guangzhou and Shenzhen) using VECM. The study covers the period 2003M3 – 2013M5, a total of 123 monthly observations. The author finds that a long-run equilibrium relationship exists among these six cities and that Beijing is the main source of house price diffusion.

III. Methodology and Justification

The researcher employs VECM to pinpoint ripple effect across China's regional housing markets. Furthermore, variance decomposition is utilized to identify an information cascade effect in the system. Theoretically speaking, the house price of a given city is determined by *local specific factors* as well as by *common factors* affecting the house prices of all cities in a country. Local specific factors can be local employment rate, population density, productivity, land availability, etc., whilst common factors can be global or national economic growth, fiscal spending, money supply or credit constraint. In pure time series models, we make no distinction among these factors but rely on the conviction that such complex bundle of common factors will be reflected in the house price of a city itself[1] and whose relation to other cities can be teased out using the past house prices of the latter. Hence, we can model the processes of RHPs as:

$$x_{i,t} = \mu_{i,t} + \sum_{s=1}^{p} \Phi_s x_{j,t-s} + \varepsilon_{i,t} \qquad 1$$

where $x_{i,t}$ is the price of city i at time t. $\mu_{i,t}$ is determined by local specific factors, Φ measures the degree to which the prices of city i is related to that of city j via the common factors driven both. The preceding discussion offers a conceptual foundation supporting the application of a VAR model in this context. The first two terms in equation 1 pick up the predictable hence expected house price movements for given information. The unexpected part, shocks to local and/or common factors will show up in $\boldsymbol{\varepsilon_{i,t}}$. Decomposing the variance of $\boldsymbol{\varepsilon_{i,t}}$ using appropriate techniques will enable us to identify the source of information cascade arising from unexpected shocks. The following sub-sections explain the statistical base of this application.

A. Cointegration and error-correction representation

Engle and Granger (1991) show that systems with cointegrated *I(1)* variables have three equivalent representations: common trends, ARMA, and error correction. Consider a simple bivariate VAR(1) system

$$\overrightarrow{x_t} = \Phi\overrightarrow{x_{t-1}} + \overrightarrow{\varepsilon_t} \qquad 2$$

Where $\overrightarrow{x_t} = \begin{pmatrix} x_{1t} \\ x_{2t} \end{pmatrix}$

The characteristic equation of Φ is given by

$$|\Phi - \lambda I| = 0 \qquad 3$$

Case one, two unit characteristic roots: $\boldsymbol{\lambda}_1 = 1$ and $\boldsymbol{\lambda}_2 = 1$, and we have the spurious regression case, primarily because that the standard errors are highly misleading (Granger and Newbold 1974). In this case, a VAR(1) specification for the *differenced* variables should be adopted.

Case two, no unit roots: $\boldsymbol{\lambda}_1 < 1$ and $\boldsymbol{\lambda}_2 < 1$, and we have the stationary case and the above VAR(1) specification for the *level* variables is appropriate.

Case three, one unit and one stable root: $\boldsymbol{\lambda}_1 = 1$ and $\boldsymbol{\lambda}_2 < 1$. In this case, the two variables in $\overrightarrow{x_t}$ are cointegrated and we should estimate a system of the form

$$\overrightarrow{\Delta \boldsymbol{x}_t} = \vec{\boldsymbol{\alpha}}\overrightarrow{\boldsymbol{\beta}^T}\overrightarrow{\boldsymbol{x}_{t-1}} + \overrightarrow{\boldsymbol{\varepsilon}_t} = \boldsymbol{\Pi}\overrightarrow{\boldsymbol{x}_{t-1}} + \overrightarrow{\boldsymbol{\varepsilon}_t} \qquad 4$$

This is the *vector error correction representation (VECM)* of the VAR(1) system, with $\vec{\beta}$ being a *cointegrating vector* for x_{1t} and x_{2t} and $\vec{\alpha}$ the *error-correction coefficient vector*. Note that since the requirement $\lambda_2 < 1$ means $\vec{\alpha} \neq 0$, *cointegration also implies Granger-causality* in at least one direction. In a more general representation involving *k I(1)* processes, the system can be represented by

$$\overrightarrow{\Delta \boldsymbol{x}_t} = \sum_{i=1}^{r}\Pi_i\overrightarrow{\boldsymbol{x}_{t-1}} + \sum_{j=1}^{p-1}\boldsymbol{\theta}_j\overrightarrow{\Delta \boldsymbol{x}_{t-j}} + \overrightarrow{\boldsymbol{\varepsilon}_t} \qquad 5$$

Where

$$\Pi_i = \vec{\boldsymbol{\alpha}}\overrightarrow{\boldsymbol{\beta}^T} = \begin{bmatrix}\alpha_{1,i}\\ \vdots \\ \alpha_{k,i}\end{bmatrix}\begin{bmatrix}\beta_{1,i} & \cdots & \beta_{k,i}\end{bmatrix}$$

$$\sum_{i=1}^{r}\Pi_i = \begin{bmatrix}\sum_{i=1}^{r}\alpha_{1,i}\beta_{1,i} & \cdots & \sum_{i=1}^{r}\alpha_{1,i}\beta_{k,i}\\ \vdots & \ddots & \vdots \\ \sum_{i=1}^{r}\alpha_{k,i}\beta_{1,i} & \cdots & \sum_{i=1}^{r}\alpha_{k,i}\beta_{k,i}\end{bmatrix}$$

Since the difference vector $\overrightarrow{\Delta \boldsymbol{x}_t}$ is determined by the level vector $\overrightarrow{\boldsymbol{x}_{t-1}}$ (more precisely, by the magnitude $\overrightarrow{\boldsymbol{x}_s}$ are above or below their respective long-run equilibrium value in the previous period), *Π measures the equilibrium relation which ties these variables together in* *the long-run.* On the other hand, the vector of parameters θ gauges the predictable short-run responses of $\overrightarrow{\Delta \boldsymbol{x}_t}$ to $\overrightarrow{\Delta \boldsymbol{x}_{t-1}}$ on top of the long-run adjustments.

Johansen (1991) show that in a *VAR* system with *k I(1)* processes, there can be up to $r = (k\text{-}1)$ cointegrating relationships linking the *k* processes. The number of cointegrating relationships is called the cointegrating rank, *r*, of the system. To determine the cointegrating rank, a sequence of tests is conducted using trace statistic and maximum-eigenvalue statistic. First, we test $H0\!: r = 0$ against $H1\!: r \geq 1$ to determine if there is at least one cointegrating relationship. If H0 is rejected, we proceed to test $H0\!: r \leq 1$ against $H1\!: r \geq 2$. The process is carried on until we fail to reject $H0\!: r \leq m$, and we estimate a VECM system with *m* cointegrating relationships.

Engle and Granger (1991) proposed a two-step estimator for an error-correction model. In the first step of the regression, the level variables are used to estimate the cointegrating vectors. The estimates, $\hat{\vec{\beta}}$, are then used as a known parameter in estimating the error-correction coefficient, $\vec{\alpha}$, in the second step of regression where the short-term parameters, θ_j, are also estimated. They show that this two-step estimator has the same limiting distribution as the maximum likelihood estimator using the true value of $\vec{\beta}$, and the least squares standard errors will be consistent estimates of the true standard errors. On top of that, under standard conditions, the two-step estimator will also be asymptotically normal.

B. Variance decomposition

Variance decomposition decomposes the variance matrix of the forecast error by sources of contributors. It has been applied in Diebold and Yilmaz (2009) to the global equity market and by Tsai (2015) to the UK regional housing markets to identify the source of volatility spill-over. The author in this paper gives this type of spill-over an explicit name, *information* *cascade*, because it results from the adjustment to surprise information rather than to economic fundamentals. Mathematically, the covariance matrix of the h-step-ahead prediction error, $\overrightarrow{e_{(t+h|t)}} = \overrightarrow{x_{t+h}} - \overrightarrow{x_{(t+h|t)}}$, is given by

$$\Sigma(h)=\Sigma_{i=1}^{h}\left(\Sigma_{j=0}^{h-1}\Psi_j\Sigma\Sigma_{j=0}^{h-1}\Psi_j^{'}\right) \quad 6$$

Decompose Σ, such that $\Sigma = QQ^{'}$, where Q is a lower triangular matrix, and let $\Psi_j^0 = \boldsymbol{\Psi}_j Q$, then

$$\Sigma(h) = \Psi_j^0\Psi_j^{0}{}' \quad 7$$

The i^{th}diagonal elements of $\Sigma(h)$give the MSE of the prediction of the i^{th}variable in $\overrightarrow{x_t}$. That is

$$MSE(x_{(i,t+h|t)}) = \Sigma_{n=1}^{k}\Sigma_{j=0}^{h-1}\Psi_{j,in}^2 \quad 8$$

The proportion of the h-step-ahead forecast error covariance of *city i* accounted for by the innovations in *city n* is given by

$$\frac{\Sigma_{j=0}^{h-1}\Psi_{j,in}^2}{MSE(x_{(i,t+h|t)})} \quad 9$$

C. Impulse response function

Since all variables in a VAR model depend on each other, individual parameter estimates only provide limited information on the reaction of the system to a shock. Forecast error impulse response function (FEIR) provides a better picture of the model's dynamic behaviour. Mathematically, the FEIR for the h^{th} period after the shock is obtained by

$$\overrightarrow{e_h} = \sum_{j=1}^{h} \Phi^j \overrightarrow{e_{h-j}} \qquad 10$$

with $\overrightarrow{e_h} = I_K$ and $\Phi^j = 0 \; for \; j > p$, where K is the number of endogenous variables and p the lag order of the VAR model. When VECM is estimated, this needs to be converted back to VAR representation before calculating FEIR.

IV. Data and Summary Statistics

Geographically, we cover 7 tier-one cities for the purpose of inter-cluster convergence analysis. In addition, we cover 28 tier-two cities for the examination of intra-cluster convergence (see NexusPacific (2013) for a discussion on China's tiered cities). A list of these cities is presented in Table 1, and their relative location can be viewed on Google Map. The time series employed for the mainland cities are *monthly* price indices on *newly built residential buildings* sourced from National Bureau of Statistics of China. These indices are constructed in a way such that their corresponding previous period (CPPY) values are equal to 100 (NBS 2016). As such, these are in truth year-on-year inflation indices rather than price indices suggested by the name. The index used for Hong Kong is the *monthly* Property Price Index of Private Domestic Premises published by Census and Statistics Department of Hong Kong. For conformity, this price index has been transformed so that its corresponding previous period value equals to 100. The study sample begins in July 2005 and ends in August 2015, consisting of 122 monthly (or 4270 time-space) observations.

(Insert Table 1 about here)

(Insert Figure 1 about Here)

The summery statistics for the examined cities are plotted in Figure 1. The cities in the plot are organized by the size of their mean year-on-year inflation rate, so that the city with the highest mean is at the right end of the plot. The range of variation in this inflation is indicated by the distance between the min and the max. These cities will be referred to by their abbreviations given in table 1 during later discussions.

V. Description of Empirical Findings

A. Ripple effect

The existence of a ripple effect requires the house prices to be cointegrated, therefore price non-stationarity is also a prerequisite. We apply the three different forms of ADF to test the hypothesis that index *X* contains a unit root. Results show that the null cannot be rejected at 5 per cent significance level. The tests also show that in general these series are single-mean stationary or trend stationary, indicating the existence of deterministic or stochastic trends. Thus, shocks have permanent effects on these random walking indices.

Are these wandering indices bonded together by an equilibrating force so that, while they have the tendency to embark on an explosive path, they nevertheless will not move too far apart from one another? To answer this question, we conduct the Johansen test of cointegration. A priori, there may be up to r = 34 cointegrating vectors (equilibrium relation) among the 35 series, with r being the cointegrating rank of the system. This is tested sequentially until the null is rejected. The null hypothesis that there is at most r cointegrated processes is rejected for r < 32[ii]. We therefore fit to these series, using ML method, a *VECM(p-1)* of the form

$$\Delta x_{j,t} = \sum_{s=1}^{35} \sum_{i=1}^{32} \alpha_i \beta_i^T x_{s,t-1} + \sum_{s=1}^{35} \phi_s^* \Delta x_{s,t-1} + \varepsilon_{j,t}\,, \qquad j = 1, 2, \ldots, 35$$

The first term on the right is the long-run equilibrium term and the second the short-run dynamics. The order, p = 2, is selected using AIC and SBC criteria.

Since cointegration implies Granger-causality in at least one direction, we further conducted Granger-causality test. The null hypothesis of block-exogeneity is rejected for all indices, suggesting that feedback loops exist among some paired prices (Table 2). This outcome agrees with the later observation that ripple effect can be bi-directional sometimes and competition among receiving cities affects the overall picture.

(Insert Table 2 about Here)

1. The Pearl River Delta cluster

The PRD cluster contains three of the seven tier-one cities: Hong Kong (HK), Shenzhen (SZ), and Guangzhou (GZ). It is the first region in China that grew rich, following the establishment of the Shenzhen Special Economic Zone (the first of its kind in the country) in May 1980. Located right next to SZ, HK played a key role in driving the economic growth within the PRD cluster and beyond. Consequently, its house price has greatly influenced those of the mainland cities. Within the cluster, a ripple effect flowed from HK to GZ and SZ. However, this ripple effect did not match the classical pattern described by Meen (1999) where a unique epicentre is expected. In this case, GZ appeared to receive direct long-run influence from both HK and SZ, with the one from HK being positive as expected in a ripple effect, but the one from SZ negative suggesting competition between the two cities.

Beyond the PRD, HK's long-run influence "rippled" out to 15 cities (the discussions in the text are based on the 5% level of significance). Simultaneously, however, HK was significantly affected in the long run by 10 inland cities (half of which positive, half negative). These mixed messages imply that while an inter-cluster ripple effect existed, with Hong Kong being the epicentre, this ripple effect was not exactly as described by Meen. In the short-run, HK also exerted influences on the price dynamics of 21 cities and was influenced by 7 with mixed coefficient signs (Figure 2; table 3&4).

Interestingly (and perhaps unsurprisingly), SZ's long-run influence on other cities was negative in most cases, suggesting that proximity to HK had given SZ geo-advantage in competing for resources relocation from HK. On the other hand, 12 cities apart from HK had a long-run impact on SZ, with some positive and some negative. It is perhaps worth noting that the bidirectional long-run impacts between SZ and Wuhan (WH), the major city in the YRMR cluster, were both positive, suggesting complementarity between the two cities. In the short-run, SZ affected a separate set of cities, mostly positively. It also received short-run influences from a different list of 13 cities with mixed signs.

In comparison, the long-run influence of GZ was limited to only 7 mainland cities outside the cluster with mixed signs (Table 3). On the other hand, fifteen geographically dispersed cities, including five tier-one cities, exerted certain degree of either positive or negative influence on the long-run price inflation of GZ. In the short-run, GZ had a large positive impact on Beijing, the capital city of the country 1365.4 miles away.[iii] This short-run positive influence was also felt by seven tier-two cities outside the cluster.

In summary, ripple effect existed within the PRD cluster, with HK being the prime centre of positive long-run influences. However, this ripple effect did not match the classical pattern described by Meen, as SZ exerted a negative long-run impact on its close competitor GZ. In addition, ripple effect ran across the cluster boundaries in both directions with no clear identifiable geographical patterns.

(Insert Figure 2 about Here)

(Insert Table 3 & 4 about Here)

2. The Yangtze River Delta cluster

The YRD contains only one tier-one city: Shanghai (SH). It is the second region after the PRD that have benefited enormously from China's economic reform. Although opened to the outside world almost ten years later, its prosperity soon rivalled the PRD. It is also the only cluster in our sample revealed a classical intra-cluster ripple effect exactly as described by Meen (1999), with SH being the unique powerhouse (Figure 2) driving both the long-run equilibrium level and short-run dynamics of the housing markets in the neighbouring cities. Beyond the YRD, SH had a significant positive long-run influence on ten different cities scattered all over the country, mostly positively. The influences of SH's short-run dynamics were much less widely distributed. Six cities outside the cluster (including HK) had an impact on SH's long-run equilibrium price (some positive, some negative). In the short-run, HK also exhibited a significant albeit small impact on SH along with a few other cities. In this list of cities, only HZ is geographically close.

3. The Bohai Economic Rim cluster

The BER cluster encompasses two tier-one cities: Beijing (BJ) and Tianjin (TJ). BJ is the capital city of China with one of the most expensive housing markets in the country. The long-run influence of its house price inflation was nevertheless limited and exhibited no clear geographical pattern both within and beyond the BER. Within the cluster, there was evidence of a long-run influence running from BJ to TJ and DL, from TJ to JN, from QD to BJ, and from DL to BJ --- all positive except for the last pair. No city exhibited cluster-wide dominance in the short-run dynamics neither. The dominance of BJ over TJ was however evident in both long- and short-run (Figure 2). Beyond the cluster, BJ's influence was sparse both in the long- and the short-run, with mixed signs. At the same time, BJ was affected by a variety of cities in the long-/short-run (table 3&4).

In Contrast, TJ had a wide influence on the housing markets across all five clusters. Interestingly, the magnitude of such influence was not linearly related to the land distance in between. For example, TJ's largest positive long-run impact fell on HZ, and its biggest negative long-run impact on HK, rather than on its close neighbours such as DL and JN. In the short-run, TJ had a very strong positive influence on Sya, a city 2984km away from it. Eleven other cities, including itself, were significantly and negatively affected by its short-run price dynamics. The strongest negative influence was felt, again, by two far-away cities HZ and HK. Like BJ, TJ was also affected by a wide range of cities, in the long-/short-run.

4. The Chengdu-Chongqing and the Yangtze River Middle Reaches clusters

Chongqing (CQ) is the only inland tier-one city sits in the CC cluster, while the major city of the YRMR cluster, Wuhan (WH), is only a tier-two city. The two clusters are lumped together in the discussion, partly because the two are situated next to each other along the Yangtze River, and partly the estimates show that they are inseparable. The CC cluster refers to a group of cities centred, in theory, on CQ. Figure 2 however indicates that, within the CC cluster, a large positive ripple effect runs to CQ from Chengdu (CD), the capital city of Sichuan province and a tier-two city by earlier classification, rather than the other way around. The influence of CQ is nevertheless far wider than CD, affecting 17 of the 35 cities in the long run with the largest impact fell upon the coastal cities such as HZ (negative), Nbo (negative) and HK (positive). In the short run, only six cities, all outside the cluster, responded to its stimulus.

Figure 2 reveals a competitive relation between the CC and the YRMR clusters. The long run negative influence revealed was unidirectional from CQ to Csa, but bidirectional between CQ and WH. These negative influences are likely a result of competition for business relocations from the more expensive YRD & PRD regions. In the short-run, CQ had a positive impact on both Csa and NC while a positive short-run influence ran from WH to CQ.

Beyond CC and YRMR, the housing market of CQ was closely linked to those in the YRD cluster, as significant negative long-run influence was observed to run from CQ to SH, HZ and Nbo, while a significant positive ripple effect ran from SH to CQ. In fact, when tier-two cities are included, the results suggest an inter-cluster ripple effect running from the YRD to both the CC and the YRMR. It is worth noting these three clusters are linked by the Yangtze river, the major commercial inland waterway of the country and a cost-effective natural transportation infrastructure.

B. Information cascade effect

As shown in table 5, shocks originating from BJ had the widest and the biggest impact throughout the country. In the second place stood SH. Although shocks originated from SH had as widespread an influence as those from BJ, their impacts in magnitude were much more modest.

Among the tier-one cities, innovations in BJ accounted for 100.0% of the one-step-ahead forecast errors in BJ and 71.4% of those in SH. In comparison, SH's own contribution to itself was only 28.6%. Local innovations were more important in GZ, SZ, TJ and CQ, which accounted for 81.1%, 64.5%, 77.1% and 57.8% of their own one-step errors, with usually BJ or SH occupied the second place in the list of contributors. With a few exceptions, the difference between the first and the second contribution was quite large. For instance, as the second contributor to GZ's forecast error, SH contributed only 12.6%. BJ was also the number one contributor, with a significant contribution, to all tier-two cities but a few. As for HK, UrM (not very intuitively) was the number one contributor of its forecast error (14.7%), followed by HK itself (13.7%) and SH (13.4%). On the other hand, HK's contribution to mainland cities' forecast errors was entirely absent, even among SZ and GZ, its nearest neighbours.

(Insert Table 5 about Here)

C. Impulse response analysis

A further conduction of impulse response analysis confirms that the price indices are non-stationary and any shock to the system will send each on an explosive path. Figure 3 depicts the impulse response functions of the seven tier-one cities. This figure suggests complementarity between BER and YRD clusters but competition between these two with the rest (PRD, CC, and YRMR clusters). For example, a positive shock to the house price of BJ had a positive influence on those of SH and TJ but a negative effect on those of GZ, SZ, CQ, and HK. Similarly, a positive shock to the house price of SH (TJ) had a positive influence on those of BJ and TJ (SH) but a negative effect on the other four tier-one cities. The reverse is not necessarily true. Within the PRD, the competition was again obvious between GZ and SZ in the sense a positive shock to one had the tendency to send the other on a negative explosive path. However, while a positive shock to GZ or SZ had a negative effect on HK's house price, a positive shock to HK housing market had a positive effect on the house prices of both GZ and SZ. There was also a clear complementarity between HK and CQ, the only tier-one city which is far away from the coastal regions. These pictures agree with earlier analysis using ripple and information cascade effects.

(Insert Figure 3 about here)

VI. Discussion and Conclusion

This study examines the regional inequality dynamics through the lens of housing market which to a great extent reflects local economic prosperity. More specifically, the analysis starts by examining these dynamics within and across China's five mega-city clusters. The role of each tier-one city in driving such dynamics is zoomed in on. These intra- & inter-cluster dynamics are sliced into an equilibrating ripple effect and a diverging information cascade effect. Ripple effect is captured by a VECM model while information cascade through residual variance decomposition.

Evidence emerged suggests that there existed in China no country-wide ripple effect matching the classical pattern described by Meen (1999), and the influences of most mainland tier-one cities were limited in this regard. This result nevertheless could be an artefact arising from a short sample. As discussed earlier, a ripple effect resulting from production factor relocation can take a very long time to see its effect, especially in such a vast country as China.

Among the group of seven tier-one cities, there was however a classical ripple effect with Hong Kong (rather than Beijing) being the epicentre (Figure 2). This is in contrast to the results of Chiang (2014) who found Beijing to be the source of long-run house price adjustment for other mainland tier-one cities. This disagreement arises perhaps partly because that our results are based on year-on-year inflation rate rather than on house price; partly Chiang had employed a different set of price indices which covers *both residential and commercial* properties; and partly we have added 28 tier-two cities into the analysis; but more importantly because we have added Hong Kong into the picture. Given its unique economic position in relation to the country, omitting Hong Kong may distort our understanding of the dynamics of China's regional inequality, as exemplified by this study.

(Insert Figure 4 about Here)

In terms of *inter-cluster ripple*, both Beijing and Shanghai had limited influence over cities in other three clusters. In contrast, Chongqing and Hong Kong were much more influential - house price inflations in both rippled out to multiple cities outside their own respective cluster (Figure 4). This outcome is not surprising with regard to Hong Kong, the wealthiest city of the country. The wide influence of Chongqing may be explained by its location: it is the only tier-one city sits right in the middle of the country and is conveniently connected to the bustling YRD region via the Yangtze river. With the addition of tier-two cities, it is also possible to analyse a contiguous ripple effect within the neighbourhood of the tier-one cities. Evidence suggests the existence of such *intra-cluster ripple effect*, but its pattern matched that described by Meen only for the YRD cluster.

As argued earlier, ripple effect in housing market reflects movements of production factors. The findings of this study suggest that Shanghai had been an effective economic powerhouse for the YRD region and beyond. As one of the most prominent cities in the country, Shanghai is a magnet for both capital and labour, and its attractiveness has helped cities in its neighbourhood to prosper. Our findings also suggest that Hong Kong had played a key role in bringing prosperity to the PRD cluster, which then helped to spread that prosperity gradually inland. In contrast, as one of the most attractive investment destinations in the country, Beijing had not done as well in propelling the economic progress of its neighbouring cities close or afar. The reasons behind are worth examining but beyond the scope of the current study.

This study further suggests that information cascade had been an important source of regional house price volatility, with Beijing being the most important source of this volatility spill-over. It is seconded by Shanghai in this respect. Their influences are evident not only in the mainland cities, but also in Hong Kong. On the other hand, despite its role in setting the long-run price growth in the mainland, Hong Kong's contribution to the forecast errors of the mainland cities was entirely absent.

This study has some policy implications. First, long-run economic fundamental forces work their way very slowly through the country. Hence any policy designed along that line (such as establishing Xiongan New Area to release the congestion and pollution pressures in Beijing), although more desirable, will not see its effect immediately. On the other hand, policies that aim for immediate outcome will have large disturbing impact on the markets throughout the country with unpredictable effect on the dynamics of regional inequalities.

This study contributes to the literature in several ways. The researcher takes a unique and cost-effective approach to regional inequality dynamics and offers production factor relocation as a fundamental economic force driving the equilibrating ripple effect. I provide partial information efficiency as a conceptual foundation supporting the application of VAR model in this context. I introduce into the housing literature (for the first time as far as I am aware) the concept of information cascade arising from unexpected shocks in idiosyncratic factors. I apply these concepts to examine the inequality dynamics among the tier-one and tier-two cities of China from the perspective of mega-city clusters. I include into this scrutiny Hong Kong whose important contribution had been left out in earlier studies in this line of inquiry. I examine the complex pattern of intra- and inter-cluster ripple effects. I also offer conceptual explanations why a nationwide ripple effect is missing from the data. I further point out future research direction in terms of understanding why China's tier-one cities performed differently as a regional or national economic powerhouse.

The complex pattern of ripple effect emerged from China reflects a different geo-economic structure from that of the UK. Unlike the UK where London has been the firmly established centre of economic gravity, China has multiple powerhouses driving its economic process. Earlier studies on the ripple effect in the UK suggest that the country as a whole may be described by a monocentric city model, with London being the "central business district (CBD)". The multiplex picture emerged from the current study indicates that, by analogy, China is so far better described by a bicentric model with PRD and YRD being the twin "CBDs". This bicentric model has propelled great economic growth in the coastal areas. It has also resulted in vast regional inequalities between these areas and the rest of the country. The need to narrow this regional gap is what sits behind the mega-city cluster plan which strives to develop a polycentric model with multiple economic powerhouses spread out geographically. Running along with this ambitious plan is a fast-extending high-speed rail network, connecting the most remote parts of the country to the prosperous tier-one cities. As discussed earlier, being the major commercial inland waterway, the Yangtze river mattered greatly in bringing forward a desired interregional ripple effect from the prosperous YRD region to the less developed CC and YRMR regions. This natural experiment of a polycentric model supported by transportation infrastructure building will deliver lessons worth learning for both academics and policy makers in years to come.

Data availability statement to confirm the presence of absence of shared data.

The data that support the findings of this study were downloaded from DataStream and are available from the corresponding author upon request.

Bibliographies

Alexander, C. and M. Barrow (1994). "Seasonality and cointegration of regional house prices in the UK." Urban Studies **31**(10): 1667-1689.

Ashworth, J. and S. C. Parker (1997). "Modelling regional house prices in the UK." Scottish Journal of Political Economy **44**(3): 225-246.

Bai, T. (2015, 7 Apr 2015). "China plans new city clusters." Global Times Retrieved 02 Jan 2016, 2016, from http://www.globaltimes.cn/content/915518.shtml.

Chiang, S.-h. (2014). "Housing markets in China and policy implications: Comovement or ripple effect." China & World Economy **22**(6): 103-120.

Cook, S. (2003). "The convergence of regional house prices in the UK." Urban Studies **40**(11): 2285-2294.

Cook, S. and D. Watson (2015). "A new perspective on the ripple effect in the UK housing market: Comovement, cyclical subsamples and alternative indices." Urban Studies.

D'Arcy, S. P. and P. Oh (1997). "The cascade effect in insurance pricing." Journal of Risk and Insurance **64**(3): 465-480.

Devaney, S. and Q. Xiao (2017). "Cyclical co-movements of private real estate, public real estate and equity markets: A cross-continental spectrum." Journal of Multinational Financial Management **42-43**: 132-151.

Diebold, F. X. and K. Yilmaz (2009). "Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets." Economic Journal **119**(534): 158-171.

Drake, L. (1995). "Testing for convergence between UK regional house prices." Regional Studies **29**(4): 357-366.

Engle, R. F. and C. W. J. Granger (1987). "Co-Integration and Error Correction: Representation, Estimation, and Testing." Econometrica **55**(2): 251-276.

Giussani, B. and G. Hadjimatheou (1991). "Modeling regional house prices in the United Kingdom." Papers in Regional Science **70**(2): 201-219.

Granger, C. W. J. and M. Hatanaka (1964). Spectral analysis of economic time series. Princeton, New Jersey, Princeton University Press.

Granger, C. W. J. and P. Newbold (1974). "Spurious regressions in econometrics." Journal of Econometrics **2**(2): 111-120.

Hamnett, C. (1988). "Regional variations in house prices and house price inflation in Britain, 1969-1988 " The Royal Bank Scotland Review **159**: 29-40.

Holmans, A. E. (1990). House prices: changes through time at national and sub-national level. Government Economic Service Working Paper No. 110. London, the United Kingdom, Department of the Environment.

Holmes, M. J. and A. Grimes (2008). "Is there long-run convergence among regional house prices in the UK?" Urban Studies **45**(8): 1531-1544.

Johansen, S. (1991). "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models." Econometrica **59**(6): 1551-1580.

Krugman, P. (1991). "Increasing Returns and Economic-Geography." Journal of Political Economy **99**(3): 483-499.

MacDonald, R. and M. P. Taylor (1993). "Regional house prices in Britain : Long-run relationships and short-run dynamics." Scottish Journal of Political Economy **40**: 43-55.

Meen, G. (1999). "Regional house prices and the ripple effect: A new interpretation." Housing Studies **14**(6): 733-753.

NBS. (2016). "China, House Prices, by City, Newly Built Residential Buildings, Beijing, Index, Corresponding Period of the Previous Year = 100." 2016, from http://data.stats.gov.cn/english/easyquery.htm?cn=E0104.

NexusPacific. (2013). "China City Tier System: How it Works and Why its Useful." Retrieved 13/11/2015, 2015, from http://nexus-pacific.com/blog/2013/7/9/china-city-tier-system-how-it-works-and-why-its-useful.

Petersen, W., S. Holly and P. Gaudoin (2002). Further work on an economic model of the demand for social housing. Report to the Department of the Environment, Transport and the Regions.

Pippenger, M. K. and G. E. Goering (1993). "A Note on the Empirical Power of Unit-Root Tests under Threshold Processes." Oxford Bulletin of Economics and Statistics **55**(4): 473-481.

Rosenthal, L. (1986). "Regional House Price Interactions in the Uk, 1975-81 - a Cross-Spectral Analysis." Applied Economics **18**(9): 1011-1023.

Thomas, A. (1993). "The influence of wages and house price decisions on British interregional migration decisions." Applied Economics **25**: 1261-1268 .

Tsai, I. C. (2015). "Spillover effect between the regional and the national housing markets in the UK." Regional Studies **49**(12): 1957-1976.

UN-Habitat (2012). State of the world's cities 2012/13 - Prosperity of cities, United Nations Human Settlements Programme.

Welch, I. (1992). "Sequential Sales, Learning, and Cascades." Journal of Finance **47**(2): 695-732.

Widuto, A. (2019). Regional inequalities in the EU. E. P. R. Service. **PE 637.951**.

Willcocks, G. (2010). "Conditional variances in UK regional house prices." Spatial Economic Analysis **5**(3): 339-354.

Xiao, Q. and G. Tan (2006). Markov-switching unit root tests: a study of property price bubbles in Hong Kong and Seoul. The 35th Australian Conference of Economists.

Zhang, F. and B. Morley (2014). "The convergence of regional house prices in China." Applied Economics Letters **21**(3): 205-208.

Table 1 Mnemonic Table

Tier-one cities		Tire-two cities							
Beijing	BJ	Chengdu	CD	Hohhot	Hot	Nanning	NN	Taiyuan	TY
Shanghai	SH	Changchun	CCn	Haikou	HaK	Ningbo	Nbo	Urumqi	UrM
Guangzhou	GZ	Changsha	Csa	Harbin	HrB	Nanchang	NC	Wuhan	WH
Shenzhen	SZ	Dalian	DL	Hangzhou	HZ	Nanjing	NJ	Wuxi	WX
Tianjin	TJ	Fuzhou	FZ	Jinan	JN	Qingdao	QD	Xian	XiA
Chongqing	CQ	Guiyang	GY	Kunming	KM	Sanya	Sya	Xiamen	XiM
Hong Kong	HK	Hefei	HF	Lanzhou	LZ	Shenyang	ShY	Zhengzhou	ZZ

Table 2 Granger Causality Test. H0: X is block exogenous (critical value = 48.60). The null is rejected for all, indicating mutual feedbacks.

City	p-value	stat	City	p-value	stat
BJ	0.00	478.61	KM	0.00	270.05
SH	0.00	358.34	LZ	0.00	141.65
GZ	0.00	361.24	NN	0.00	161.83
SZ	0.00	150.92	Nbo	0.00	225.48
TJ	0.00	149.79	NC	0.00	174.06
CQ	0.00	143.60	NJ	0.00	207.78
CD	0.00	183.54	QD	0.00	81.71
CCn	0.00	179.42	Sya	0.00	132.27
Csa	0.00	210.80	ShY	0.00	115.74
DL	0.00	269.29	TY	0.00	276.02
FZ	0.00	200.58	UrM	0.00	168.93
GY	0.00	165.93	WH	0.00	107.40
HF	0.00	507.40	WX	0.00	286.94
Hot	0.00	339.58	XiA	0.00	307.11
HaK	0.00	136.89	XiM	0.00	312.35
HrB	0.00	382.83	ZZ	0.00	127.58
HZ	0.00	145.03	HK		
JN	0.00	207.68			

Table 3 Long-run parameter estimates of tier one cities. The first row lists the dependent variable, i.e., the monthly change in the year-on-year inflation rate of house price in the named cities; the first column lists the lagged year-on-year inflation rate. The long-run parameter estimate, Π, is calculated via multiplying the long-run adjustment parameter α by the cointegrating parameter β, and then summed across the 32 cointegrating vectors. The response parameter estimate on its own past is negative in all tier-one cities, indicating mean reversion. For instance, if the year-on-year inflation rate of Beijing is above its long-run level by 1% in the previous month, this inflation rate will decrease in the current month by 0.36%, other things equal. The asterisks ***, **, * indicates significance at 1%, 5% and 10% respectively.

	BJ	SH	GZ	SZ	TJ	CQ	HK
BJ	-0.36**	0.08	0.26**	-0.29*	0.26***	-0.06	-0.51*
CCn	0.17	0.02	0.01	-0.45***	-0.06	0.11	0.40
CD	-0.47*	-0.37	0.48**	-0.98***	0.16*	0.50**	1.55***
CQ	-0.13	-0.31**	-0.30***	-0.24	-0.31***	-0.92***	0.60**
Csa	-0.49**	-0.20	-0.21	-0.31	-0.10	-0.27	-0.38
DL	-0.30***	0.03	-0.03	0.11	-0.06	-0.62***	-0.16
FZ	0.47**	0.16	0.14	0.43*	-0.14*	1.03***	-0.03
GY	0.09	0.09	0.27*	0.06	0.20***	-0.46***	-0.64*
GZ	-0.08	0.04	-0.43***	-0.18	-0.08**	-0.24**	0.31
HaK	0.39***	0.07	-0.11	0.32***	0.01	-0.08	0.07
HF	-0.07	-0.12	0.16	-0.44***	0.10*	-0.72***	-0.62**
HK	0.18***	0.17***	0.18***	0.15***	0.06***	0.15***	-0.33***
Hot	0.35**	-0.02	0.35***	0.27	0.23***	0.65***	-0.47
HrB	-0.25	0.25	-0.26	-0.22	-0.22**	0.60***	1.13**
HZ	0.05	-0.01	-0.12	-0.24*	-0.14***	-0.06	0.78***
JN	-0.40	-0.09	0.12	-0.34	0.05	0.07	-0.28
KM	-0.05	0.01	0.17*	0.01	0.06	0.15	0.43*
LZ	-0.36**	-0.38***	-0.24**	-0.59***	-0.10*	-0.10	0.83***
Nbo	-0.07	0.16	0.10	0.57***	0.11**	0.10	-0.32
NC	-0.04	0.13	-0.03	0.42***	0.15***	0.22	0.18
NJ	0.08	-0.23	0.35***	0.12	0.05	0.09	0.47
NN	0.67***	0.44***	-0.07	0.64***	0.11*	0.77***	-0.86***
QD	0.85***	0.16	0.42**	0.03	0.06	0.20	-0.94**
SH	0.15	-0.16	0.47***	0.16	0.18***	0.57***	-0.24
ShY	0.27	0.29*	0.57***	0.19	0.34***	-0.31*	-1.12***
Sya	-0.35***	0.01	0.08	-0.18*	0.03	0.15*	0.09
SZ	0.01	0.01	-0.12***	-0.12**	-0.09***	-0.09**	-0.07
TJ	0.04	0.01	-0.05	0.19	-0.34***	0.38	-1.08**
TY	0.18	0.39**	-0.26*	0.48**	-0.10	-0.11	0.39
UrM	-0.07	0.03	-0.05	-0.13	0.04	0.17	-0.07
WH	0.16	0.10	-0.18	1.18***	0.07	-0.91***	-0.15
WX	-0.14	-0.27	-0.16	-0.03	0.16*	-0.34	0.89*
XiA	-0.18	-0.45**	-0.86***	-0.69***	-0.46***	-0.21	0.36
XiM	-0.34**	-0.05	-0.26**	0.04	0.08	-0.62***	-0.08
ZZ	0.07	-0.01	-0.40***	0.03	-0.31***	0.21	-0.05

Table 4 Short-run parameters of differenced lags. The first row lists the dependent variables and the first column the *lagged monthly changes in the year-on-year inflation rates* of the named cities. The parameter estimates indicate short-run dynamics of the year-on-year inflation rate. The asterisks ***, **, * indicates significance at 1%, 5% and 10% respectively.

	BJ	SH	GZ	SZ	TJ	CQ	HK
BJ	-0.06	0.04	-0.17	-0.32*	0.23***	0.12	0.00
CCn	-0.06	0.10	-0.11	-0.14	0.12*	-0.08	-1.02***
CD	0.21	0.21	-0.83***	0.74***	-0.23***	0.13	-0.62*
CQ	0.15	0.03	0.12	-0.06	0.31***	0.03	-0.37
Csa	0.17	-0.03	-0.05	0.15	0.04	0.23**	0.27
DL	0.26	-0.05	0.07	-0.19	0.15**	0.12	-0.50
FZ	-0.20	-0.10	0.04	-0.40**	0.05	-0.39**	-0.36
GY	-0.04	-0.04	-0.06	0.27	-0.03	0.13	0.94***
GZ	0.47***	0.20	0.14	0.55***	0.08	0.23*	0.76***
HaK	-0.05	0.01	0.06	-0.10	0.09***	0.11	-0.17
HF	0.12	0.24	-0.23*	0.72***	-0.09	0.43***	0.18
HK	0.16***	0.14***	-0.02	0.11**	0.07***	0.05	0.31***
HOT	-0.05	0.03	0.04	-0.20	0.04	-0.07	-0.53
HrB	0.06	-0.16	0.27	-0.15	-0.02	-0.16	0.39
HZ	0.22**	0.31***	0.17**	0.26**	0.16***	0.18*	0.01
JN	0.13	-0.01	-0.17	0.22	-0.08	0.15	0.01
KM	-0.10	-0.01	-0.26**	0.50***	-0.01	-0.20	-0.37
LZ	0.21*	0.19*	0.17*	0.40***	0.09**	0.03	-0.43**
Nbo	0.08	-0.05	0.15*	-0.04	-0.08*	-0.15	-0.28
NC	-0.19	-0.32**	-0.06	-0.74***	-0.06	-0.21	0.46
NJ	0.06	0.10	0.07	0.00	0.05	-0.11	-0.08
NN	-0.32***	-0.20**	-0.11	-0.46***	-0.03	-0.47***	0.27
QD	-0.39**	-0.02	-0.21*	0.02	0.14***	0.06	0.28
SH	-0.02	0.03	0.39**	-0.02	-0.16*	-0.41*	0.45
ShY	-0.11	-0.08	-0.20	0.36**	-0.04	0.24	0.57**
Sya	0.06	-0.03	0.01	0.09	-0.12***	-0.17**	-0.01
SZ	-0.04	0.02	0.15**	0.24***	0.08**	0.14*	0.14
TJ	-0.32	-0.18	-0.28	0.13	-0.23***	-0.35	-1.06***
TY	0.10	0.00	0.25*	-0.02	0.05	0.24	0.13
UrM	-0.11	-0.05	-0.01	0.01	-0.13***	-0.13	-0.38**
WH	0.19	0.09	0.42***	-0.43*	0.03	0.58***	0.07
WX	0.21	0.18	0.14	0.31	-0.08	0.14	-0.61
XiA	-0.10	-0.10	0.26**	-0.19	0.18***	-0.04	-0.62**
XiM	0.42***	0.34***	0.49***	0.40***	-0.04	0.27**	-0.20
ZZ	0.06	-0.14	0.05	-0.34*	0.12**	0.10	0.43

Table 5 Information cascade effect.

(a) *Contributions **by** tier-one cities.* The first row lists the contributing cities and the columns the affected.

BJ		SH		GZ		SZ		TJ		CQ		HK	
Sya	1.6%	BJ	0.0%	BJ	0.0%	BJ	0.0%	BJ	0.0%	BJ	0.0%	BJ	0.0%
TY	2.1%	LZ	0.0%	SH	0.0%	SH	0.0%	SH	0.0%	SH	0.0%	SH	0.0%
QD	3.0%	XiM	1.3%	NN	0.0%	GZ	0.0%	GZ	0.0%	GZ	0.0%	GZ	0.0%
XiM	5.2%	HrB	1.6%	FZ	0.0%	FZ	0.0%	SZ	0.0%	SZ	0.0%	SZ	0.0%
GZ	6.3%	TJ	2.2%	NJ	0.0%	LZ	0.0%	HaK	0.0%	TJ	0.0%	TJ	0.0%
KM	9.5%	HF	2.6%	HrB	0.0%	HK	0.1%	Sya	0.0%	NN	0.1%	CQ	0.0%
HK	10.6%	NJ	2.9%	HK	0.1%	TJ	0.2%	HZ	0.0%	Nbo	0.1%	CD	0.0%
TJ	13.7%	TY	3.0%	Sya	0.1%	Nbo	0.2%	FZ	0.0%	NJ	0.1%	CCn	0.0%
LZ	14.0%	GY	3.3%	DL	0.1%	ZZ	0.2%	DL	0.1%	WH	0.1%	Csa	0.0%
HrB	14.2%	ZZ	3.4%	Nbo	0.1%	HrB	0.2%	ShY	0.1%	QD	0.2%	DL	0.0%
JN	15.6%	KM	3.4%	Csa	0.1%	DL	0.3%	Hot	0.1%	TY	0.5%	FZ	0.0%
ZZ	17.0%	WX	3.7%	UrM	0.1%	HaK	0.4%	WH	0.1%	Csa	0.5%	GY	0.0%
ShY	21.1%	ShY	4.2%	HZ	0.3%	JN	0.4%	Nbo	0.1%	GY	0.5%	HF	0.0%
WX	23.0%	QD	4.5%	GY	0.3%	TY	0.4%	NN	0.2%	HaK	0.5%	Hot	0.0%
NJ	24.1%	FZ	6.0%	CD	0.5%	UrM	0.4%	HF	0.2%	WX	0.6%	HaK	0.0%
SZ	24.2%	Sya	6.8%	HF	0.8%	CQ	0.5%	XiA	0.2%	ZZ	0.7%	HrB	0.0%
CQ	.31.9%	WH	8.0%	XiA	1.0%	HZ	0.6%	HK	0.3%	Hot	0.9%	HZ	0.0%
HF	32.0%	CQ	8.3%	CQ	1.1%	Hot	0.8%	CQ	0.3%	CD	1.1%	JN	0.0%
GY	35.1%	Hot	9.0%	WX	1.3%	QD	1.2%	KM	0.4%	Sya	1.3%	KM	0.0%
NC	37.0%	SZ	10.0%	SZ	1.3%	KM	1.3%	WX	0.5%	XiA	1.3%	LZ	0.0%
DL	38.8%	NC	10.1%	LZ	1.4%	NN	1.4%	HrB	0.5%	KM	1.3%	NN	0.0%
HaK	39.8%	JN	11.0%	HaK	1.4%	XiA	1.5%	CD	0.6%	HZ	1.4%	Nbo	0.0%
NN	49.4%	Nbo	12.4%	XiM	1.5%	NJ	1.5%	ZZ	0.8%	CCn	1.4%	NC	0.0%
CCn	50.2%	XiA	12.5%	QD	1.8%	HF	1.5%	NC	0.8%	JN	1.5%	NJ	0.0%
FZ	51.0%	GZ	12.6%	CCn	1.9%	ShY	1.7%	Csa	1.1%	NC	2.0%	QD	0.0%
Csa	52.4%	CD	12.8%	JN	2.5%	Sya	1.8%	UrM	1.1%	HF	2.6%	Sya	0.0%
WH	53.8%	Csa	13.0%	Hot	2.7%	WX	2.0%	CCn	1.2%	UrM	3.4%	ShY	0.0%
HZ	60.8%	HaK	13.3%	NC	2.8%	XiM	2.3%	GY	1.7%	HK	4.9%	TY	0.0%
CD	62.2%	HK	13.4%	WH	2.9%	GY	2.5%	QD	2.2%	DL	6.7%	UrM	0.0%
XiA	64.1%	UrM	13.6%	ShY	4.8%	Csa	2.6%	TY	2.3%	FZ	8.1%	WH	0.0%
UrM	64.4%	NN	14.7%	TJ	6.9%	WH	3.0%	XiM	3.3%	HrB	10.8%	WX	0.0%
Hot	65.8%	HZ	15.1%	TY	7.8%	CD	3.3%	LZ	4.7%	XiM	11.9%	XiA	0.0%
SH	71.4%	CCn	15.4%	ZZ	11.2%	CCn	4.7%	NJ	6.0%	ShY	11.9%	XiM	0.0%
Nbo	73.3%	DL	24.7%	KM	17.7%	NC	5.4%	JN	7.6%	LZ	14.3%	ZZ	0.0%
BJ	100.0%	SH	28.6%	GZ	81.1%	SZ	64.5%	TJ	77.1%	CQ	57.8%	HK	13.7%

(b) Contributors ***to*** tier-one cities. *The columns list all contributing cities and the first row the affected tier-one cities.*

BJ		SH		GZ		SZ		TJ		CQ		HK	
SH	0.0%	GZ	0.0%	SZ	0.0%	TJ	0.0%	CQ	0.0%	CD	0.0%	TY	0.0%
GZ	0.0%	SZ	0.0%	TJ	0.0%	CQ	0.0%	CD	0.0%	CCn	0.0%	NN	0.0%
SZ	0.0%	TJ	0.0%	CQ	0.0%	CD	0.0%	CCn	0.0%	Csa	0.0%	Sya	0.0%
TJ	0.0%	CQ	0.0%	CD	0.0%	CCn	0.0%	Csa	0.0%	DL	0.0%	ShY	0.0%
CQ	0.0%	CD	0.0%	CCn	0.0%	Csa	0.0%	DL	0.0%	FZ	0.0%	WX	0.0%
CD	0.0%	CCn	0.0%	Csa	0.0%	DL	0.0%	FZ	0.0%	GY	0.0%	CD	0.0%
CCn	0.0%	Csa	0.0%	DL	0.0%	FZ	0.0%	GY	0.0%	HF	0.0%	KM	0.0%
Csa	0.0%	DL	0.0%	FZ	0.0%	GY	0.0%	HF	0.0%	Hot	0.0%	GZ	0.1%
DL	0.0%	FZ	0.0%	GY	0.0%	HF	0.0%	Hot	0.0%	HaK	0.0%	GY	0.1%
FZ	0.0%	GY	0.0%	HF	0.0%	Hot	0.0%	HaK	0.0%	HrB	0.0%	SZ	0.1%
GY	0.0%	HF	0.0%	Hot	0.0%	HaK	0.0%	HrB	0.0%	HZ	0.0%	HZ	0.1%
HF	0.0%	Hot	0.0%	HaK	0.0%	HrB	0.0%	HZ	0.0%	JN	0.0%	HrB	0.2%
Hot	0.0%	HaK	0.0%	HrB	0.0%	HZ	0.0%	JN	0.0%	KM	0.0%	TJ	0.3%
HaK	0.0%	HrB	0.0%	HZ	0.0%	JN	0.0%	KM	0.0%	LZ	0.0%	LZ	0.3%
HrB	0.0%	HZ	0.0%	JN	0.0%	KM	0.0%	LZ	0.0%	NN	0.0%	NJ	0.4%
HZ	0.0%	JN	0.0%	KM	0.0%	LZ	0.0%	NN	0.0%	Nbo	0.0%	HaK	0.5%
JN	0.0%	KM	0.0%	LZ	0.0%	NN	0.0%	Nbo	0.0%	NC	0.0%	NC	0.5%
KM	0.0%	LZ	0.0%	NN	0.0%	Nbo	0.0%	NC	0.0%	NJ	0.0%	Hot	0.6%
LZ	0.0%	NN	0.0%	Nbo	0.0%	NC	0.0%	NJ	0.0%	QD	0.0%	Nbo	0.6%
NN	0.0%	Nbo	0.0%	NC	0.0%	NJ	0.0%	QD	0.0%	Sya	0.0%	HF	0.9%
Nbo	0.0%	NC	0.0%	NJ	0.0%	QD	0.0%	Sya	0.0%	ShY	0.0%	CCn	1.6%
NC	0.0%	NJ	0.0%	QD	0.0%	Sya	0.0%	ShY	0.0%	TY	0.0%	ZZ	1.9%
NJ	0.0%	QD	0.0%	Sya	0.0%	ShY	0.0%	TY	0.0%	UrM	0.0%	QD	2.3%
QD	0.0%	Sya	0.0%	ShY	0.0%	TY	0.0%	UrM	0.0%	WH	0.0%	XiA	2.6%
Sya	0.0%	ShY	0.0%	TY	0.0%	UrM	0.0%	WH	0.0%	WX	0.0%	JN	2.9%
ShY	0.0%	TY	0.0%	UrM	0.0%	WH	0.0%	WX	0.0%	XiA	0.0%	FZ	3.7%
TY	0.0%	UrM	0.0%	WH	0.0%	WX	0.0%	XiA	0.0%	XiM	0.0%	WH	3.7%
UrM	0.0%	WH	0.0%	WX	0.0%	XiA	0.0%	XiM	0.0%	ZZ	0.0%	DL	3.8%
WH	0.0%	WX	0.0%	XiA	0.0%	XiM	0.0%	ZZ	0.0%	HK	0.0%	CQ	4.9%
WX	0.0%	XiA	0.0%	XiM	0.0%	ZZ	0.0%	HK	0.0%	TJ	0.3%	XiM	6.9%
XiA	0.0%	XiM	0.0%	ZZ	0.0%	HK	0.0%	SZ	0.2%	SZ	0.5%	Csa	8.7%
XiM	0.0%	ZZ	0.0%	HK	0.0%	GZ	1.3%	SH	2.2%	GZ	1.1%	BJ	10.6%+
ZZ	0.0%	HK	0.0%	BJ	6.3%	SH	10.0%	GZ	6.9%	SH	8.3%	SH	13.4%
HK	0.0%	SH	28.6%	SH	12.6%	BJ	24.2%	BJ	13.7%	BJ	31.9%	HK	13.7%
BJ	100.0%	BJ	71.4%	GZ	81.1%	SZ	64.5%	TJ	77.1%	CQ	57.8%	UrM	14.7%

[i] Full information revelation in price is assumed in the efficient market hypothesis which we only admit partially here, allowing for inefficiencies of some kinds such as market incomplete understanding of a given piece of information or the time required for a housing market to adjust to changes, which can be much lengthier than the stock market.

[ii] Due to space limitation, the ADF and cointegration test statistics along with the diagnostic statistics are not presented in the text but obtainable in an excel file upon requests.

[iii] This number is taken from Bing Maps at https://www.bing.com/maps/, accessed on 6 July 2018.

Figure 1 Summary statistics sorted by mean year-on-year inflation (Jul 2005 – Aug 2015)

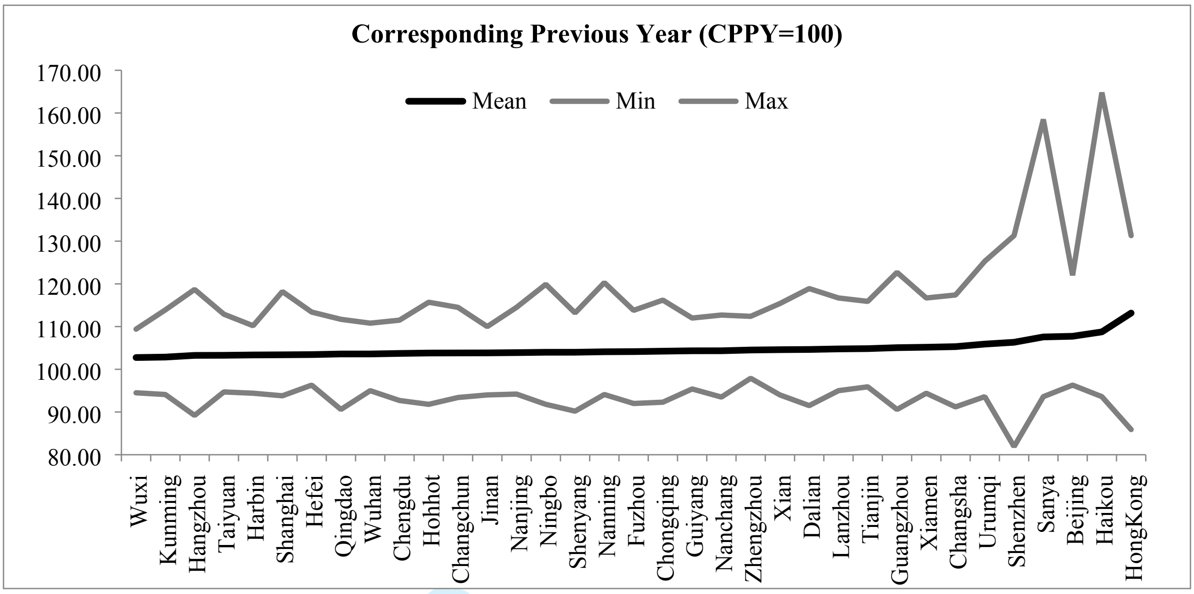
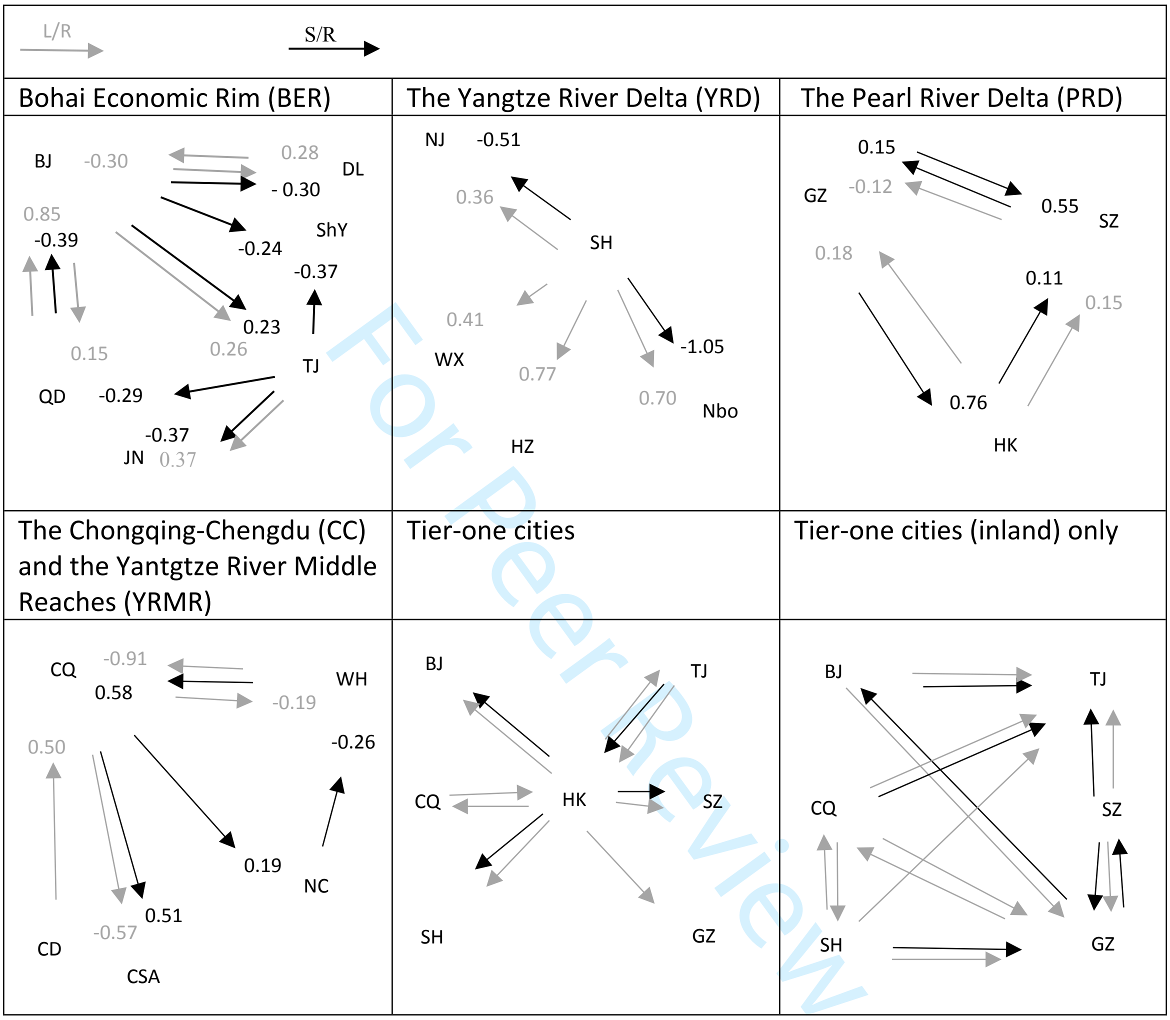


Figure 2 Intra-cluster and inter-tier-one-city ripple effect. The pictures below illustrate the relationship among the housing markets within each major economic cluster and among the tier-one cities. Lines and numbers in grey indicate long-run equilibrium relations hence ripple effects while those in black the short-run dynamics. The numbers are parameter estimates. The associated parameter estimates for the tier-one cities are given in table 2 and 3. Those for tier-two cities are excluded due space limitation but are obtainable upon request. Only estimates which are significate at 5% or 1% levels are included in the illustration. The pictures below indicate an intricate ripple relation among the tier-one cities and their nearby tier-two cities.



Equilibrating ripple effect or disturbing information cascade effect

Figure 3 Impulse response functions of the tier-one cities. The impulse response functions of the tier-two cities are excluded because of space limit but obtainable upon request. "X on Y" means the picture illustrates the impact on Y of one unit of shock to X. The x-axis indicates the forecast horizon in months, and the y-axis the year-on-year inflation rate. The pictures are consistent with the ADF test outcome that these time series are non-stationary *I(1)* processes, hence information cascade can be very disturbing to the regional markets.

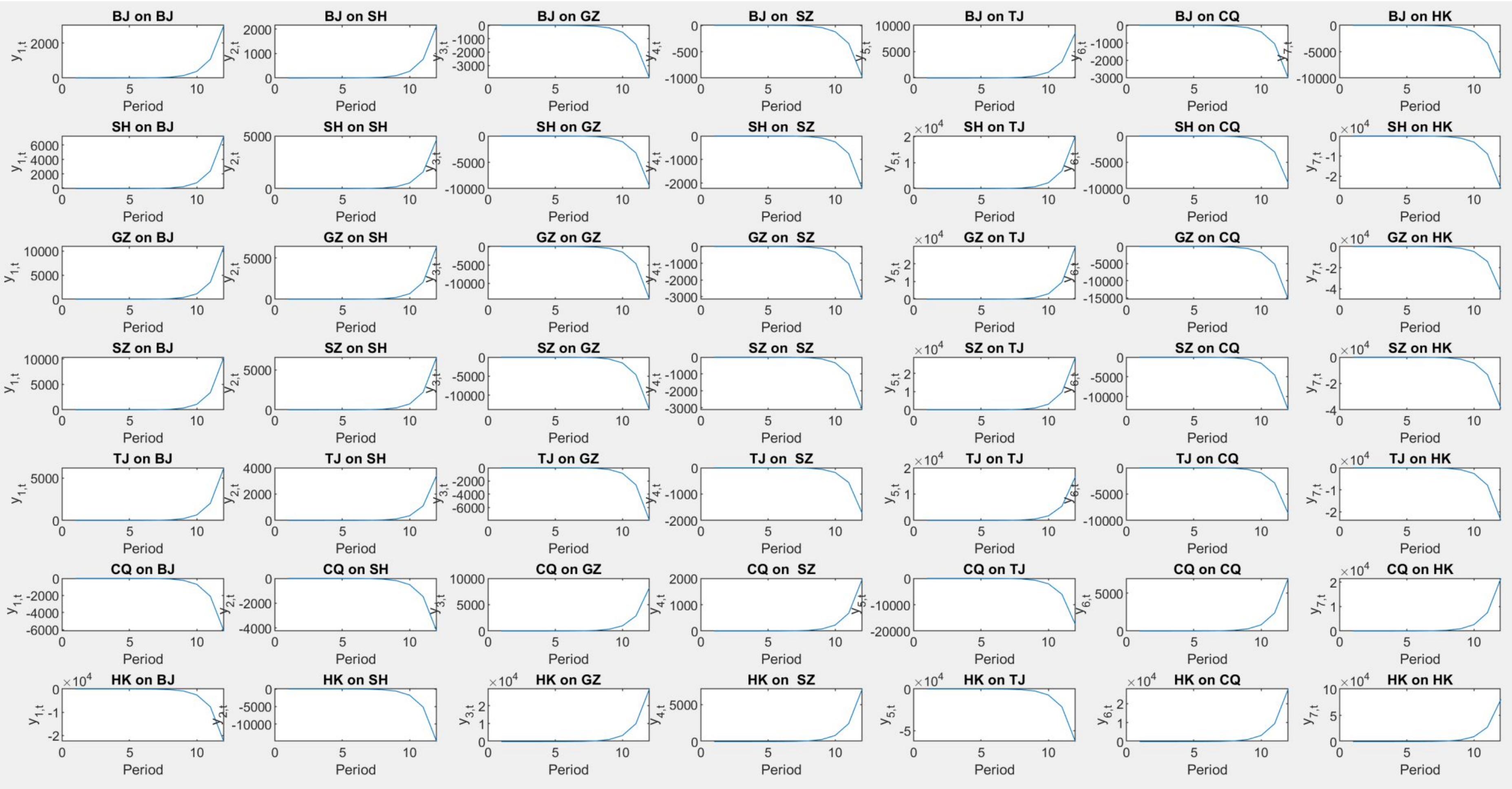
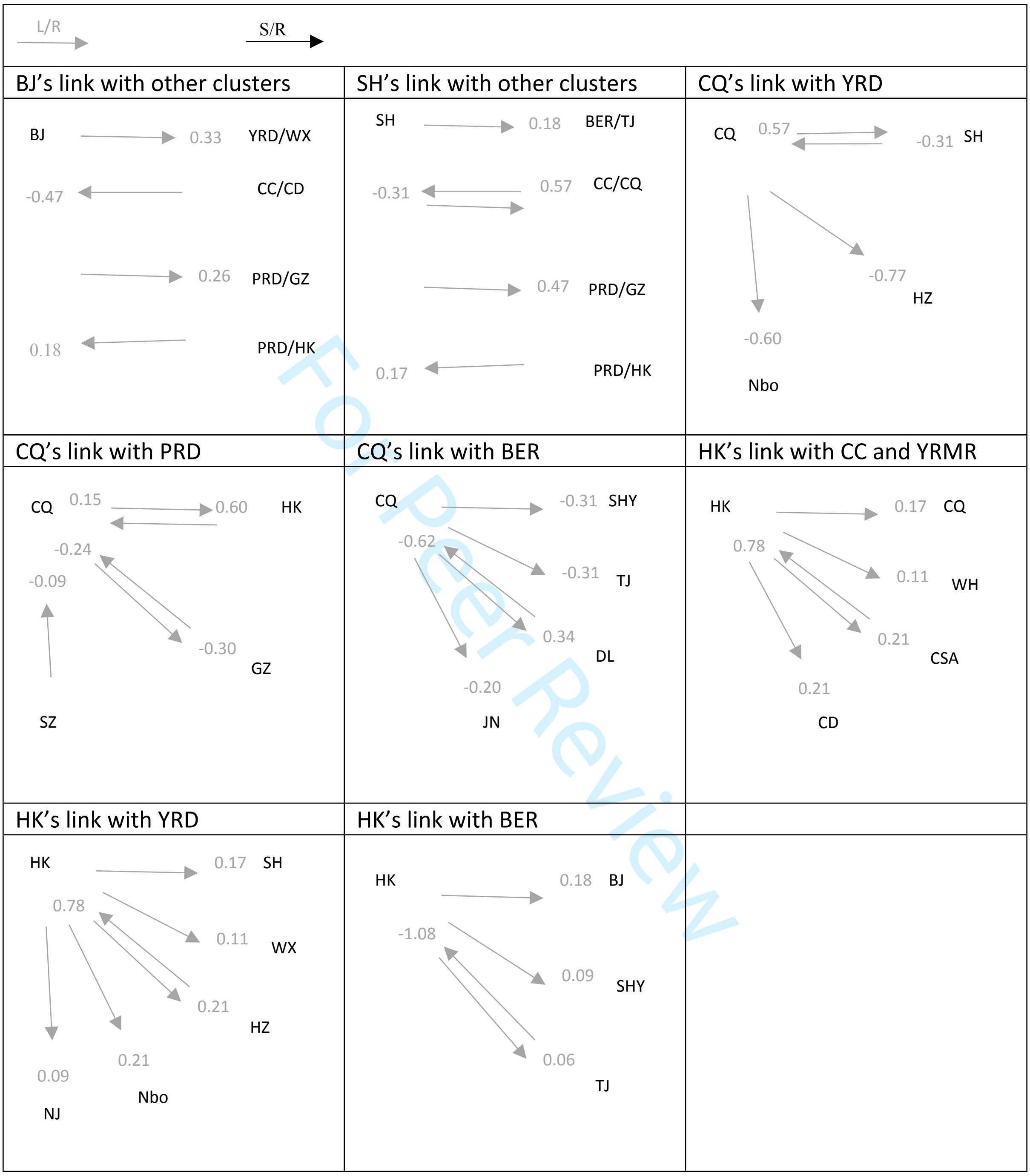


Figure 4 Inter cluster ripple effect. The pictures below indicate the long-run impact of selected tier-one cities on cities outside their respective clusters. BER, YRD, PRD, CC and YRMR refer respectively to the five megacity clusters.



	Beijing	Shanghai	Guangzhou	Shenzhen	tianjin	Chongqing	Chengdu	Changchun
Name	CH HSE PRICE	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI
Code	CHHPCRBEF	CHHPCRSH	CHHPCRGZ	CHHPCRSZI	CHHPCRTIF	CHHPCRCH	CHHPCRCE	CHHPCRCG
	BJ	SH	GZ	SZ	TJ	CQ	CD	CCn
7/15/2005	106.2	107.3	107.6	106.9	106.7	110	102.5	106.9
8/15/2005	106.2	105.4	104.4	106.1	106.3	108.8	102.7	105
9/15/2005	115.3	106.2	107.9	116.5	107.2	113.9	109.6	110.4
10/15/2005	117.8	108.3	107.8	116.8	107.3	112	111.5	110.6
11/15/2005	108.2	100.1	104.5	110.9	106.1	108.7	103.1	104.6
12/15/2005	107.4	97.9	104.4	108.9	106.5	107.7	103	101.2
1/15/2006	108.4	96.9	105.2	110	105.5	104.4	109.1	102.1
2/15/2006	107.3	95.9	104.9	111.3	105.8	103.4	109.2	102.6
3/15/2006	107	94	107.3	109.9	106.6	103.1	108.6	102.1
4/15/2006	108.2	93.8	108.2	113.6	106.7	102.7	108.3	101.2
5/15/2006	109	93.8	109.7	113.7	107.3	102.95	108.25	101.7
6/15/2006	111.2	94.6	110	114.6	107.4	103.2	108.2	102.2
7/15/2006	111.1	96.5	109	113.6	107.5	102	109	102.8
8/15/2006	111.4	97.8	107.3	112.8	107.6	102.9	108.9	102.7
9/15/2006	110.3	98.7	108.7	110.6	107.7	103.1	108.9	103.4
10/15/2006	110.7	99.4	108.8	109.9	107.7	102.5	108.4	102.3
11/15/2006	110.3	99.9	107.1	109.8	107.8	103.9	108.9	102.4
12/15/2006	110.4	99.9	108.3	110	107.8	103.7	108.5	101.4
1/15/2007	109.9	99.9	108.9	110.2	107.3	103.6	108.3	103.5
2/15/2007	109.7	100.1	109.6	109.9	107.3	103.6	108.3	103.4
3/15/2007	109.9	100.2	108.6	110.7	107.4	102.3	108.4	103.9
4/15/2007	110.7	100.3	107.2	111.3	107.2	103	108.3	103.7
5/15/2007	110.3	100.3	107.1	112.3	106.9	104.9	108.3	105.1
6/15/2007	110	100.9	107.3	113.9	106.8	105.3	108.1	107.4
7/15/2007	111.6	102	107.8	116.1	106.9	106.7	108.4	108.4
8/15/2007	113.5	103.7	107.4	117.6	107.1	109.5	108.8	109.9
9/15/2007	115.3	106.2	107.9	116.5	107.2	113.9	109.6	110.4
10/15/2007	117.8	108.3	107.8	116.8	107.3	112	111.5	110.6
11/15/2007	117.4	109	107.7	117	107.8	114.9	110.5	111.4
12/15/2007	117.5	109.3	106.1	114.3	108.1	115.9	110.9	112.9
1/15/2008	117.2	110.1	103.8	112.9	108.3	116.2	109.2	114.5
2/15/2008	116.5	110	102.8	111.7	108	113.8	108.3	113.4
3/15/2008	116.9	109.9	102.5	105.7	107.8	113.8	107.1	111.4
4/15/2008	116.1	109.8	101.7	102.6	108.1	113.3	106.2	110.9
5/15/2008	115.7	109.6	101.3	101.3	108.3	112.8	105.2	108.4
6/15/2008	114.3	108.8	100.3	100.3	108	111.7	103.9	106.7
7/15/2008	113	107.3	100.1	98.3	107.5	109.3	103.3	105
8/15/2008	111.7	105.4	96.7	95.9	106.4	106.4	102.6	104.5
9/15/2008	108.7	101.9	94.8	89.2	105.5	102	100.1	104.2
10/15/2008	106.9	99.7	92.6	85	104.4	96.5	98.8	104.4
11/15/2008	104.2	98.6	91.2	82	103.2	95.4	97.5	104.2
12/15/2008	101.4	98.1	90.6	81.9	102.3	94.8	97	103.2
1/15/2009	100.4	97.3	91	83.5	102	96.7	96.4	102.1
2/15/2009	100.1	97.4	91.1	83.7	101.9	98.9	96.7	101.2
3/15/2009	99.2	97.3	91.1	87.8	101.3	98.7	97.4	99.9
4/15/2009	99.4	97.3	93.3	91.2	101	98.7	97.6	99.9
5/15/2009	99.4	97.7	94.4	93.1	101	98.9	98.5	100.7
6/15/2009	99.6	98.8	97.8	93.4	101.6	100.1	99.6	101.8

7/15/2009	100.8	99.9	99.9	95.4	102.5	100.2	100.2	102
8/15/2009	102.1	101.4	104.2	97.7	104.5	101.7	100.8	101.5
9/15/2009	103.6	103.3	107.3	105	105.8	102.3	102	100.7
10/15/2009	104.3	105.6	112.1	108.9	106.8	103.9	103.6	100.6
11/15/2009	108	107.4	114.7	112.6	107.4	107.4	104.4	103.3
12/15/2009	113.2	109.2	119.9	114.3	111.2	107.6	105.4	106.3
1/15/2010	116	110.2	122.4	115.2	112.7	109.1	106	106
2/15/2010	116.9	110.3	122.7	116.1	113.5	111.4	106.7	106.8
3/15/2010	119	111.2	120.3	115.7	113.9	112.5	106.9	107.9
4/15/2010	121.5	112	117.3	114.2	115.6	112.8	107.5	110.2
5/15/2010	122	111.5	114.5	112	115.9	112.8	106.9	110.9
6/15/2010	121.5	109.5	110.1	110.2	114	111	106.4	109.4
7/15/2010	120.1	108	106.2	107.8	113.1	110.7	105.8	108.4
8/15/2010	118.6	106.3	104	105.8	111.7	110.3	106	108.1
9/15/2010	118.2	104.9	103.2	104.5	110.2	111	104.8	108
10/15/2010	117.5	103.3	101.1	103.5	109.4	110	104.1	108.2
11/15/2010	114.3	102.3	99.4	102.5	109.4	109.5	103.9	105.6
12/15/2010	109.9	101.3	100.1	101.6	106.8	108.2	103.8	105.5
1/15/2011	106.8	101.5	100.1	103.1	106.7	107.9	104.9	106.9
2/15/2011	106.8	102.3	100.6	103.2	106.7	106.2	104.9	106.8
3/15/2011	104.9	101.7	102.7	103.1	106.6	105.6	104.4	106.7
4/15/2011	102.8	101.3	103.8	103.1	104.9	105.3	103.5	104.1
5/15/2011	102.1	101.4	105.1	103.7	103.4	105.3	103.7	102.6
6/15/2011	102.2	102.2	105.4	104.6	103.9	105.8	103.6	102.9
7/15/2011	101.9	102.5	106.4	104.7	104.2	105.6	103.5	103.2
8/15/2011	101.9	102.8	107	104.9	103.4	104.2	102.9	103.4
9/15/2011	101.8	103.1	106.3	104.5	103.1	102.2	102.8	103.2
10/15/2011	101.7	102.9	106.1	104.4	102.9	101.2	102.4	102.6
11/15/2011	101.3	102.4	106	104.1	102	100.1	101.9	102.4
12/15/2011	101	101.8	103.1	103.1	101.2	99.4	101.3	101.9
1/15/2012	100.1	100.7	101.1	101	100.2	99.3	99.8	101.4
2/15/2012	99.6	99.6	100.3	99.8	99.3	98.9	99.3	101.6
3/15/2012	99.2	99.2	99.7	99.4	98.8	98.5	99.1	100.6
4/15/2012	99	98.7	98.8	98.4	98.4	98.2	99.1	100.1
5/15/2012	98.8	98.4	98.4	97.7	98.9	98.1	98.5	99.7
6/15/2012	99	98.5	98.4	97.5	99	98.1	98.7	99.2
7/15/2012	99.3	98.5	98.7	97.6	98.9	98.5	99.3	99
8/15/2012	99.4	98.5	99	97.8	99.2	99.1	99.2	99
9/15/2012	99.5	98.4	99.3	97.9	99.4	99.5	99.4	99
10/15/2012	99.8	98.7	99.9	98.4	99.6	99.9	99.3	99.3
11/15/2012	100.7	99.2	100.7	99.3	100.4	100.6	99.9	99.2
12/15/2012	101.6	100	102.3	100.8	100.8	101.3	100.4	100.1
1/15/2013	103.3	101.3	104.7	103.2	101.4	102.5	101.5	100.1
2/15/2013	105.9	103.4	108.1	105.7	102.8	103.5	102.3	101.4
3/15/2013	108.6	106.4	111.1	108.9	104.3	104.3	103.4	102.5
4/15/2013	110.3	108.5	113.5	111.3	105.2	105.5	105.4	103.6
5/15/2013	111.8	110.2	115.3	113.7	105.4	106.2	106.8	104.7
6/15/2013	112.9	111.9	116.3	115.7	105.8	106.8	107.7	105.8
7/15/2013	114.1	113.7	117.2	116.6	106	107.1	107.7	106.3
8/15/2013	114.9	115.4	118.8	118.1	106.1	107.9	108.6	107
9/15/2013	116	117	120	119.7	106.7	108.9	109.1	107.7
10/15/2013	116.4	117.8	120.5	120.2	107	109.2	109.6	107.8

11/15/2013	116.3	118.2	120.7	120.6	107	109.5	109.8	108.8
12/15/2013	116	118.2	120.1	119.9	107.4	109.3	109.6	108.6
1/15/2014	114.7	117.5	118.6	117.8	107.3	108.7	109.2	109.2
2/15/2014	112.2	115.7	115.7	115.6	106.3	107.9	108.9	108.4
3/15/2014	110.3	113.1	113.3	112.8	105.1	107.2	108.3	108
4/15/2014	108.9	111.5	111.1	111	104.5	106.1	106.5	107.2
5/15/2014	107.7	109.6	109.5	108.7	104.1	105.4	105.1	106.1
6/15/2014	106.4	107	107.7	106.6	103.3	103.9	103.6	104.5
7/15/2014	104	104.1	105.2	105.1	102.1	102.4	102.2	103.1
8/15/2014	102.1	101.5	102.1	102.5	100.6	100.3	100.1	101.3
9/15/2014	100.4	99.2	99.4	100.3	99.3	97.7	98.5	99.3
10/15/2014	98.7	98	97.3	99	98.4	96.4	96.9	98.3
11/15/2014	97.9	97.1	96.2	98.1	97.7	95.2	95.8	97.1
12/15/2014	97.3	96.3	95.3	98.7	97	94.8	95.4	96.3
1/15/2015	96.8	95.8	94.6	98.7	96.4	94	94.5	95.6
2/15/2015	96.4	95.3	94	98.6	96	93.2	93.7	95
3/15/2015	96.3	95	93.6	99.1	95.9	92.6	92.9	94.5
4/15/2015	96.8	95.3	93.9	100.7	95.9	92.3	92.7	93.8
5/15/2015	97.7	97.7	95.2	107.5	96.1	92.3	93.1	93.4
6/15/2015	98.9	100.3	97.3	115.7	96.9	93.1	93.8	93.9
7/15/2015	101	103.1	99.7	123.6	97.8	94.2	95.3	94.8
8/15/2015	103	105.6	102	131.3	99	95.5	96.7	95.8

changsha	Dalian	Fuzhou	Guiyang	Hefei	Hohhot	Haikou	Harbin	Hangzhou
CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI
CHHPCRCS	CHHPCRDN	CHHPCRFZ	CHHPCRGY	CHHPCRHF	CHHPCRHH	CHHPCRHK	CHHPCRHR	CHHPCRHZ
Csa	DL	FZ	GY	HF	Hot	HaK	HrB	HZ
102.5	106.9	104.7	101.9	105.7	113.3	108.1	105.4	108.1
107.6	107.8	106.9	104.6	105.2	115.2	106.1	105.7	110.3
110.7	107.5	107.9	107.2	102.6	104.3	111.4	104.8	115.6
114	107.7	108.6	107.4	103.8	104.4	111.3	105	110.8
105	115.1	103.8	102.2	102.6	115.7	101	106.3	104.7
106	118.2	104.5	100.9	100.8	114.6	99	105.9	105.4
104.3	118.9	104.4	104	102.6	114.7	102.9	101.9	106.5
102.5	115.1	104.8	104.8	102.8	114.9	103	102.4	102.6
107	112.9	105.6	104.6	102	113.5	105.1	102.5	102.6
104.8	111.1	109.9	104.9	102.8	114.9	104.2	103.4	103.6
106.05	110	109.6	105.6	101.6	112.65	104.95	103.6	102.9
107.3	108.9	109.3	106.3	100.4	110.4	105.7	103.8	102.2
104.3	108.6	107.4	107.1	100.7	109.6	107.9	103.7	102.5
107.1	107	108.2	106.2	100.5	108.4	104.9	103.7	104.4
105.4	107.3	110	105.5	100.6	107.2	104.3	102.8	103.3
105.8	107.8	109.6	102.6	100.4	106.3	103.9	102.9	104.7
107.7	107.9	110.4	108.4	100.9	105.9	103.2	103.1	102.8
106.7	107.9	109.8	107.6	100.8	105.4	106.1	104	102.9
106	107.8	109.4	108.1	99.8	104.4	102.6	103.1	102.9
105.4	107.8	109.1	107.9	100	104.5	104.2	102.2	102.8
110.1	107.2	108	107.4	100.9	104.1	105.3	103	103.3
105.9	107.2	107.5	107.3	101	104.1	104.5	105.3	104
105.2	107	106.2	107.1	101	104.1	104.1	105.4	103.2
107.9	107.3	107.5	107.1	101.3	103.8	105.1	103.3	106.9
107.7	107.7	107.2	107.3	101.7	103.8	107.4	103.5	107.4
109.4	107.7	107.9	107.1	101.3	104.4	109.9	104.1	110.2
110.7	107.5	107.9	107.2	102.6	104.3	111.4	104.8	115.6
114	107.7	108.6	107.4	103.8	104.4	111.3	105	110.8
117.2	108.1	109.3	108	106.2	104.7	113.3	109.9	116.7
115.1	108.3	108.8	110.9	107.2	104.7	112.9	109.9	115
117.4	106	109.6	112	111.9	100.2	116.1	109.6	116
114.1	105.7	109.4	110.8	112.8	100.6	118.9	109.7	115.9
114.7	105.6	108.5	109.8	112.4	100.7	118.3	108.6	115.3
112.8	105.3	107.3	107.2	112.2	100.8	119.2	107.9	115.3
111.7	105.1	106.2	105.8	113.4	101.3	117.6	106.1	115.2
109.9	104.9	105	105.3	112.8	102.2	118.1	106.1	113.3
108.5	104.7	103.8	105	111.7	102	116.7	105.6	110.7
107.6	105.1	102.9	105.1	111.1	101.5	116.5	104.4	107.8
105.3	104.6	101.3	105.2	108.5	101.3	115	103.4	104.7
103.8	104.1	100.5	104.8	106.1	101	113.6	102.6	102.6
100.1	103.2	100	104.8	102.5	100	109.3	102.4	101.1
99.6	102.6	98.3	104.5	100.4	99.6	104.5	101.9	100.4
99.1	101.7	98.4	103.4	99.3	99.1	103.7	99.8	100.3
99.6	100.1	98.1	102.9	98.7	98.4	100.8	99.2	99
99	99.7	98.1	103.1	98.7	98.6	100.5	100.1	98.7
99.1	99.2	98.1	103.3	99.3	98.6	99.5	99.6	97.9
99.4	99.1	98.8	103	98.4	98.2	99.7	100	98.3
100.3	99	99.3	103	98.3	98.9	99.8	100.7	98.8

101.1	100.5	99.6	103.1	99	99.5	101.8	100.8	100.1
100.5	100.9	99.8	103.2	99.9	100	101.6	101.3	101.7
101.1	101.7	100	103.6	100.9	100.3	102.7	101.7	103.9
102.5	102.1	100.1	103.8	101.9	101.8	104.7	101.9	105.9
106.3	102.7	100.6	104	102.4	103.2	109.6	102.7	109.2
107.9	104.2	103.1	106.7	103.4	104.4	113.4	103.8	111.4
109.6	104.4	105.8	110	106.3	106.5	135.1	105.4	112.9
111.5	106	106.1	110.7	108.1	107.4	158.4	105.7	114.6
112.8	108.6	106.8	110.3	110.1	107.8	164.8	105.7	114.8
113.4	110.3	108	109.9	111.9	109.9	164.3	107.1	118.7
112.7	110.3	107.2	109.4	113	110.6	164.4	107.8	117.5
111.6	110.5	106.6	109.3	112.7	109.9	163.8	107.5	116.7
110.5	108.4	106	109	109	109.5	161	107.5	114.4
109.6	107.9	105.6	107.9	108.5	109.9	159.3	108	110.2
110.1	107.4	106.3	106.5	108.5	109.8	157.5	107.5	108.5
109.7	107.5	106.2	105.9	108.4	108.8	155.5	108.1	105.9
109.4	108.1	105.9	105.5	108.6	108.4	149	107.7	102.5
109.6	106.6	104.6	105.3	108.7	108	144.2	107.1	100.2
109.9	106.6	104.1	104.7	106.4	106.8	121.6	107.3	100.8
108.9	106.8	105.2	105	105.1	106.9	104.2	106.6	101.6
108.1	106.3	104.7	105.3	103.4	106.4	100.6	106.8	101.4
107.1	105.6	104	105.4	101.7	105	100.7	105.6	98.8
107.7	105.9	103.8	105	100.3	104.7	100.6	104.7	99
108.2	105.9	103.8	104.6	100.6	104.8	100.7	104.3	99.3
108.4	106	103.8	104.4	103	105	100.7	104	100
108.7	104.9	103.8	104.3	103	104.2	101.3	102.3	101.8
108.1	104.3	103.1	104	102.6	104	101.3	102.2	101.2
107.3	103.8	103.1	103.6	101.9	103.3	100.5	101	101.5
106	102.5	102.8	103.3	101.4	103	99.8	100.6	101.3
104.6	102.2	102.7	102.8	100.3	102.3	99.6	100.2	101
102.4	102.1	101.8	102.5	99.9	102.2	98.8	100	99.3
101.3	101.7	100.2	102	99.3	101.5	98.6	100.4	98.3
100.9	100.9	99.6	101.4	99.1	101.1	98.7	100	94.1
100.3	100.2	99.1	100.9	98.7	100.3	98.5	100.2	90.8
99.7	99.9	99	100.9	99	99.8	98.4	100.1	90.2
99.3	100.1	99.1	100.9	98.8	99.5	98.3	99.7	90.5
99.3	100.2	99.8	100.8	99	99.2	98.5	99.8	90.9
99.3	100.6	100	100.9	99.1	98.8	98.7	99.8	91.2
99	100.6	100	100.9	99.1	98.4	98.7	99.8	91.6
99.2	100.9	99.9	101	99.4	98.4	98.9	99	91.6
100.1	101.1	100.2	100.8	100	98.9	99.7	99.8	91.8
100.7	101.4	101.4	101	100.8	99.2	99.7	100.5	92.7
101.9	102	102.3	101.4	101.5	100.3	99.7	101.6	93.6
103.4	103.1	104.3	102	102.7	101.7	99.9	102.7	94.7
105	104.3	105.9	102.7	103.6	101.9	100.1	103.5	100.3
106.3	105.8	107.6	103.9	104.5	101.9	100.3	104.2	105.2
107.5	107	108.3	104.6	105.4	103.4	100.8	105	106.7
108.4	107.7	110.8	104.5	106.2	104.5	100.9	106.4	107.1
109.3	108.2	110.8	105.1	107	105.8	101	106.7	107.5
110.1	108.4	111.1	104.9	107.5	106.9	101	107.4	108.3
110.7	108.9	112.1	105.5	108.1	107.9	101.1	107.9	109.4
111.6	109.3	112.6	106.3	108.3	109.3	101.8	109.7	110.5

111.6	109.4	113.8	106.7	109.2	109.7	101.8	110	111.2
112.1	110	113.1	106.7	109.9	110.3	102.3	110.2	111
111.7	109.7	113.1	106.6	109.8	109.5	103.1	108.8	110
110.8	108.9	111.6	106.2	109.1	108.6	103	107.9	109.1
109.3	108.3	110.6	105.5	108.5	108.5	102.6	107.1	107.8
108.2	106.8	108.8	104.6	107.8	108.6	102.4	106.1	105.6
106.7	105.5	108.4	104	106.9	107.2	101.9	105.4	103.4
104.8	104.4	105.2	104.3	105.7	106.4	101.2	104.2	100.6
102.3	102.3	102.9	103.2	104	104.1	100.3	103.1	97.6
99.7	100.3	101.2	101.9	102.7	101.7	99.8	101.5	94.6
98.1	98.8	98.4	100.5	101.1	100	98.8	100	92.4
95.8	97	97	98.7	100.5	98	97.2	98	91.3
94.3	95.3	95.3	98	99.4	96.3	96.3	96.8	90.5
93.2	93.6	94.7	97.3	98.3	94.9	95.4	95.8	90.1
92.4	92.8	93.5	96.8	97.6	94.1	94.4	95.3	89.9
91.6	92.1	92.5	96.2	96.9	92.8	93.8	94.9	89.6
91.4	91.5	92.1	96.3	96.5	92.7	94	94.4	89.2
91.2	91.5	92	95.8	96.3	92.2	93.6	94.5	90.1
91.4	91.5	92	95.5	96.5	91.9	93.7	94.5	91.8
92.2	91.9	93	95.4	97	91.8	94.2	94.5	94.6
93.6	93.3	94.7	96	98	92.6	95	95.5	97.7
95	94.8	95.9	97.6	98.6	94.1	95.9	96	100.3

Jinan	Kunming	Lanzhou	Nanning	Ningbo	Nanchang	Nanjing	Qingdao	Sanya
CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRICE	CH HSE PRICES	CH HSE PRICE
CHHPCRJAI	CHHPCRKU	CHHPCRLA	CHHPCRNA	CHHPCRNE	CHHPCRNC	CHHPCRNJF	CHHPCRQDF	CHHPCRSAF
JN	KM	LZ	NN	Nbo	NC	NJ	QD	Sya
109.1	106.5	106.4	106.2	109	107.3	106.6	111.7	108.3
110	106.5	106.1	105.3	104.7	107.4	106.8	111.2	109
107.7	102.4	106.7	110.5	114.6	107.2	108.7	108.4	107.4
108.2	103.6	108	111.3	119.1	108.5	108.4	109	108.3
109.9	106.8	106.2	106.8	101	104.5	105.1	109.9	106.2
107.5	106.2	105.9	106.5	105	106.3	104.4	109.7	103.3
106.4	102	105.8	104.3	103.2	106.8	105.7	108.4	103.2
105.1	101.7	106.5	109.9	103.1	106.2	101.7	106.7	100.9
105.4	100.6	107	103.7	103.1	106	103.4	107.6	102.7
104.4	101.5	105.8	104.5	102.2	105.3	103.6	108.2	101.4
103.8	102.15	105.2	105.05	102.25	106.2	103.5	107.6	101.9
103.2	102.8	104.6	105.6	102.3	107.1	103.4	107	102.4
103.3	101.9	103.4	106.1	102.2	107.5	103.1	105.6	101.7
103.6	100.1	106	103.4	102.6	107.3	102.5	106.6	102.5
103.7	99.3	106.5	104.7	102.1	106.3	104.1	107.1	102.4
103.6	100.9	105.6	103.9	101.7	105.6	104.2	107.2	102.5
104.5	100.6	105.9	104.7	103.9	105.1	105.2	107	101.6
104.7	101.7	106.9	104.6	102.8	106.2	105	105.6	101.1
103.3	101.3	106.7	105.3	104.8	106.5	106.1	106	101.2
103.7	101.3	106.6	104.7	104.3	106.6	104.7	105.5	100.3
103.4	101.6	104.6	107.1	105.7	107.7	106.8	105.7	101
105.1	102.5	104.6	107	104.8	107.7	108.8	105.7	100.7
104.9	102.4	107.7	108.4	107.9	107.1	109.2	105.8	101.9
106	103.1	106.7	108.5	108.6	108	111.3	106.1	103.6
105.3	102.7	107.2	112	109.2	108.4	109.2	106.4	106
105.8	102.3	106.7	109.7	110.5	107.8	107.5	106.8	107.6
107.7	102.4	106.7	110.5	114.6	107.2	108.7	108.4	107.4
108.2	103.6	108	111.3	119.1	108.5	108.4	109	108.3
107.2	105	109.8	116.1	118.8	108.8	109.4	109	107.2
107.7	105.8	116.7	117.4	117.3	109.7	109	108.9	106.1
107.6	107.7	115.5	120.3	119.9	108.1	110.9	106	109.7
107.8	106.6	113.3	118.8	118.9	108.9	110.6	106.8	113.4
108.2	107.1	111.5	115.8	118.2	108.6	108.4	106.6	114.7
108.3	107.5	112.5	114.2	117.8	107.7	108.9	106.6	113.7
108.1	107.7	108.3	112.3	116.6	106.4	106.6	106.4	113.2
109.1	107.7	110.9	111.5	114.7	104.7	105.2	106.1	112.6
109	105.9	110	109.1	113.3	103.1	103.8	106	110.5
109	100.4	110.7	106.9	111	102.1	103	105.6	108.1
107.7	97.7	110	105.2	109.6	102.1	99.2	105.8	106.7
107	97.1	107.3	102.8	106.2	101.8	97.4	104.9	105
105	98.5	103.9	101.5	103.2	101.7	94.8	103.8	105.3
103.2	98.9	103.1	99.5	102.8	101.6	94.2	102.6	106.1
101.7	96.1	103.9	98.3	102.4	100.6	94.8	100.9	104.2
101.4	95.6	103.8	97.9	102.4	98.5	94.4	100.2	101
101	95.4	104.6	98.3	102.5	98.2	95.8	99.1	99.3
100.7	95.5	104.7	98	102.5	98	94.6	98.9	99.6
100.8	96	105.7	97.6	102.9	98.9	95.1	99.9	99.6
99.7	97.8	104.6	96.9	104.4	100.1	95.6	100.9	99.5

99.8	99.5	103.8	97.4	106.4	100.9	96.8	101.1	100
101.2	104.7	103.6	98.7	107.4	102	97.9	101.8	100.5
101.8	106.1	103.2	99.7	107.5	102.6	101.1	101.5	100.7
102.2	106.9	102.3	101.4	108.5	103.2	104.3	102.1	100.7
102.7	108.8	104.2	102.9	109.5	103.9	108.8	103	101.5
105	110.8	104.9	105.8	111.7	105.1	111.7	104.9	107.2
106.2	113.9	104.3	107	111.8	108.1	111.4	106.9	131.2
106.5	111.9	104.6	108.1	111.7	108.9	112	107.6	156.1
106.4	111.3	104.4	108.4	111.9	109.8	113.5	109.2	157.5
107.4	110.9	106.5	109	113.2	112.7	114.5	110	158.2
107.3	110.4	106.2	109	112.4	111.3	114	108.7	158.4
108.4	108.6	104.2	108.9	110.5	110	113.3	107.6	158.5
108.7	107.2	104.7	107.2	108.5	108.1	111.4	107.2	156.9
106.8	105.2	105.5	105.4	107.8	106.8	110.2	106.6	156.1
107.5	105.9	106.9	104.2	107.5	107	109.4	106.2	156.8
106.9	107.5	109.8	103	106.5	107.5	107	108.4	156.6
106.9	105.7	110.2	102.4	105.5	108.6	104.9	107.7	155.1
106	105.4	110.3	101.6	103.5	107.5	102.7	106.2	147.5
105.6	105.6	111.8	102.4	103.7	108.8	103.9	105.8	119.1
105.7	107.8	111.4	101.6	104.1	109.6	103.7	104.6	100.2
106.1	107.4	110.9	102.2	103.2	108.6	101.5	104.4	99.4
105.6	106.9	107.5	102	101.9	106.1	100.2	104.1	99.1
105.4	106.8	107.7	102	102	107.1	100.3	104.4	97.9
104.5	106.7	108.2	101.6	102.1	108.2	100.7	104.6	98
103.9	106.1	108.2	102.8	101.4	109.3	101.4	104.8	98.9
103.2	106.4	106.9	103.5	101.2	109.1	101.4	104.6	101.6
102.1	105.4	105.3	103.1	100.2	107.5	101.2	104.7	101.3
102.1	103.4	103	102.8	99.8	105.6	100.7	101.6	101.4
101.4	102.7	102.7	102.4	99.2	103.1	100.3	101.2	101.1
100.8	102.3	101.7	101.9	98.8	102.1	99.7	100.5	100.9
100.6	101.3	100.5	100.2	98.5	100.1	98.7	99.8	100.6
100.2	100.8	100	100	97.9	99.1	98.1	100	100.1
99.5	100.5	100.5	98.9	97	99.1	97.4	98.5	99.6
98.4	100.4	100.4	98.3	94.5	98.2	97.3	96.4	99.4
98.1	100.1	100.3	98.3	92.7	98	97.3	96.1	98.9
97.8	99.9	100	98.6	92.4	97.9	97.6	95.9	99
97.9	100.3	99.9	98.8	92.2	98.3	98.1	95.6	98.9
98.5	100.3	100.1	98.7	91.9	98.7	98.4	95.7	98.9
98.5	100.2	99.9	99	91.8	99	98.6	95.2	98.9
99.1	100.1	99.7	99.3	92	99.5	99.2	95.5	98.9
99.4	100.8	100.1	99.4	92.5	100	99.9	95.8	99.1
100	101.3	100.1	99.5	92.9	101.1	101	96.6	99.6
100.9	101.7	100.5	99.7	93.7	101.6	102.3	97.6	99.9
101.7	101.7	101.4	101.3	95	103.1	104	99	100.3
102.9	102.7	102.6	103.3	96.7	104.8	105.7	101.2	101.1
104.7	103.3	103.5	104	99.4	106.3	107.3	103.6	102
105.5	104.1	104.1	105.6	101.7	107.2	108.5	104.7	102.2
106	104.7	105.3	106.4	102.9	108.2	109.2	105.5	102.4
106.9	104.6	105.8	107.4	103.4	108.2	109.6	106.6	102.8
107.6	105.3	107	108.3	104.5	108.4	110.2	108	103.4
108.2	105.6	107.3	108.7	105.6	109.2	111	108.9	103.7
108.7	105.9	107.7	109.4	106.3	109.6	111.6	109.4	104.6

109.3	105.9	107.7	109.4	106.8	110	112	109.9	105.5
109.4	105.8	107.9	110.1	107.3	109.9	111.9	110	105.3
109	106.1	107.6	110.9	107.1	109.9	111.2	109.9	105.4
108.6	106.3	106.9	109.9	106.1	108.6	109.8	108.8	105.2
108.1	105.5	105.8	108.4	105.9	107	108.7	107.8	105
107	105.1	105.2	107.8	105.1	106.2	107.5	107.1	104.6
105.9	104.4	104.3	106.4	103.8	105	106.6	106.1	104.7
104.6	103.4	102.4	104.8	101.3	103.4	105.1	104.6	104.4
102.3	102.3	101.3	102.3	100	102	103.5	102.6	101.6
100	100.5	99.8	100.4	98.7	100	101.7	100.3	100.5
98.7	99.2	99	98.5	97.3	98	100.2	98.5	99.8
97.8	98.3	98.1	97.2	96.5	96.3	99.1	96.6	98.4
96.8	97.2	97.4	96.7	95.6	95.6	98.5	95.2	96.8
96	96.2	97	95.7	94.7	94.9	97.9	93.8	96
95.3	95.4	96.5	94.9	94.1	94.6	97.6	92.7	95.1
94.7	94.9	95.9	94.1	93.6	93.8	97.2	91.7	94.7
94.1	94.7	95.7	94.1	93.5	93.5	97	91.1	94.2
94	94.3	95	94.3	93.7	93.5	96.8	90.7	93.8
94.7	94.1	95	94.2	94.9	93.9	97	90.6	93.6
95.4	94.5	95.4	95.2	96.9	94.5	97.8	91.2	93.6
96.4	95	95.8	96.3	98.9	95.4	99.3	92.5	96
97.9	95.6	96.1	97.8	100.1	96.9	101.3	93.4	96.8

Shenyang	Taiyuan	Urumqi	Wuhan	Wuxi	Xian	Xiamen	Zhengzhou	HongKong
CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	CH HSE PRI	HK PROP. F
CHHPCRSYI	CHHPCRTY	CHHPCRUR	CHHPCRWI	CHHPCRWI	CHHPCRXIF	CHHPCRXM	CHHPCRZZI	HKPRPALLF
ShY	TY	UrM	WH	WX	XiA	XiM	ZZ	HK
105.7	112.9	100.3	108.5	108.6	104.9	103.8	108	123.9
107.9	106.5	100.7	106.3	108.5	104	103.5	107.7	121.0
106.1	105.8	121.1	107.8	107.6	107.2	107.9	106.5	116.2
106.4	105.6	118.5	109.2	106.4	109.1	107	106.2	109.2
105.9	105.7	100.3	104.1	106.1	104.4	106.6	104.8	107.0
106.2	104.3	97.3	104.2	105.6	104.1	104.7	105.2	108.2
105.5	98.2	99.8	103.3	105.6	103.6	105.8	105.5	106.0
106.9	103	100.3	104	103.4	103.7	104.7	105.9	101.9
106.9	104.4	100.2	103.4	104.7	103.8	106.7	104.9	97.9
106.2	103.4	100.1	104.5	103.8	103.1	106.3	104.8	97.9
106.65	103.9	100.4	103.25	103.55	103.55	108.7	104.3	98.6
107.1	104.4	100.7	102	103.3	104	111.1	103.8	99.4
106.8	104.7	101.3	103.4	104.2	104.1	107.3	104.1	99.0
106.3	104	101.4	103.1	103.8	103.9	111.4	104.6	99.0
106.5	106.7	101.9	104.1	105	103.7	111.4	104.3	99.3
109	106.4	102.1	103	103.4	104.1	110.5	105.1	101.4
107.2	106.3	101.4	103.6	102.5	104.2	109.6	104.7	105.1
107.5	105	103	104.3	103.5	104.8	109.1	104.8	104.1
106.9	103.9	103	104.7	103.6	104.6	108.3	105.7	104.8
108.6	104.9	102.3	103.4	103.3	105.5	108	105.1	106.0
105.9	104.2	101.1	105.1	103.8	105.1	107.7	106.5	105.7
106	104.7	103.5	105.3	105.5	105.8	106.5	106.7	105.7
105.4	103.9	103.2	105.4	104.4	105.9	106.4	105.5	106.9
105.7	104	106.4	105.8	103.8	106.2	106.6	105.2	110.1
105.2	104.7	112	105.6	104.5	105.8	106.4	105.3	111.9
105.4	105.5	115.5	106.9	103.9	106.5	107.1	105.9	111.8
106.1	105.8	121.1	107.8	107.6	107.2	107.9	106.5	112.9
106.4	105.6	118.5	109.2	106.4	109.1	107	106.2	116.5
108.5	105.7	121.1	109	108.5	114.3	107.7	105.7	121.8
109.4	104.2	125.3	109.8	107.9	110.1	107.9	104.8	125.7
110.2	104.8	125	110.2	109.4	112.3	107	105.9	129.4
108.1	104.7	124.2	109.5	109.2	112.8	106.2	105.6	129.9
107.6	104.8	125.3	108.9	109	112.9	106	104.4	129.1
106.3	105.3	122	108.3	108.8	112.1	105.8	104.3	126.3
105.3	105.3	122.8	107.9	108	111.6	105.2	104.3	125.8
103.8	106.2	120.2	106.7	106.9	110.7	104.9	104.1	124.6
103.1	106.6	115.8	106.1	105.8	109.8	104.5	103.4	121.5
102.1	106.2	111.2	104.7	104.9	109.2	103.6	103.3	118.2
102.2	105.7	108.9	103.4	103.1	107.2	101.8	102.8	115.8
100.2	105.7	107.3	102.7	102.3	104.3	99.6	102.1	105.3
100	104.7	106.8	101.1	101.3	100	96.2	102.1	92.6
101.1	103.7	105.3	99.8	100.5	104	95.6	101.7	88.9
101.8	103.2	104.1	98.1	99	101	94.4	101.5	86.9
102.7	103.2	104.3	97.9	98.9	99.3	94.6	101.3	85.9
103	102.8	102.2	97.7	98.7	98.3	94.6	101	86.4
102.7	101.9	102.4	97.4	99	98	94.7	100.7	90.9
102.9	101.5	101.5	97.6	99.2	97.1	96	100.7	92.3
102.9	100.9	102	97.9	100.1	97.4	97.1	100.8	95.7

102.5	100.4	101.5	98.1	100.7	97.6	98.8	101.3	99.4
102.7	100.9	101.6	98.6	101.2	98.2	100	101.9	103.7
101.9	100.7	101.7	98.8	101.6	99.8	100.6	102.3	106.6
102.1	100.9	102.7	99.1	102.7	102.3	102.5	102.6	115.2
102.6	100.9	104.4	101.1	104.6	103.6	105.4	102.6	126.1
102.8	102.5	104.8	102.3	106.1	105.8	107.7	103.5	128.5
102.8	102.7	106.3	103.6	107.2	110.2	109.6	104.7	129.1
101.7	102.8	106.9	104.6	107.6	111.4	109.9	105.1	130.5
102.8	103.2	107.4	105.8	107.7	113.1	110	105.9	131.3
104.2	103.9	108	107.5	107.9	114.5	110.3	107.5	129.3
105.5	104.4	108	108.4	107.4	115.4	108.6	108.3	124.9
106.1	104.1	107.6	108.4	107	115.2	106.9	108.9	121.3
106.7	103.8	107.7	108.2	105.9	115	105.3	109	121.9
107.1	103.1	107.9	107.7	105.8	114.5	104.2	108.4	121.6
107.5	103	108.3	107.7	105.5	114.2	104.4	108.5	120.2
109	102.9	108.3	107.6	104.9	112.2	103.9	109.1	121.6
108.8	102.9	108.7	107.3	103.6	110.7	104.7	109.5	123.7
109.2	101.7	108.4	106.4	103	108.1	102.9	108.8	121.0
108.8	102.1	109.2	107.1	103.4	105.6	105	109.3	122.6
108.6	101.6	109.7	106.4	102.9	105.8	106.4	110.3	125.4
107.7	101.6	110.1	105.5	103.3	104.9	106.6	106.7	125.2
107.3	101.3	109.3	104.3	103.1	103.8	106.4	107.7	125.0
106.6	101.1	109.1	103.1	102.4	103.5	106.4	106.8	127.5
106.4	101.1	109.2	103.2	102.4	103.8	106.5	106.4	128.0
106.2	101.2	108.9	103.3	102.6	104	106.5	105.7	122.6
106	101.2	108.8	103.8	102.4	103.6	106.5	106	119.1
105.4	101.4	108.5	103.7	102.1	103.3	105.7	105.6	118.9
103.9	101.3	107.5	103.2	101.6	103.3	105.7	104.7	114.4
103	101.2	105.5	102.8	100.9	103.1	103.5	103.8	111.2
102.4	101.2	105.5	102.3	100.5	103.4	103.2	103.2	111.1
101.9	100.9	103.8	101.2	99.5	102.2	101.6	101.6	106.1
101.7	101.4	102.7	100.5	99.5	101.6	100	100.1	104.2
101	101	101.9	100	98.5	100.5	99.5	100.1	107.1
100.3	100.8	101.6	99.5	98	99.9	99	99.5	108.3
99.6	100.3	101.1	99.2	98.5	99.8	98.7	99.3	109.3
99.2	100.1	100.8	99.1	98.5	99.9	98.9	99	109.0
99	99.9	100.9	99	98.9	99.7	99.3	99.3	111.1
98.6	100.1	100.9	98.9	99.5	100.1	99.4	99.3	114.3
98.6	100	101	98.8	99.5	100.1	99.4	99.2	117.3
98.3	100	101.4	99.2	99.7	100.3	99.5	99.4	122.1
99.3	100.3	102	99.8	100.2	100.5	99.9	99.9	124.1
99.7	101	102.3	100.8	100.2	100.8	100.7	100.8	125.7
101.3	101.3	103.5	102	100.4	101.4	102.3	102.5	129.3
102.9	102.4	105	103.5	101.1	102.4	104.1	104.2	130.6
104.2	103.2	106.1	104.7	102.7	103.8	106.5	106.3	124.8
106.4	104.5	107.3	105.8	103.2	104.7	108.4	108	120.6
108.5	106.8	108.1	106.9	103.7	105.8	110	109.1	118.5
109.4	107.9	107.9	107.6	103.8	106.6	111.6	110.1	118.6
110.5	108.8	108.2	108.5	103.7	107.7	113.6	111.7	118.9
111.5	109.6	109	109.4	103.4	108.3	114.6	112.3	116.8
112.6	110.8	110	110	103.9	108.8	116.1	112.4	112.7
113.2	112	110.2	110.7	104.5	109.3	116.5	112.2	109.7

113.1	112.1	110	110.8	104.8	109.5	116.7	112.1	108.5
113.1	111.7	110.7	110.4	105.1	109.8	116.5	111.7	107.7
111.8	112.2	109.6	109.7	105.5	109.6	116	110.9	105.2
110.7	111.4	108.5	108.8	105	109.1	115	109.6	101.8
109.9	110.9	108	108.2	103.7	108.3	113.4	108.1	101.6
107.8	109.6	106.7	107.2	103	107.7	112	106.6	102.3
105.6	107.5	105.8	106.3	101.8	106.2	110.8	105.9	102.7
103.6	105.9	105.5	105	100.9	105.3	109.2	104.8	102.9
100.8	103.4	104.2	102.3	100.1	103.6	107.1	103.1	104.6
98.4	101.3	101.7	99.7	99.2	101.4	106.3	101.8	106.0
96.2	99.1	99.8	98.5	98.2	99.8	104.8	100.7	108.5
94.7	97.6	98.5	97.2	97.3	98.6	103.7	100.6	110.2
93.3	97	97.3	96.4	96.3	97.6	102.9	100.4	111.9
92.2	96.3	96	96	96	96.6	102.1	100.2	113.5
91.6	95.3	95.5	95.5	95.1	95.7	100.8	99.3	116.3
90.8	94.7	94.8	95.2	94.7	95	100	98.7	119.3
90.3	94.7	94	95	94.5	94.6	99.6	98.5	119.6
90.2	94.7	93.7	95.1	94.5	94	99.4	98.2	121.4
90.4	94.8	93.6	95.3	95.3	94.2	99.4	97.9	120.8
91.6	95.2	93.9	96	96.1	94.2	99.5	98.4	120.3
93.5	96.9	94.5	98	96.4	95	99.8	98.9	118.5
95.3	98.1	95.6	100.3	97.1	96.4	100.1	99.9	116.8

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