Understanding Price Convergence Clubs in China

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Introduction

- The paper analysis the behavior of retail prices for individual goods across cities in China to understand the degree and patterns of China's domestic market integration
  - Did Chinese cities become more integrated over time?
  - How did the national price convergence patterns change over time in different product markets?
  - Do Chinese cities form convergence clubs? If yes, how do the convergence clubs vary across goods?
  - What can explain formation of regional convergence clubs?

Literature

- Price integration in China - mixed empirical evidence
  - Young (2000); Poncet (2005); Li et al. (2003)
  - Fan and Wei (2006), Lan and Sylwester (2010), Li et al. (2018).
- Non-linearities in price convergence process
  - Dumas (1992); Sercu, Uppal, and Van Hulle (1995)
  - Phillips and Sul(2007) - log t test/convergence clubs
- Club convergence literature
  - Zhang et al. (2001); Ma and Oxley (2012)
  - Glushenkova et al (2018); Tsai (2018); Maynou et al (2021)

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Contribution

- We employ a panel of disaggregate data for a large number of goods at the monthly frequency.
- We find that China has become more integrated over time, but there is a lower pace of convergence after 2008.
- The cities form various regional convergence clubs and their formation varies significantly across goods.
- The formation of the convergence clubs is determined by a variety of factors pertaining to the traded and non-traded components used in the production of goods.

Data

- Monthly retail prices collected by the China Price Information Centre (CPIC) for the period 1997.1-2018.12
  - average prices across stores;
  - use 36 major cities as they have the most complete time series;
  - remove cities with fewer than 100 observations, and commodities available in less than 36 cities;
  - exclude goods with erroneous price movements;
  - eliminate prices that are at least five times bigger or smaller than the cross-city median price for that item in that month;
  - keep goods available in more than two-thirds of the cities;
  - keep cities available in at least three-fourth of the periods;
  - 102 items in 36 cities from 1997.11 to 2018.12

Price deviations

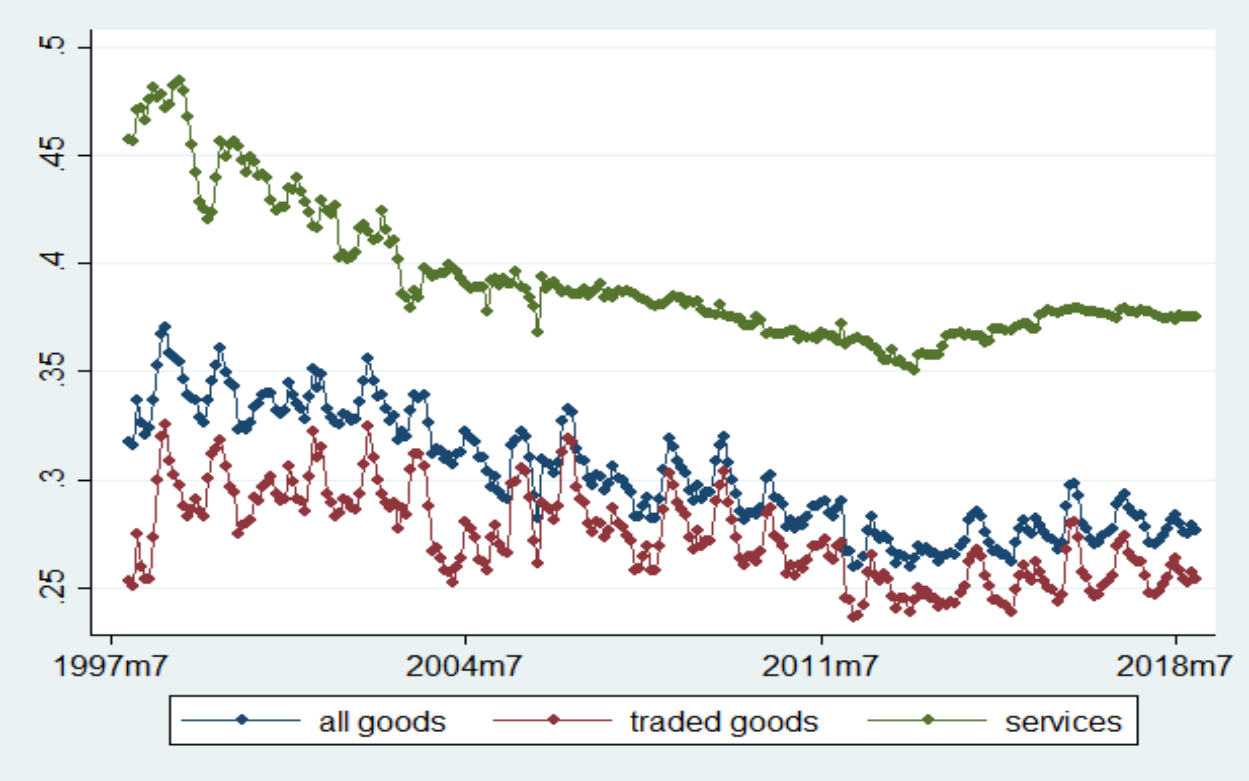


Figure: Price dispersion by type of good

A nonlinear factor model for prices

- For each good j the logarithm of prices p_{ijt} in city i at time t is described by a nonlinear factor model proposed by Philips and Sul (2007). This model takes the form

$$p_{ijt} = \delta_{ijt}\mu_{jt}.$$

μ_{jt} - good specific trend common for all locations, and δ_{ijt} transition path of good j in city i

- Phillips and Sul (2007) propose the concept of "relative" long-run equilibrium or convergence between two series. Relative price convergence for each good j means

$$p_{ijt+k}/p_{ljt+k} \to 1 \text{ as } k \to \infty \text{ for any } i \neq l$$
$$\text{or } \delta_{ijt+k} = \delta_j \text{ as } k \to \infty.$$

Convergence Test

- The relative convergence can be tested using the log t test, which is based on an auxiliary least-squares regression that involves the logarithm of time as a regressor.

$$\log\left(\frac{D_{j1}}{D_{jt}}\right) - 2\log\log t = \alpha_0 + \alpha_1 \log t + \epsilon_t,$$

- where $D_{jt} = \frac{1}{N}\sum_{i=1}^{N}(h_{ijt} - 1)^2 \to 0$ is the sample transition distance, and $h_{ijt} = p_{ijt}/N^{-1}\sum_{i=1}^{N} p_{ijt}$ is the relative transition curve for $t = [rT], [rT]+1, ..., T$ with some trimming percentage $r > 0$. We test

$$H_o : \alpha_1 \geq 0 vs H_1 : \alpha_1 < 0$$

- We can use a conventional one-sided t-test on HAC standard errors.
- The magnitude of the coefficient α_{1j} measures the convergence speed of p_{ijt}. We have growth convergence if $0 \leq \alpha_{1j} < 2$, and level convergence in log prices if $\lambda_{1j} \geq 2$.

Domestic Convergence test

Item	α	T-stat
Air conditioner 1.5 horse power	-1.56	-18.31
Apple, red Fuji	1.64	24.36
Bananas local	2.12	50.94
Beans, fresh	0.97	27.80
Beer canned, 350ml	-1.24	-88.76
Bicycle female 26	-1.07	-62.04
Bus trip (one ticket)	0.82	4.32
Cable TV (monthly fee)	0.96	22.19
Carbonated beverages, 2.5L	-0.45	-30.78
Oranges	1.62	98.34
Celery	3.63	6.27
Chicken (white, gutted)	0.08	4.45
Color TV, 25 inch	-1.46	-25.67
Commercial housing, Second-class	-1.05	-748.14
Computer, mainstream brand	-0.96	-69.12
Dish-washing liquid (500g)	-0.91	-102.57
Domestic call fee, within network	0.56	25.06
Domestic cigarette (high-end)	-2.50	-108.27
Electric hot water heater 50L	-1.04	-48.92
Electricity 220v	-0.56	-9.58
Taxi (per km)	0.43	6.17
Washing machine, top load (5kg)	-0.72	-43.68
Water usage not incl. sewage	1.96	55.43
Women's cotton sweater, YOUR SUN cotton	-3.03	-17.74
Dormitory fee for college students, 4 ppl	0.19	36.95
Imported cigarettes, 84mm	-0.88	-9.65
University tuition, teachers college	0.26	4.93

The null of convergence cannot be rejected at the 5% significance level if T-stat> -1.65.

Club Convergence procedure

1. Sort observations according to the last period of the panel;
2. Using the log t test a primary convergence club is formed against which the other cities may be compared;
3. Sieve through cities one at a time to check for possible membership of the primary convergence club using the log t;
4. Repeat steps 2 and 3 and if no further convergence clubs emerge, the remaining observations are assumed to display divergent behavior.

Regional Convergence clubs

Item	club 1	club 2	club 3	club 4	club 5	divergent group
Air conditioner 1.5 horse power	-0.638	-0.587	0.611	0.088		
Beer canned, 350ml	0.183	0.426	0.623			
Bicycle female	-0.022	0.319	2.113	5.261		
Carbonated beverages, 2.5L	-0.032	0.546	-0.305			
Color TV, 25 inch	-0.128	0.017				
Commercial housing, Second-class	0.096	0.412	-0.027			
Computer, mainstream brand	0.007	0.560	0.409	0.302		-1.635*
Cookies (100 gram/bag)	-0.022	0.032				
Digital camera (3 mln pixel, 3x zoom)	0.279	0.070	0.231			
Dish-washing liquid (500g)	0.363	-0.054	0.048			
Domestic cigarette (high-end)	0.089	0.267	1.970			-4.140*
Electric hot water heater 50L	-0.032	0.718	-0.853			
Electricity 220v	0.088	0.232	-0.120	0.997		-0.122**
Fish, carassius live (350 gram)	-0.007	0.267				-0.773*
Fresh beef tendon meat	0.018	0.607				
Fresh pork without bones	-0.010	0.565				
Gas stove	-0.015					-0.736*
Imported cigarettes, 84mm	2.411	0.627				
Laundry detergent (1kg)	-0.010	0.044				
CT plain scan of the skull	0.182	0.640	0.336			
Sewage treatment fee	-1.443	-0.280	0.464			-3.060*
University tuition, artistic college	0.617	0.320				-2.421*

*, ** refer to the significance level of 1% and 5% at which the null of convergence is rejected.

Industry level analysis

		Convergence coefficients					
Industry	national	club1	club2	club3	club 4	club 5	Diverg.
Agriculture	2.866						
Alc&Cig	-0.230*	0.09	0.09				-3.450*
Household App	-2.069*	-1.73	-0.60	0.58	0.14	-1.48	-6.722*
Perishable goods	0.640						
Non-Perishable goods	1.865						
Services	1.249						
Real Estate	-0.801*	0.23	0.03	0.70			
Daily-use chemicals	-0.999*	-0.01	0.29				

*, ** refer to the significance level of 1% and 5% at which the null of convergence is rejected.

Map for convergence clubs

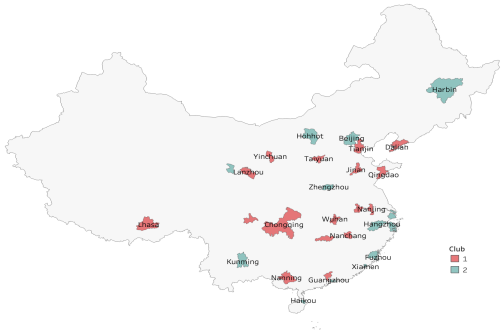


Figure: Alcohol and cigarettes

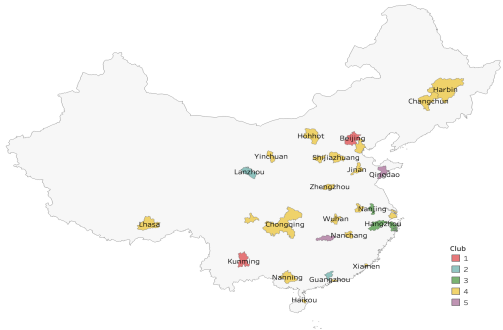


Figure: Household appliances

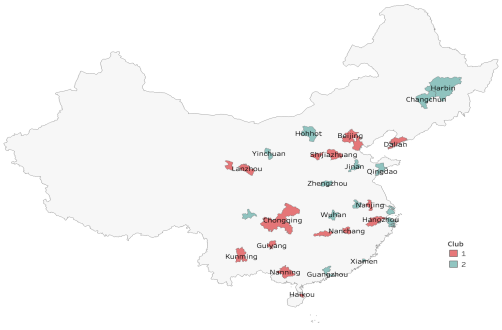


Figure: Daily-use chemical products

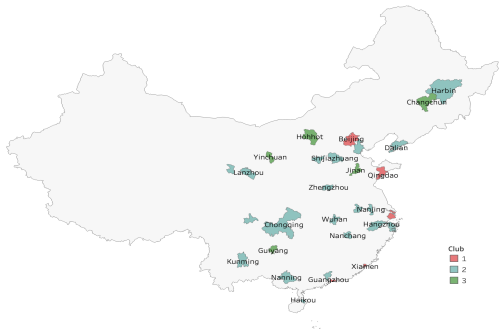
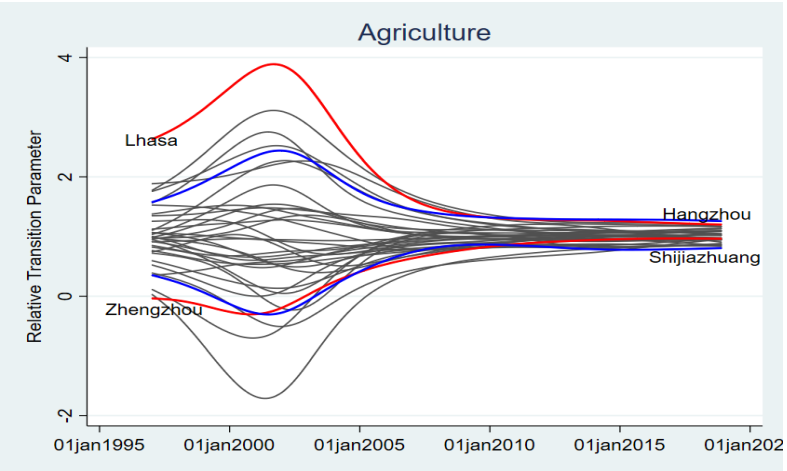
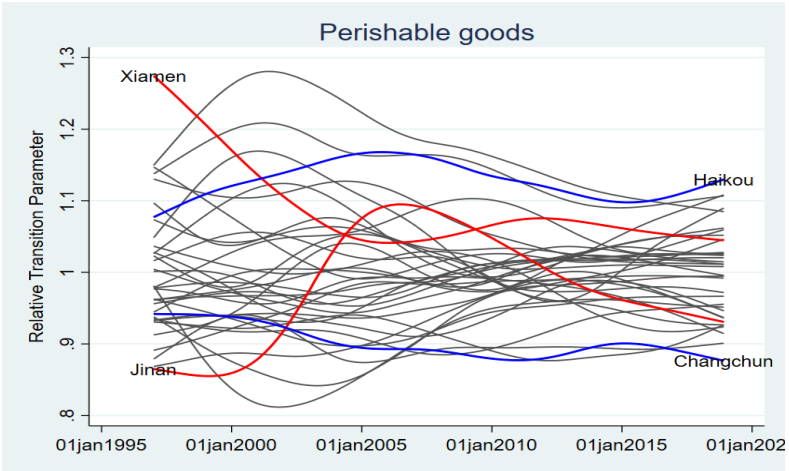
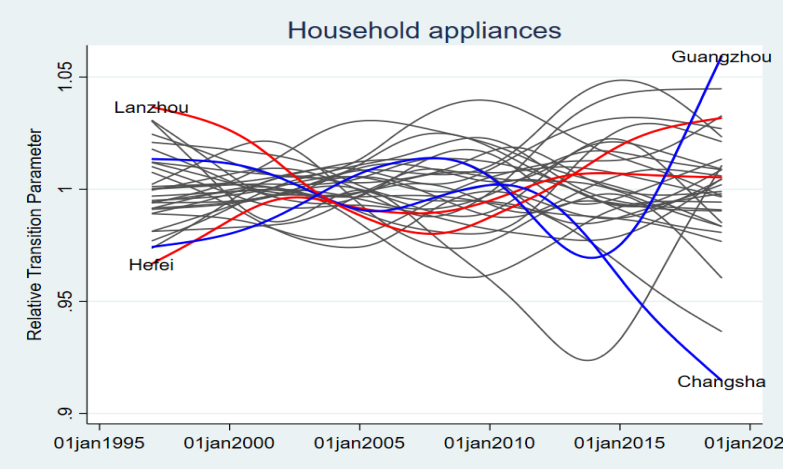


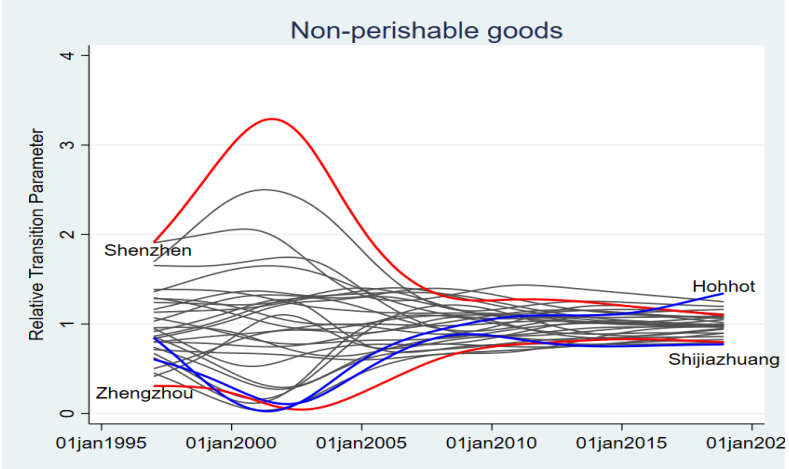
Figure: Real estate

Transition curves









Short run convergence clubs

	1997-2000		2001-2004		2005-2012		2012-2018	
Industry	α	T-stat	α	T-stat	α	T-stat	α	T-stat
Household App	0.05	3.86	-1.24	-12.68	-1.14	-41.31	-0.56	-10.29
Agriculture	-2.09	-60.14	-0.43	-43.87	0.70	33.06	-0.19	-8.77
Alc&Cig	-0.28	-29.76	-0.36	-24.62	-0.16	-8.32	-0.41	-80.48
Services	-5.00	-5.54	0.65	46.01	0.05	2.66	-0.11	-30.96
Real Estate	NA		-1.11	-156.18	-0.73	-602.92	-0.82	-709.21
Perishable goods	-1.16	-62.98	-0.68	-54.88	-0.39	-21.97	-0.93	-34.55
Non-Perishable goods	-1.79	-63.84	0.44	11.10	-0.14	-10.99	-0.13	-8.56
Daily-use chemicals	NA		NA		NA		-0.99	-140.67

Industry level analysis

- Evidence of national price convergence for agricultural products, food and services
- No national price convergence for household appliances, daily used chemicals, alcohol&cigarettes and real estate, while cities form regional price convergence clubs.
- Formation of clubs vary a lot over time and across industries.
- Next, we investigate factors that might determine formation of clubs

Explaining Formation of Clubs

- Crucini et al (2005): price differences are determined by the share and cost of the traded input used in the production of good j in location i at time t and the share and cost of the non-traded input required to produce the good.
- Tradeability

$$\gamma_{ht} = \frac{X_{ht} + M_{ht}}{Y_{ht}},$$

where X_{ht} and M_{ht} are exports and imports of industry h in China, respectively. Y_{ht} is gross output of industry h in China.

- Share of the non-traded input required to produce goods in industry h in China, α_{ht}. Constructed using Input-Output tables.

Explaining Formation of Clubs

- We investigate the factors that sort cities into price convergence clubs using multinomial logit regression.

$$log(\frac{prob(Y_{iht}=2)}{prob(Y_{iht}=1)}) = \beta_{0,2} + \beta_{1,2}\alpha_{ht} + \beta_{2,2}\gamma_{ht} + \beta_{3,2}X_{it} + \epsilon_{iht,2}$$

$$log(\frac{prob(Y_{iht}=3)}{prob(Y_{iht}=1)}) = \beta_{0,3} + \beta_{1,3}\alpha_{ht} + \beta_{2,3}\gamma_{ht} + \beta_{3,3}X_{it} + \epsilon_{iht,3}$$

- We use club 1 as the reference group and ignore clubs 4-5 as their appearance is rare.

Explaining Formation of Clubs

			Club 2		
Non-traded input	0.313	0.299	0.784	0.783	0.458
	(0.603)	(0.619)	(0.643)	(0.643)	(0.627)
Tradeability	-1.801***	-1.966***	-2.032**	-2.037**	-1.569**
	(0.670)	(0.695)	(0.727)	(0.726)	(0.707)
Distance			1.628***	1.645***	
			(0.429)	(0.388)	
Wages			0.007	-0.007	-0.052
			(0.121)	(0.121)	(0.119)
Pop.Density			-0.012		-0.270**
			(0.156)		(0.137)
Constant	0.300	0.450	-11.29**	-11.48**	2.448*
	(0.269)	(0.589)	(3.852)	(3.167)	(1.346)
			Club 3		
Non-traded input	1.846***	1.817***	2.831***	2.827***	2.432***
	(0.630)	(0.653)	(0.703)	(0.702)	(0.675)
Tradeability	-3.070***	-3.349***	-2.032**	-3.016***	-2.348**
	(0.889)	(0.923)	(0.965)	(0.963)	(0.930)
Distance			2.359***	2.299***	
			(0.524)	(0.464)	
Wages			-0.308***	-0.307***	-0.401**
			(0.163)	(0.163)	(0.159)
Pop.Density			-0.048		-0.376**
			(0.204)		(0.178)
Constant	-0.750**	-0.879	-14.98***	-14.26***	5.341***
	(0.316)	(0.789)	(4.856)	(3.865)	(1.777)
City FE		YES			
Observations	584	584	576	576	576

Conclusion

- No evidence of national price convergence for almost half of product markets, but strong evidence of regional convergence clubs. National convergence is evident for products that belong to agriculture, food, and services, while cities form regional convergence clubs for items that belong to the industries, such as household appliances, daily-use chemicals and real estate.
- Formation of price convergence clubs can be explained by the share of non-traded inputs into production, and by tradeability of goods.
  - There is higher likelihood of having more than 2 clubs for products with larger share of non-traded input.
  - The high importance of tradeability and distance implies a key role for trade costs in determining price differences between cities. Markets for less traded goods tend to be more segregated.
- Cities with high avg. wages and large market size tend to form high-price convergence clubs with higher probability than cities with low avg. wages and small market size.