Are Chinese Cities Too Small? Discussion of Au and Henderson, ReStud 2006

Nathan Schiff
Shanghai University of Finance and Economics

Graduate Urban Economics, Lecture 8
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Administration 1: Short Presentations Next Class

Presentations for next class (equal sized groups)

1) Lu, Jiangyong and Tao, Zhigang, "Trends and determinants of China's industrial agglomeration," *Journal of Urban Economics*, 2009

2) Long, Cheryl and Zhang, Xiabo, "Cluster-based industrialization in China: Financing and performance," *Journal of International Economics*, 2011

Focus on 1) method 2) identification strategy 3) results 4) flaws or weaknesses

Administration 2: Midterm

Midterm

1. Take-home exam, mostly on theory models
2. Tentatively hand out on 5/9, due 5/16
3. Cover all models and papers through 5/2, “Glaeser and Gottlieb”

Administration 3: Paper Proposal

Research proposal presentations due last day, June 6th

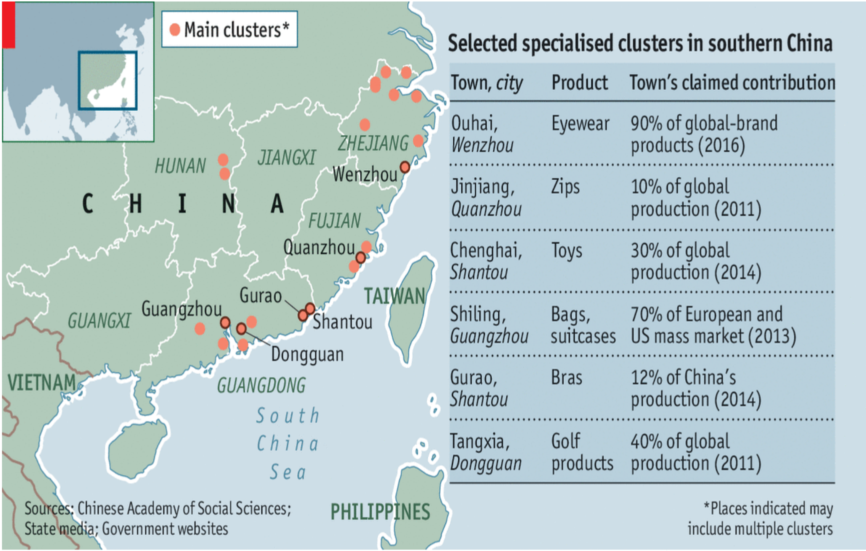
However, I have to be away; will reschedule later in week or following week

Submit outline for research idea by 5/23; best to submit earlier

I will give you written feedback on idea

“Bleak times in bra town”, *Economist* April 16th

Industrial clusters in Guangdong



Selected specialised clusters in southern China

Town, *city*	Product	Town's claimed contribution
Ouhai, *Wenzhou*	Eyewear	90% of global-brand products (2016)
Jinjiang, *Quanzhou*	Zips	10% of global production (2011)
Chenghai, *Shantou*	Toys	30% of global production (2014)
Shiling, *Guangzhou*	Bags, suitcases	70% of European and US mass market (2013)
Gurao, *Shantou*	Bras	12% of China's production (2014)
Tangxia, *Dongguan*	Golf products	40% of global production (2011)

Economist.com

Review: Equilibrium in Self-Organizing Cities

$$c_i = P^j \left(\beta^j * N_i^{\sigma^j} - \frac{\tau}{\gamma} N_i^{\gamma} \right) \tag{5.42}$$

If $\sigma^j < \tau$ utility (consumption) is concave in population

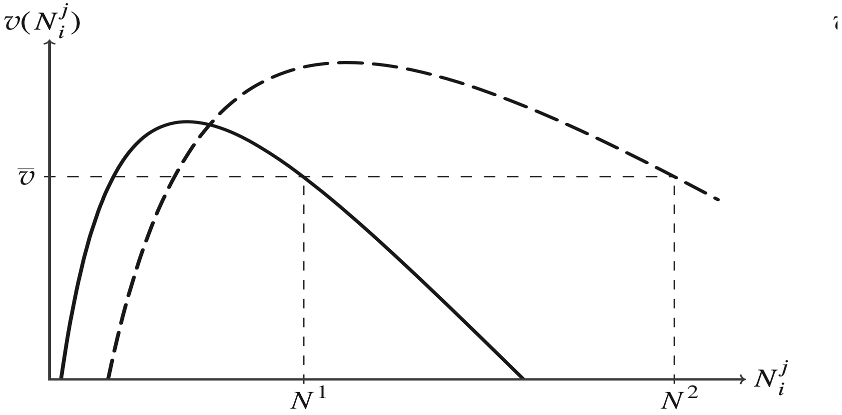
This yields the inverse U graph of utility against population

There will be an optimal city size but the stable size has too many people

$N^* = \left(\beta^j \frac{\sigma^j}{\tau} \right)^{\frac{1}{\gamma - \sigma^j}}$

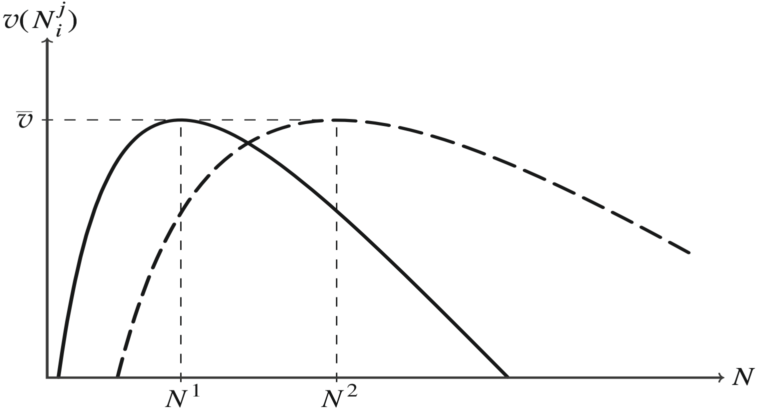
In equilibrium all cities must offer same utility but cities with different specialities can have different populations

Self-organized City Has Too Many People



Panel (a)
Self-organization

Optimal Size (see ReStud footnote 5)



Panel (b)
Land developers

Using this model

How can we use this model to calculate whether Chinese cities are too small/big?

What data do we need?

What do we estimate?

What are the challenges?

Production

Uses Cobb-Douglas production function with imbedded CES:

$$\tilde{y} = y - c_y = A(\cdot)k_y^{\alpha} l_y^{\beta} \left(\int_{s_x} x(i)^{\rho} di \right)^{\gamma/\rho} - c_y \tag{1}$$

$\alpha + \beta + \gamma = 1$, and $0 < \rho < 1$

Term c_y represents fixed cost of entry in terms of output–what is point of this?

Intermediate suppliers have usual IRS production function:

$$l_x = f_x + c_x X \tag{3}$$

Agglomeration Economies: Three Sources

First, as city *effective* labor size L increases, TFP (productivity) increases

$$A(\cdot) = AL^{\epsilon} \quad (2)$$

Microfoundations include spillovers, search, matching economies

Second, sharing economies through CES production (number varieties $s_x$increases with city size)

Can see IRS effect by rewriting production function with symmetric intermediates: $y = A(\cdot)k_y^{\alpha} l_y^{\beta}(xs_x)^{\gamma} s_x^{\gamma(1-\rho)/\rho}$

Third, home-market effect: larger home markets will minimize trade costs (iceberg)

Aggregate Demand for Final Good

Consumer utility:

$$U = \left(\int y(i)^{(\sigma_y - 1)/\sigma_y} di \right)^{\sigma_y/(\sigma_y - 1)} \quad (4)$$

From above we can derive aggregate demand (how?) as:

$$p_{y,j} = MP_j^{1/\sigma_j} (y - c_y)^{-1/\sigma_j} \quad (5)$$

$$MP_j = \sum_{\nu} \frac{E_\nu I_\nu}{\tau_{j\nu}^{\sigma_y - 1}}, \text{ where } I = \left[\sum_{u} s_{y,u} (p_{y,u} \tau_{\nu u})^{1-\sigma_y} \right]^{-1} \quad (6)$$

Market Potential

$$MP_j = \sum_{\nu} \frac{E_\nu I_\nu}{\tau_{j\nu}^{\sigma_y - 1}}, \text{ where } I = \left[\sum_u s_{y,u} (p_{y,u} \tau_{\nu u})^{1-\sigma_y} \right]^{-1} \quad (6)$$

In above equation authors incorporate demand from all locations with positive trade costs

Last class we talked about role of demand in System of Cities framework without explicitly defining

The I_ν term is a price index, takes into account trade costs

Urban Costs: Commuting

Assume commuting costs measured in time; time cost at location b is tb

Then if lot size is fixed at $h = 1$, city is circular, and population is N the radius (fringe) of city is $\pi^{-1/2}N^{1/2}$

Can define effective labor as population's total time minus time spent commuting:

$$L = N - (2/3\pi^{-1/2}t)N^{3/2} \tag{7}$$

Also try specifications allowing for congestion: commuting costs increase with city size $L = N - (2/3\pi^{-1/2}t)N^{z}$, where $z > 3/2$

Net Output per Worker

Given setup can solve for net output per worker as function of:

Parameters σ_y (consumer subst. elasticity), α (capital share), β (labor share),ϵ (labor agglomeration), γ (intermediate share), ρ (producer subst. elasticity), and A (TFP)

Costs: f_x (intermediate fixed cost), c_x (variable cost), r (cost of capital), t (time commuting cost) as part of a_0, τ (trade cost), c_y (final good fixed cost)

Maximizing this gives optimal city size N^*; note that σ is not part of equation 9

Total Value Added

Authors note that they can't estimate net output per worker because they don't have capital rents r

Instead they measure "total value-added", $p\tilde{y}s_y$:

$$VA = Q_3 MP^{1/\sigma_y} AK^{\alpha}(N - \alpha_0 N^{3/2})^{\epsilon+\beta+\gamma/\rho} \tag{10}$$

Holding constant the capital stock per worker, K/N, eq 10) is maximized at N^*

Manufacturing to Service Ratio

Value added in y sector: $p_y(y - c_y)s_y$

Value added in x sector: $p_x s_x X$

Can show that ratio of these is:

$$MS = \frac{p_y(y - c_y)s_y}{p_x s_x X} = \frac{1 - \gamma}{\gamma} \tag{A3}$$

Will use this to estimate intermediates share γ_g in different sectors

Note that they assume elasticity is constant across sectors; last class we assumed this partly explained different city sizes for different sectors

Extend Model to Multiple Cities

First expand consumer utility function to incorporate taste heterogeneity

Consumers consume g varieties of composite goods with Cobb-Douglas top level utility function

$$U = \Pi_g \left(\int y_g(i)^{(\sigma_g - 1)/\sigma_g} di \right)^{\mu_g \sigma_g (\sigma_g - 1)} \tag{4a}$$

Assume elasticities don't vary by product, $\sigma_g = \sigma_y$

Main point is just to allow different consumption weights μ_g in different cities

Empirical Specification

Make usual assumption that agglomeration occurs within sector but congestion costs are across sectors

Then every city will specialize to some degree; this specialization is solely measured in MS ratio

Authors note that in China, and other countries, bigger cities have a smaller MS ratio (more employment in services compared to manufacturing)

Use this idea to define urban hierarchy in China

Then log VA for a given city is:

$$\ln VA = \ln Q_3 + 1/\sigma_y \ln MP + \ln A + \alpha \ln K + (1 - \alpha + \epsilon) * \ln(N - \alpha_0 N^{3/2}) + \frac{1-\rho}{\rho(1+MS)} \ln(N - \alpha_0 N^{3/2}) \tag{10a}$$

Data

Data for 225 prefectural cities for 2 years: 1990 and 1997

- MS defined as ratio of VA in 2nd to VA in 3rd sector
- Value Added is basically output, GDP includes government taxes and subsidies
- Use proportion of population with high school education and cumulative foreign direct investment (FDI) divided by population as measure of TFP (A)
- To measure *MP* use GDP as measure of expenditure E_ν
- Uses measure of rail transport costs in China to back out τ
- Have no data on prices by city and so assume all prices $p_y = 1$ in price index $I_\nu =$

Identification

$$\ln VA = \ln Q_3 + 1/\sigma_y \ln MP + \ln A + \alpha \ln K$$
$$+ (1 - \alpha + \epsilon) * \ln(N - \alpha_0 N^{3/2}) + \frac{1-\rho}{\rho(1+MS)} \ln(N - \alpha_0 N^{3/2}) \tag{10a}$$

Authors argue that *all* 1997 variables could be endogenous

As instruments they use historical characteristics (1990 values), arguing that central planning in 1980's determined 1990 values and is uncorrelated with 1997 city shocks

Do you agree that these are good instruments?

Why do authors use non-linear least squares and IV?

Further identification: instrumenting for labor force

Use a migration model (from Au and Henderson, JDE 2006) to argue that amenities can predict city populations using rural populations within same municipality

Urban amenities include: library books, doctors, telephones, and roads, divided by city population

Therefore use urban amenities in 1990 plus rural municipality population in 1990 (assumed exogenous) to predict 1997 urban population

Urban Productivity Results

TABLE 2

Results for urban productivity (S.E. in parentheses)

	IV estimation structural model	Ordinary non-linear least squares structural model
a for capital	0·428** (0·0846)	0·417** (0·0442)
$(1-\alpha+\varepsilon)$	0·605** (0·182)	0·576** (0·874)
$(1-\rho)/\rho$	0·425** (0·187)	0·143* (0·0779)
$-a_0(=2/3\pi^{-1/2}t)$	−0·0347** (0·00494)	−0·00833 (0·0228)
% High-school education	0·000473 (0·00432)	0·00432 (0·00313)
FDI per worker	0·0793** (0·0272)	0·0727** (0·0166)
$1/\sigma_y$	0·650** (0·0987)	0·536** (0·0790)
E_R/σ_y	1·46 (2·91)	4·45** (2·01)
Constant	0·182 (1·13)	1·38* (0·741)
N	205	205
R^2	0·914	0·923
χ^2-test statistics from specification test (critical value)	14·8 (16·9)	

Discussion of Estimates

- High capital share in production $\alpha = 0.43$–note that this is consistent with other estimates for China
- Writing production as $y = A(\cdot)k_y^\alpha l_y^\beta (xs_x)^\gamma s_x^{\gamma(1-\rho)/\rho}$ gives $\gamma(1-\rho)/\rho$ as elasticity of number of intermediates in production (sharing agglomeration). They estimate this value at 0.18 and note it's quite high and must be an important force in explaining Chinese city size
- Estimate for matching/search agglomeration is low: $\epsilon = 0.33$
- Estimate of a_0 gives commuting costs equal to 25% of labor force–very high. These estimates actually decrease when they allow congestion to vary with city size, implying more efficiency in commuting in larger cities (surprising result)

Estimates of Optimal Population

TABLE 3

Urban agglomeration: city employment at the peak to net output per worker

MS	0·6	1·0	1·4	1·7	2·0	2·5	3·0	4·0
Peak point in thousands	1441	1174	1019	926	849	744	663	544
Lower* 95% confidence interval	977	749	552	411	283	99		
Upper 95% confidence interval	1905	1598	1486	1441	1414	1390	1376	1360

*A blank indicates a negative lower bound.

Optimal Population Calculation

Find that cities with lowest MS (most advanced) have optimal population of 1.4 million people

Does this imply that Shanghai, Beijing, Guangzhou, Chongqing, Tianjin way oversized?

Main point is that most cities are undersized: given MS they should be bigger

Discussion of Size Results

- “Enormous agglomeration economies”: moving from 100,000 to 1.27 million for MS=1 raises real output by 83%
- Agglomeration benefits are concave: increase very quickly with population at first but then level out. Moving from 635,00o to 1.27 million only increases real output by 14%
- Agglomeration benefits accumulate quickly in small cities (high MS) compared to large cities (point of Figure 1)
- Asymmetric around peak size: being too big lowers output less than being equally too small; past the peak curve declines slowly
- Large potential benefits: “What is clear is that free migration would result in large increases in city sizes and productivity gains.”

Agglomeration Benefits Estimation

TABLE 6

Agglomeration benefits (MS = 1)

	Employment in thousands										
	20	50	100	320	635	950	1270	1590	1900	2490	3000
Per cent gain in net output per worker of moving to peak size $N^* = 1270$	133	103	83	40	14	2·9	0	2·3	8·0	26	46
Current city size as a per cent of peak size	1·6	3·9	7·9	25	50	75	0	125	150	196	236

Inverted U Estimate

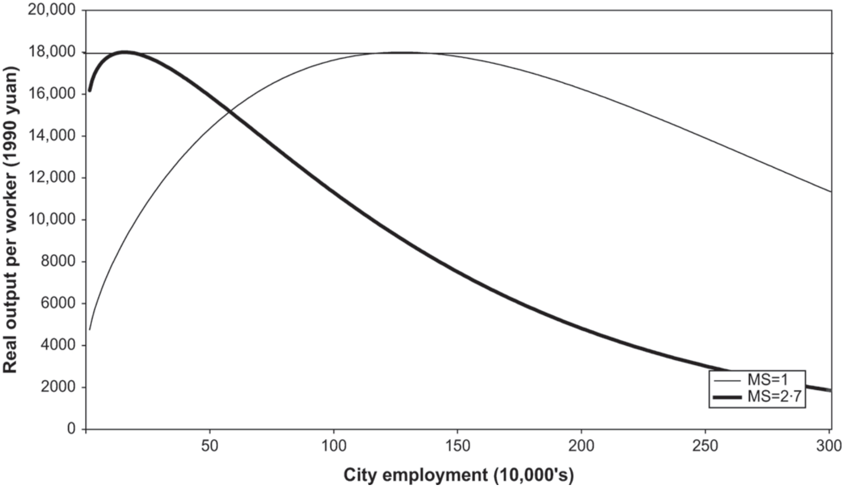


FIGURE 1

The inverted U for cities

Flexible Form Estimates

TABLE 4

Flexible functional form specifications

	IV estimation	IV estimation
	Generalized Leontief	Regular Taylor series (terms in square brackets)
$\ln(K/N)$	0·362** (0·0916)	0·363** (0·0897)
$N^{0\cdot5}\,[N]$	0·366** (0·116)	0·0102** (0·00230)
$N\ [N^2]$	−0·00805** (0·00254)	−0·0000140** (0·00000394)
$N^{0\cdot5} \times \mathrm{MS}^{0\cdot5}\,[N \times \mathrm{MS}]$	−0·184** (0·0872)	−0·00474** (0·00199)
$\mathrm{MS}^{0\cdot5}\,[\mathrm{MS}]$	0·218 (1·93)	−0·128 (0·278)
$\mathrm{MS}\,[\mathrm{MS}^2]$	0·206 (0·615)	0·0508 (0·0521)
% High-school education	0·00142 (0·00491)	0·00209 (0·00452)
FDI per worker	0·0683** (0·0286)	0·0652** (0·0291)
$\ln(\mathrm{MP}_{j,\mathrm{domestic}})$: $\{1/\sigma_y\}$	0·680** (0·117)	0·746** (0·109)
$(\mathrm{MP}_{j,\mathrm{domestic}}(Ad^{0\cdot82}_{j,\mathrm{coast}}))^{-1}$: $\{E_R/\sigma_y\}$	3·94 (3·16)	3·94 (3·28)
Constant	0·00576 (1·35)	0·593 (1·01)
N	205	205
R^2	0·550	0·530
χ^2-test statistics from specification test (critical value)	10·8 (16·9)	10·3 (16·9)

Implications for China

- From Table 4 estimates: 51% of 205 cities in sample are too small
- Depending on estimates, 1%, 6%, or 3% of cities are too *large*–Shanghai?
- Able to estimate welfare as loss net real output from being below peak
- Estimates imply large welfare losses for significant number of cities; relaxing migration barriers would lead to huge increases in real wages for rural migrants