GEOGRAPHICAL ECONOMICS "B"

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week 10

Empirics

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1 Krugman-style models and some empirical results

1.1 Results and hypotheses

Empirical evidence

- Geographical Economics – Krugman-style models – empirical facts
- BGM Chapter 5.4, 5.5, 6.2.1, Box 6.5
- Head, K., and T. Mayer (2004), The empirics of agglomeration and trade, in J. V. Henderson and J.-F. Thisse (eds.), The Handbook of Regional and Urban Economics, vol. IV, Cities and Geography, Amsterdam: North Holland, 2609–65.
- Topics for today
    1. Testable hypotheses
    2. Model and reality
    3. The impact of the shocks
- Companies - next week

Testable hypotheses

Five key results of the model

1. **The home market effect.** Regions with a large demand for increasing returns industries have a more than proportional share of their production and are net exporters of these goods.
2. A large **market potential** raises local factor prices. Regions that are close to regions with a high real income will have higher **real wages**.
3. A large **market potential** induces **factor inflows**. Footloose workers move to the region with the highest real wage, and, similarly, firms prefer locations with good market access.
4. **Non-linear reactions** to changes, shock sensitivity.
5. **Changes** (reductions) **in trade costs** determine the outcome equilibria. (i) Reduction in T (after point $B(T)$) leads to agglomeration. (ii) Reduction in T leads to agglomeration then to the spreading equilibrium.

Important readings

1. Home Market Effect (HME) - *Davis D.R. - D.E Weinstein (1999)*, Economic geography and regional production structure: an empirical investigation, European Economic Review, 43: 379–407 és *Hanson, G.H (2005)*, Market potential, increasing returns, and geographic concentration, J. of International Economics, 67: 1–24.
2. Wage equation: *Head, K., and T. Mayer (2004)*, The empirics of agglomeration and trade, in J. V. Henderson and J.-F. Thisse (eds.), The Handbook of Regional and Urban Economics
3. Shock sensitivity: *Davis-Weinstein (2002)*, Bones, bombs and breakpoints: the geography of economic activity, American Economic Review, 92: 1269–89.
4. Reduction in transport costs - in a multi-region model *Krugman, P- A.Venables (1995)* Globalization and the inequality of nations, Quarterly Journal of Economics, 110: 857–80.
5. Taxation: *Baldwin, R. E., and P. R. Krugman (2004)*, Agglomeration, integration and tax harmonization, Eur Econ Rev 48: 1–23.

Test (1): HME

- HME (Chapter 5.4)
- Comparative advantages vs increasing returns – telling apart from former models
- HME: If a country/region has a relatively high demand for a particular good, it will be a net exporter of that. What is more, an increase in demand leads to more than proportional increase in the country's production of that particular good.
- Within-industry specialization (*Krugman video*)
- *Davis D.R. - D.E Weinstein (1999)*, Economic geography and regional production structure: an empirical investigation, European Economic Review, 43: 379–407
- The unit of estimation: country r, industry n, good g

Davies-Weinstein model

- The unit of estimation: country r, industry n, good g
- $$X_{gnr} = k_{gnr} + \alpha_1 SH_{gnr} + \alpha_2 IDIODEM_{gnr} + END + err_{gnr} \quad (1)$$
- X= output of good g in industry n in country r
- SH=share of output of good g in industry n for country r in the total worldwide output of good g in industry n - key assumption
- $IDIODEM$= country-specific demand = difference between the demand for good g in country r and the demand for that good in other countries - this is the HME variable
- END= factor endowments for country r * input coefficient for good g in industry n - this catches the neoclassical consumption theory
- k – constant, err – error term

Davies-Weinstein model

- The unit of estimation: country r, industry n, good g
- $$X_{gnr} = k_{gnr} + \alpha_1 SH_{gnr} + \alpha_2 IDIODEM_{gnr} + END + err_{gnr} \quad (2)$$
- First round (1996, 1997)
  - OECD countries
  - Variables lack any geographical content!
  - Weak results
- Second round (1999)
  - Japanese regions instead of countries
  - Better but still dubious results
- Third round (2003)
  - OECD countries, but IDIODEM also includes variables relating to location: considering transport costs
  - Quite conclusive results

Test: HME – an assessment

- Weak and not very robust results
- Waste model? - assumptions matter...
- Transport costs, real geographical contents are sufficient
- ... researches go on...

Test (2): Wages and location

- BGM Chapter 5.5
- In neoclassical trade / economic growth theory there is no prediction for them
- Agglomeration - externality which allows higher wages
- Hanson (1997) - Mexico
  - Large regional inequalities (North vs South 3x)
  - Agglomeration 1: Mexico City the centre
  - Agglomeration 2: USA
  - Effect of time: NAFTA

Mexico

Test (2): Wages / Hanson / Mexico

- Wage equation (simple reduced form) – only transport costs matter
- $$\ln(W_{it}/W_{ct}) = \alpha + \alpha_1 \ln(t_{it}) + \alpha_2 \ln(tf_{it}) + err_{it} \quad (3)$$
  - W_{it} – wages in region i, W_{ct} – wages in the centre (Mexico City)
  - t_{it} – transport costs from region i to Mexico City = f(distance)
  - tf_{it} – transport costs from the US border to Mexico City = f(distance)
- Test:
  - Relative regional wages – that is, a region's wage relative to Mexico City – are lower when transport costs (the distances from Mexico City and the United States) are higher ($\alpha_1 < 0, \alpha_2 < 0$)
  - Trade liberalization has led to a compression of regional wage differentials – effect of time is not zero.

Test: Wages / Hanson / Mexico

- Hanson (1997) – Results
  - Location matters, wages are a negative function of distance
  - But: integration in the 80s/90s affects only the regions that are close to the US border.
  - 20 years of integration, larger effect

shrink=5

Test: Wages / Market potential 1

- Market potential – not only the home market, but also the neighboring locations matter (the size)
- What does it mean?
- The closer are regions with a high GDP per capita to a given region, the higher is the wage in that region
- How can we test it? – simplification – ignoring the price index – nominal market potential

Test: Wages / Market potential 2

- Nominal market potential function
  - lack of price index
  - easy to estimate
  - based on geographical economics (distance, costs)
  - but it is not directly related to any model
- Brakman et al (2005), EU regions 1992-2000
  - spatial wage structure exists
  - the strength of demand linkages is large
  - the distance decay is quite strong

Test: Wages / Hanson estimation

- Back to the equilibrium wage equation of the core model – how could we estimate it?
- *Hanson (2005)*
  - Agricultural sector is replaced by housing sector – immobile sector – it moderates the bias towards monocentric equilibria of the core model)
- Assumptions arising from the model
- (i) regional income = total income derived from labor
- (ii) payments for housing equal the share of expenditures allocated to housing (to non-industrial goods)
- (iii) real wage equality (only in the long-run equilibrium!)

Test: Wages / Hanson estimation 2

- US counties (more than 3 thousand counties), 1970-80 vs 1980-90, Data: wage rate, housing stock, distance

Structural wage equation: (5.5)	1970–80	1980–90
δ	0.962 (0.015)	0.956 (0.013)
ε	7.597 (1.250)	6.562 (0.838)
Log(T)	1.970 (0.328)	3.219 (0.416)
Adjusted R^2	0.256	0.347
Observations	3,075	3,075
$\varepsilon/(\varepsilon-1)$	1.152	1.180
ρ	0.868	0.847

Notes: Standard errors in brackets. ε = substitution elasticity, δ = share of income spent on manufactures, T = transport costs. $\varepsilon/(\varepsilon-1)$ = mark-up; $\varepsilon = 1/(1-\rho)$.
Source: Hanson (2005: tab. 3).

Test: Wages / Hanson estimation 2a

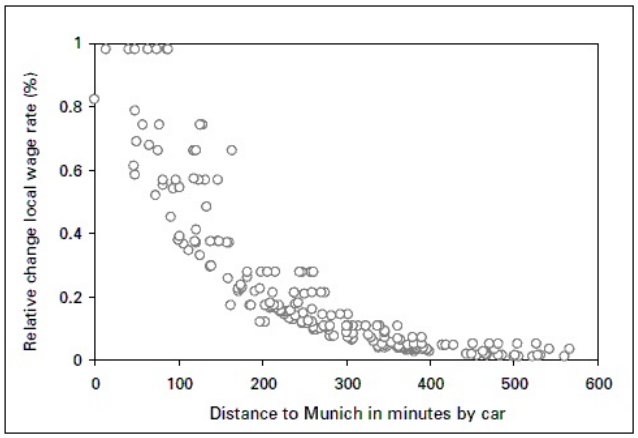
- US counties (more than 3 thousand counties), 1970-80 vs 1980-90, Data: wage rate, housing stock, distance
- Three structural parameters of the model: δ, ϵ, T all of them are significant
- T increased – advantages of agglomeration rose
- ϵ decreased – monopolistic power of the firms / the mark-up rose
- *The no-black-hole condition and the Hanson results*

Test: Wages / Hanson estimation 3

- According to the above estimation, the value for the coefficient T is high, that is changes in the market potential affect wages only within 200 km.
- Estimation with nominal market potential with the same dataset - 400-600km
- ...on the whole, the advantages of having rich neighbor regions are limited
- There are a number of objections that can be raised *(see BGM Chapter 5.5.4)*

Test: Wages / Market potential – distance

- Germany , 10% GDP increase in Munich
- 0.8% wage increase in Munich, in the surroundings - 0.8-0.1% , 2-300km - 0.2%, more than 400km 0



1.2 The Krugman model and reality

Model, transportation costs and reality

- Recall that the fall in transportation costs determine the distribution of manufacturing activity in many ways. Several formations can be obtained ...
- Depending on the model, e.g.:
  - Similarity of the regions
  - Degree of labor force mobility (between sectors/regions)
  - Economies of scale in agriculture
  - Vertical linkages
  - Parameter values
  - Number of regions

The history of the world – a story

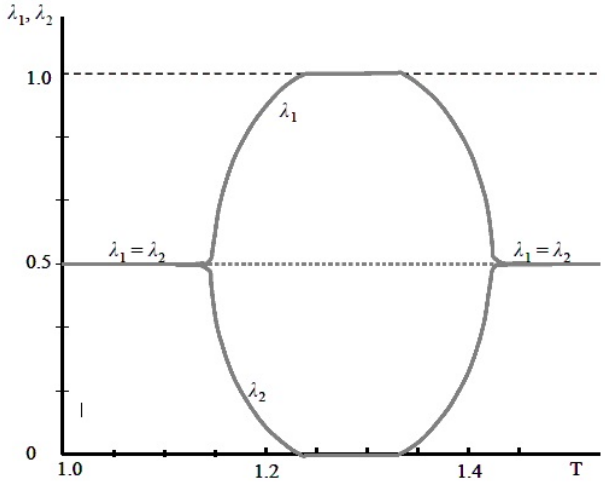
- Krugman-Venables 1995 - Textile - England and India
- The story is based on the process of gradual lowering of transport cost (sailboat, steamboat, railroad, container ship, airplane, etc.)
- Before the 19. century – transport costs were high, Indian textile industry was sufficient (larger than that of England)
- Transport costs began to fall – agglomeration in England
- Accident –> innovation
- Indian textile industry became the net importer of textiles
- 20th century - transport costs fall further
- India is quite cheap, it is worth importing to England
- Balancing ...

The bell-shaped curve

- Puga (1999) based on and generalizing the Krugman model
- Estimations – Head, K., and T. Mayer (2004), The empirics of agglomeration and trade
- How can we get data? *(see Head-Mayer 2004 Appendix)*
- ϕ : Freeness of trade, a function of transportation cost, $\phi = T^{1-\sigma}$ where:
  - (perfect isolation) $0 < \phi < 1$ (no cost)
- Put estimated/approximated model parameters (using bilateral trade and production data) in the model and it reveals the location of particular industries on the figure
  - Sticks imply the 'place' where agglomeration is expected
  - Point estimation, where we are now — France-Germany (black points) and US-Canada (triangles)

The bell-shaped curve

Puga (1999) generalized model, vertical linkages and modifications relating to the labor market Spreading equilibrium – agglomeration – spreading equilibrium

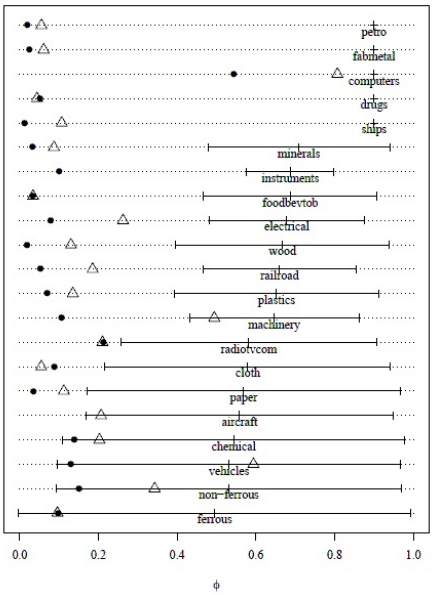


Head-Mayer (2004) data

$\mu = \delta$ (share of manufacturing industry), $\sigma = \epsilon$ (substitution parameter), α (share of intermediate inputs)

IO code	Description	μ	α	σ	$\phi_{\mathrm{fr-de}}$	$\phi_{\mathrm{us-ca}}$
3	foodbevtob	6.78%	18.52%	4.53	0.033	0.034
4	cloth	2.34%	34.66%	6.62	0.088	0.055
5	wood	0.36%	20.38%	3.64	0.019	0.13
6	paper	0.53%	36.61%	4.34	0.035	0.112
7	chemical	0.49%	42.93%	3.89	0.138	0.202
8	drugs	0.43%	7.56%	9.53	0.051	0.044
9	petro	0.72%	6.77%	5.01	0.019	0.055
10	plastics	0.26%	22.55%	5.36	0.07	0.135
11	minerals	0.1%	15.1%	2.65	0.032	0.087
12	ferrous	0.00%	58.59%	2.32	0.098	0.095
13	non-ferrous	0.04%	49.19%	6.66	0.15	0.343
14	fabmetal	0.49%	7.49%	4.85	0.024	0.061
15	machinery	3.83%	22.61%	7.87	0.106	0.494
16	computers	1.5%	19.38%	11.02	0.543	0.807
17	electrical	1.71%	19.3%	5.88	0.078	0.262
18	radiotvcom	1.89%	32.94%	9.44	0.212	0.21
19	ships	0.16%	0.12%	7.4	0.012	0.107
20	railroad	0.31%	21.01%	7.4	0.052	0.185
21	vehicles	2.67%	49.08%	7.11	0.13	0.594
22	aircraft	0.22%	39.63%	7.4	.	0.207
23	instruments	0.59%	17.8%	7.43	0.1	.

The bell-shaped curve



The bell-shaped curve – results

- What can we learn from the figure?
- The model with large enough T (or small enough ϕ) imply agglomeration, that leads to $T \simeq 1$ in most industries.
- In most cases the transport costs are large – no agglomeration

- US Canada smaller estimated costs
- Machinery, aircraft, vehicle – US-Canada already agglomeration

Estimation – Reality 1

- The results depend on the manipulation of the data, the function forms to be used, e.g.
  - Unit of observation
  - Deflation
  - Control variables
  - Econometrics (logs, OLS, panel, dif-in-dif, non-linear terms, etc.)
  - The specification of transport costs

Estimation – Reality 2

- The specification of trade costs (box 9.4)

Study and sample	Trade cost function
Direct estimation method	
Hanson (2005); US counties	$T_{ij} = \exp(\tau D_{ij})$
Brakman, Garretsen, and Schramm (2004a); German regions	$T_{ij} = \tau^{D_{ij}}$
Brakman, Garretsen, and Schramm (2006); EU regions	$T_{ij} = \tau D_{ij}^{\delta}$
Mion (2004); Italian regions	$T_{ij} = \exp(\tau D_{ij})$
Indirect estimation method	
Redding & Venables (2004); various countries	$T_{ij} = D_{ij}^{\delta} \exp(\alpha B_{ij})$ or $T_{ij} = D_{ij}^{\delta} \exp(\alpha B_{ij}) \exp(\beta_1 isl_i + \beta_2 isl_j + \beta_3 llock_i + \beta_4 llock_j + \beta_5 open_i + \beta_6 open_j)$
Knaap (2006); US states	$T_{ij} = D_{ij}^{\delta} \exp(\alpha B_{ij})$
Breinlich (2006); EU regions	$T_{ij} = D_{ij}^{\delta} \exp\left(\alpha_1 L_{ij} + \sum \alpha_2 B_{ij}^{k}\right)$
Hering and Poncet (2006); Chinese cities	$T_{ij} = D_{ij}^{\delta} \exp(\alpha_1 B_{ij}^{f} + \alpha_2 B_{ij}^{C} + \alpha_3 B_{ij}^{fC})$

Estimation – Reality 3

- The specification of trade costs (box 9.4) D=
  - distance between the two capitals, geographical centers
  - travel time
  - average distance between the two areas
  - + border dummy
- Functional form – type of relationship: linear, log
- Gravity
- Results can differ

1.3 Shock sensitivity

Shock sensitivity

- BGM Chapter 6.2.1
- Source 1 – The impact of shocks on the size of the city/region
  - Urban economics (von Thünen) – there is an optimal size, mean reversion
  - Geographical economics (Krugman) – increasing return to scale + externalities, agglomeration forces – a shock can lead to a new equilibrium
- Source 2 – Multiple equilibria – some of them are unstable. How can we find such an equilibrium?
- Ideal natural experiment – the economy under consideration (in the state of equilibrium) is hit by a (i) large, (ii) temporary, and (iii) exogenous shock
  - How can we find such a situation?

Shock sensitivity: Davis-Weinstein, 2002

- The case of the Allied bombing of Japanese cities during WWII
- Possible reactions:
  - Fundamental geography – exogenous and fixed characteristics such as access to waterways, the climate, mountains, and other fixed endowments determine city growth.
  - Increasing Returns – The WWII shock can have a permanent effect if the shock is large enough – new equilibrium
  - Random Growth – the evolution of city sizes follows a random walk, and a shock must have a permanent effect
- Question: did individual cities return to their initial, pre-war growth path (equilibrium) after the war?
  - If not: Krugman is right
  - If they did: either Krugman is right and the equilibrium was stable OR Krugman is wrong

Shock sensitivity: Davis-Weinstein, 2002

- Test: had the impact of WWII on city growth vanished by the mid-1960s?
- For Japan: fully recovered from the WWII shock and returned to their pre-war growth path
- Germany (similar model)
  - West-Germany - partial recovery
  - East-Germany - no recovery, permanent effect
- see *BGM Chapter 6.2.1*
- Additional question: How many equilibria are there? (this is a topic of another paper, for those interested see Chapter 6.2.2.)