GEOGRAPHICAL ECONOMICS B

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B

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NEW SZÉCHENYI PLAN

ELTE Faculty of Social Sciences, Department of Economics

Geographical Economics
"B"

week 8

KRUGMAN (1991) MODEL: DYNAMICS AND SIMULATION

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Outline

1. Krugman model 2: dynamics
   - Equilibrium and simulations
   - Equilibrium
   - Results and history

Equilibrium

- Krugman (1991) model - continuation
- Dynamics, equilibrium
- BGM Chapter 4.2-4.4
- BGM Chapter 4.5 in part
- Krugman's slogan: geographical economics model =
  1. Dixit-Stiglitz core
  2. + icebergs
  3. + evolution
  4. + a computer

Equilibrium

- Very difficult, non-linear model
- How can we calculate an equilibrium for a given values of parameters?
    1. Determining the exogenous parameters
    2. and using a computer for simulations. . .

The model

- The model equations can be simplified by well defined parameter values and some normalization
- How should we choose the values of parameters for the simulation?
  - Empirical observations
  - Round numbers
  - Usefulness...

Now:

- Distribution of economic activity: $\lambda_1 + \lambda_2 = 1$
- The share of labor force is equivalent in the two regions: $\phi_1 = \phi_2 = 0.5$
- Transportation cost: $T = 1.7$

Procedure

- Sequential iteration
  - Definition: $W_{1,5}$:= "the value of W_1 after the fifth iteration ($_{it}$)"
  - Guess an initial solution for the wage rate in the two regions ($W_{1,0} = W_{2,0} = 1$), where 0 indicates the number of iterations
  - Calculate the income levels ($Y_{1,0}$ $Y_{2,0}$) and price indices ($I_{1,0}$ $I_{2,0}$)
  - Substitute and determine a new possible solution for the wage rates ($W_{1,1}$, $W_{2,1}$)
- Repeat these steps until a solution is found: when W barely changes
- $(W_{r,it} - W_{r,it-1})/W_{r,it-1} < \sigma$, for each $r = 1, 2$
- $\sigma := 0.0001$

Relative real wage

- Real wages are the incentive to move
- When we get the short-run equilibrium setting $\Rightarrow$ we can calculate the ratio w_1 / w_2
- *Figure on real wages*
    - Simulations - fix a given value of λ_1 and seek the equilibrium values of variables to this
    - Execute this program several times, varying λ_1 between zero and one
    - Plotting the relative real wage in region 1 against the value of λ_1
- Equilibrium, if
    - $w_1 / w_2 = 1$ and $0 < \lambda_1 < 1$ or
    - complete agglomeration ($\lambda_1 = 1$ or 0)

Figure on the relative real wage

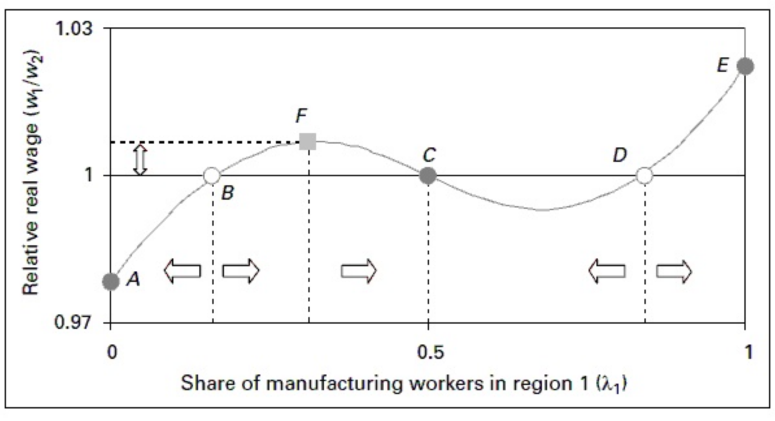


Figure on the relative real wage (2)

- There are three types of equilibrium
  - A, E – *complete agglomeration* of manufacturing production
  - C – *spreading* of manufacturing production over the two regions
  - B, D – manufacturing production is *partially agglomerated*
- Total of five long-run equilibria
  - 3 equilibria – 'finding' them analytically (guessing) (A,E,C)
  - 2 equilibria – finding them with simulations (B,D)

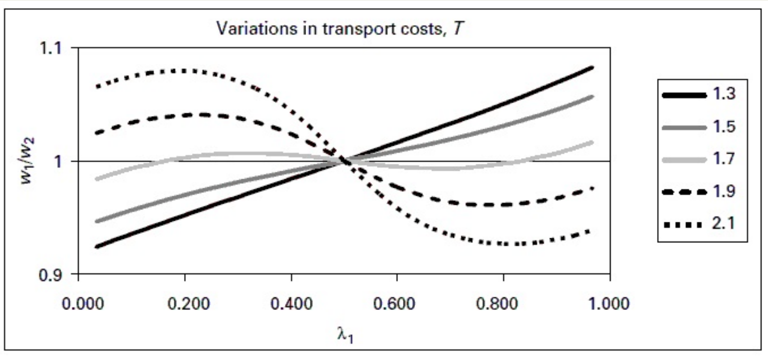
Stability

- Stability (on the basis of w_1 / w_2)
  - Suppose, e.g., that we are in point F; w_1 is greater than w_2, therefore it is worth moving to $R1$ (λ_1 increases), and get to point C.
  - It is valid for any arbitrary point between points B and C
- When the economy is located somewhere between point B and D, it reaches the spreading equilibrium sooner or later. This point is the *basin of attraction* for the spreading equilibrium.
- Similar reasonings hold for the segments between points A and B and between points D and E. They are called the *basin of attraction* for the agglomeration equilibrium.

Instability of equilibria

- There are two points (B and D), that are equilibria, but unstable.
- If the economy 'falls' exactly in these points, it will stay there (real wages are equal)
- Any arbitrarily small perturbation of this equilibrium will set in motion a process of adjustment. . .

Figure on transport costs



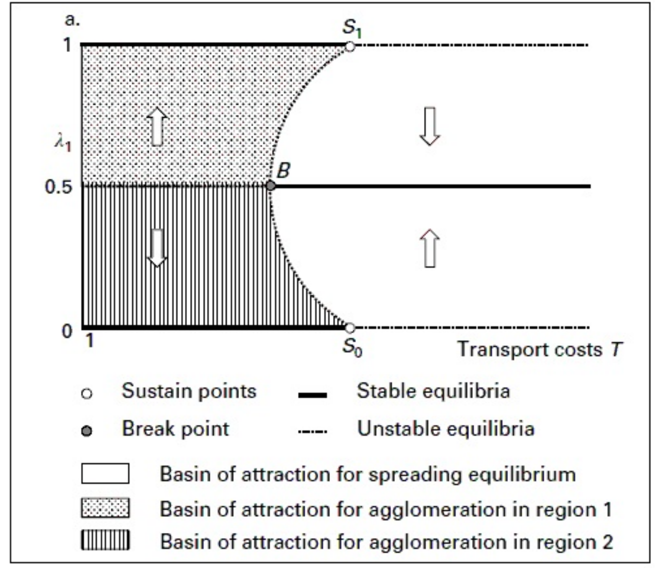
The effect of transport costs

- Recall: transport (transaction) costs are the ‘heart’ of the model
- Repeating the previous procedure for $T = \{1.3, 1.5, 1.7, 1.9, 2.1\}$
- If transport costs are large ($T = 1.9$ or $T = 2.1$), the spreading equilibrium is the globally (unique) stable equilibrium
  - When the two regions are too far away from each other, it is not worth producing in either of them and shipping to the other.
- If transport costs are smaller ($T = 1.3$ or $T = 1.5$), the agglomerating equilibria are stable
  - If the two regions are very close to each other, the one that has a production cost-advantage (lower wage), will be the ‘winner’ (complete agglomeration).
  - The spreading equilibrium exists but unstable!
- $T = 1.7$ - there exist more equilibria. How special is this settings?
  - Not so frequent, but it always exists such T

The effect of changes in transport costs

- Put the equilibrium distribution of mobile workforce λ on the vertical axis and transport costs T along the horizontal axis
- S — sustain point - until which complete agglomerations are equilibria
- B — break point - from which the spreading is equilibrium
- The segment between points B and S may be arbitrarily small or even a point.
- –>The tomahawk diagram

The ‘tomahawk’ diagram (a)



Results

- It can be shown that to prove to be a point (point B on the figure) where the symmetric equilibrium breaks up, a particular condition of parameter values is necessary.
- This condition: $\rho > \delta$ (“no-black-hole” condition) – if this condition is not fulfilled the forces working toward agglomeration would always prevail (independently from transport costs), and the economy would tend to collapse into a point.

Theorem

Suppose the “no-black-hole” condition ($\rho > \delta$) holds in a symmetric two-region setting of the Krugman model, then (i) complete agglomeration of manufacturing activity is not sustainable for sufficiently large transport costs T, and (ii) spreading is a stable equilibrium for sufficiently large transport costs T.

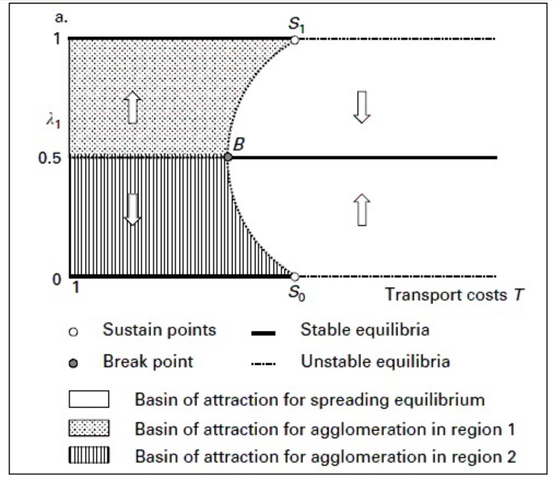
History matters! (1)

An important implication of the model

- Case A: Transport costs are large, e.g., $T = 2.5$, and the spreading equilibrium is stable
  - Suppose that transport costs start to fall, $T = 1.7$ - as B(T)=1.63, the spreading equilibrium remains stable
- Case B: Transport costs are large, e.g., $T = 1.3$, then agglomeration equilibrium is established in one of the two regions
  - Suppose that transport costs start to rise, $T = 1.7$ - as S(T)=1.81, "nothing happens." Agglomeration of manufacturing activity remains a stable equilibrium
- That is, in the case of $T = 1.7$, the outcome equilibrium depends on history.
- = "**Evolution**"

History matters! (2)

- Go back to the ‘tomahawk’ diagram. Suppose that transport costs are large and we begin to reduce them (e.g. technological progress).



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History matters! (2a)

- Go back to the 'tomahawk' diagram. Suppose that transport costs are large and we begin to reduce them (e.g. technological progress).
  - Until a particular point there is symmetry, then the economy sharply renders to agglomeration
- Which of the regions?
- The one to which the first migrant decides to move or the outcome is solely the result of a historical accident
- Non-linear relationship!
  - Due to a small step the economy suddenly reaches one of the agglomeration equilibria
  - T falls – until a particular point nothing happens
  - T falls further – sudden powerful change