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11.481J / 1.284J / ESD.192J Analyzing and Accounting for Regional Economic Growth  
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# **INNOVATION, INVENTION, AND DISPERSION**

INVENTION, creating the idea behind a change in the production process

INNOVATION, implementing that idea in the market environment for the first time

DIFFUSION, the spread of implementation to sites beyond the original one.

Distinctions drawn by Schumpeter, as indicated by Anne P. Carter in Chapter 2 of *The Economic Geography of Innovation*.

# INNOVATION MEASURES

Geographic concentration indicators, without spillover effects

Geographic concentration indices, with spillover effects

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Geographic concentration indicators, without spillover effects

$$LQ = (E_{ig} / E_{in}) / (E_{og}/E_{on})$$

LQ is location quotient

*E<sub>ig</sub>* employment in sector i in region g

*E<sub>og</sub>* is total employment in region g

*E<sub>in</sub>* is national employment in sector i

*E<sub>on</sub>* is total national employment

# INNOVATION MEASURES

Geographic concentration indicators, without spillover effects

$$\text{HCLQ} = E_{ig} - \hat{E}_{ig}$$

$E_{ig}$  is actual employment of sector  $i$  in region  $g$ ;

- $\hat{E}_{ig}$  is estimated employment of sector  $i$  in region  $g$  when  $LQ$  equals 1.

# INNOVATION MEASURES

Geographic concentration indicators, without spillover effects

$$LGC = \frac{\sum_{i=1}^n \sum_{j=1}^n |x_i - x_j|}{2n(n-1)\mu}$$

- $x$  are LQs in each region,
- $\mu$  is the mean of LQ of the study area, and
- $n$  is the number of regions.

# INNOVATION MEASURES

Geographic concentration indicators, without spillover effects

$$HHI = \sum_{i=1}^n (s_i - x_i)^2$$

$s$  is the industrial employment share in region  $i$   
 $x$  is the total employment share in region  $i$

# INNOVATION MEASURES

Geographic concentration indices, with spillover effects

$$\bullet \text{EGGCI} = \frac{\sum_{i=1}^n (s_i - x_i)^2 - (1 - \sum_{i=1}^n x_i^2) \sum_{j=1}^m z_j^2}{(1 - \sum_{i=1}^n x_i^2)(1 - \sum_{j=1}^m z_j^2)}$$

- $s$  and  $x$  are the same as both in HHI
- $z$  is the market share of each individual firm in region  $i$ .



# INNOVATION MEASURES

Geographic concentration indices, with spillover effects

$$\frac{\sum_s U_{ts} TP_{ts}}{\left[ \sum_s TP_{ts}^2 \right]^{1/2} \left[ \sum_s U_{ts}^2 \right]^{1/2}}$$

- $TP_{ts}$  is the total number of R&D lab workers in a city or an region,
- $U_{ts}$  is the university research,
- $GCI_t$  is the uncentered correlation of the vectors  $U_{ts}$  and  $TP_{ts}$  across cities or regions within a state.

# INNOVATION MEASURES

Geographic concentration indices, with spillover effects

$$\text{GR Ratio} = \frac{\sum_{j=1}^4 C_j}{\sum_{i=1}^n C_i}$$

- $C_j$  is the count of field trials of the top four frequently used gene constructs;
- $C_i$  is the count of field trials of each type of gene construct.