Language as Networks

Seminar XIV

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- People speak a wide variety of languages.

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- Why people speak different languages?

A model of diversity of languages

- Population of n individuals.
- Two languages, E (English) and S (Spanish).
- Initially, each individual speaks one single language. Denote with n_i the number of i language speakers.
- Each individual can learn a new language at cost $\phi > 0$. Denote with n_{ij} the number of individuals i-native which have learnt $j \neq i$ language.
- The Utility of i-native individual is given by

$$U_i = \begin{cases} \alpha(n_i + n_{ji}) & \text{if he does not learn a new language} \\ \alpha n - \phi & \text{if he learns } j \end{cases}$$

where $\alpha > 0$ is a parameter measuring the importance of communicating with others.

A model of diversity of languages

Definition

A **language acquisition equilibrium** is the pair (n_{ij}, n_{ji}) that satisfies

- given n_{ji}, i-speakers learn $j \iff \alpha n - \phi \geq \alpha(n_i + n_{ji})$
- given n_{ij}, j-speakers learn $i \iff \alpha n - \phi \geq \alpha(n_j + n_{ij})$

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which can be rewritten as

- i-speakers learn $j \iff \phi \leq \alpha(n_j + n_{ji})$
- j-speakers learn $i \iff \phi \leq \alpha(n_i + n_{ij})$

A model of diversity of languages

Proposition

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Positive network externalities when an individual learn a foreign language: when i learn j, not only increases his utility getting the ability to communicate with j, but also increases utility of j who then do not have to learn i.

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- Note that $(n_{ij}, n_{ji}) = (n_i, n_j)$ is not an equilibrium!
- Only three equilibria:

$$(n_{ij}, n_{ji}) = \{(n_i, 0); (0, n_j); (0, 0)\}$$

A model of diversity of languages

Proposition

Suppose that $n_i > n_j$. Then,

(a) *If $\phi \leq \alpha n_j$, there are two language acquisition equilibria given by $(n_{ij}, n_{ji}) = \{(n_i, 0); (0, n_j)\}$*

(b) *If $\alpha n_j < \phi \leq \alpha n_i$, there is one unique equilibrium given by $(n_{ij}, n_{ji}) = (0, n_j)$*

(c) *If $\alpha n_i < \phi$, there is one unique equilibrium given by $(n_{ij}, n_{ji}) = (0, 0)$*

Welfare Analysis

Define the utilitarian economy's social welfare function as

$$W = n_i U_i + n_j U_j$$

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Then, from the previous propositions we obtain

$$W(0,0) = \alpha n_i^2 + \alpha n_j^2$$
$$W(n_i,0) = \alpha n^2 - n_i \phi$$
$$W(0,n_j) = \alpha n^2 - n_j \phi$$
$$W(n_i,n_j) = \alpha n^2 - n \phi$$

where clearly $W(n_i, n_j) < W(n_i, 0) < W(0, n_j)$.

Welfare Analysis

Thus, no-learning is socially inferior to having all *j*-speakers learning *i* if and only if

$$W(0,0) = \alpha n_i^2 + \alpha n_j^2 \leq \alpha n^2 - n_j \phi = W(0, n_j)$$

Welfare Analysis

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which happens when

$$\frac{\phi}{2} \leq \alpha n_i$$

For sufficiently high value of n_i or low value of ϕ, the outcome $(0, n_j)$ is an equilibrium if and only if it is socially optimal. What can we say for intermediate values of ϕ?

Welfare Analysis

Proposition

When $\phi/2 < \alpha n_i < \phi$, *there exists a market failure where it is socially optimal to have all* j *speakers learning* i, *but such an outcome is not an equilibrium.*

Welfare Analysis

Proposition

When $\phi/2 < \alpha n_i < \phi$, there exists a market failure where it is socially optimal to have all j speakers learning i, but such an outcome is not an equilibrium.

This could be the condition under which a government of a country with dual (or more) languages should subsidise individuals' learning cost of a second language.

Remarks

- Some researchers argue that progress is established only in pluralistic societies since pluralism generates more competition among the different groups in a given society or among societies.
- Learning a new language may have benefits beyond the ability to communicate with more people.