Language competition

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Overview

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    - Setup
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Setup

- two periods: $t = p$ (past) and $t = n$ (now)
- two languages: 1 and 2
- number of speakers: q_1 and q_2
- language production:
  - p_1 and p_2 in period p
  - n_1 and n_2 in period n with $n = n_1 + n_2$

period p	→	period n
language *1* with production p_1		language *1* with production n_1 and population q_1
language *2* with production p_2		language *2* with production n_2 and population q_2

Language learning I

Payoff for a native speaker of language 1

$$u_1 = \begin{cases} p_1 + n_1 + (p_2 + n_2) - c, & \text{1 learns language 2} \\ p_1 + n_1 + \alpha_2 (p_2 + n_2), & \text{1 does not learn language 2} \end{cases}$$

where

- option demand
- accessibility α_2
  - a Spanish reader may partly understand Italian literary works (accessibility α between 0.6 and 0.8), while a German reader's accessibility to Italian writings is close to zero
  - a reader can approach foreign literature by way of translations (which are of poorer quality than the original)

Language learning II

- Learning language 2 is beneficial for a native speaker of language 1 if

$$c < (p_2 + n_2)(1 - \alpha_2) =: \bar{c}_2$$

- Uniform distribution of language learning costs c on $[0, C_2]$ with $C_2 > n + p_2$.
- Proportion of readers of language 1 that learn language 2 is

$$\frac{\bar{c}_2}{C_2} = \frac{(p_2 + n_2)(1 - \alpha_2)}{C_2} < 1$$

- Analogously, we have

$$\frac{\bar{c}_1}{C_1} = \frac{(p_1 + n_1)(1 - \alpha_1)}{C_1} < 1$$

Language learning III

We say that language 1 dominates language 2 with respect to language learning if the percentage of language-1 learners $\frac{\bar{c}_1}{C_1}$ is larger than the percentage of language-2 learners $\frac{\bar{c}_2}{C_2}$. This tends to hold under the following conditions:

- It is relatively easy to learn language 1 ($C_1 < C_2$).
- In the past, literary production in language 1 was relatively large ($p_1 > p_2$).
- The current literary production in language 1 is relatively large ($n_1 > n_2$).
- and ...

Language learning IV

- Accessibility for language-2 speakers to language 1 is relatively small ($\alpha_1 < \alpha_2$).
  Why? Language-learning dominance of language 1 is furthered if there are many and good translations of language-2 literature into language 1. In this case, speakers of language 1 do not have large incentives to learn language 2.
  If a country (let us say, France) wishes to make French dominant with respect to language learning, it should translate important works of foreign languages into French (or should subsidize these translations). It should not, however, further translations of French works into foreign languages. Note that the French government sponsored "Centre national du livre" (www.centrenationaldulivre.fr) subsidizes translations in both directions.

Literary production with one producer I

- One literary producer who chooses n_1 and hence $n_2 = n - n_1$.
- Readership for literary production n_1 is n_1 times

$$1 \cdot q_1 + q_2 \left(1 \cdot \frac{\bar{c}_1}{C_1} + \alpha_1 \left[1 - \frac{\bar{c}_1}{C_1} \right] \right)$$

- Overall readership is

$$\begin{aligned} R(n_1) &= n_1 \left[q_1 + q_2 \left(\frac{\bar{c}_1}{C_1} + \alpha_1 \left[1 - \frac{\bar{c}_1}{C_1} \right] \right) \right] \\ &\quad + (n - n_1) \left[q_2 + q_1 \left(\frac{\bar{c}_2}{C_2} + \alpha_2 \left[1 - \frac{\bar{c}_2}{C_2} \right] \right) \right] \end{aligned}$$

- interpretation
  - one producer knowing both languages
    - representative for a diverse set of producers
    - "benevolent dictator"
  - readership is of the option-demand type

Literary production with one producer II

Proposition:
Language 1 or language 2 become the exclusive literary language for production. In particular, language 1 tends to become the standard language if

- the population q_1 of language 1 is large (relative to the population q_2 of language 2),
- the cost C_1 of learning language 1 is small (relative to the cost C_2 of learning language 2), or
- the literary base p_1 of language 1 is large (relative to the literary base p_2 of language 2).

Literary production with one producer III

The effect of the accessibility parameters on language adoption is ambiguous. An increase in α_1 has two opposing effects.

- Disregarding language learning, we have

$$R(n_1) = n_1 \left[q_1 + q_2 \left(\frac{\bar{c}_1}{C_1} + \alpha_1 \left[1 - \frac{\bar{c}_1}{C_1} \right] \right) \right] + ...$$

  Readership of language 1 increases if accessibility to language 1 increases for non-learners of language 1. Thus, by this **direct effect**, the incentives to use language 1 as a medium of production increase with α_1.

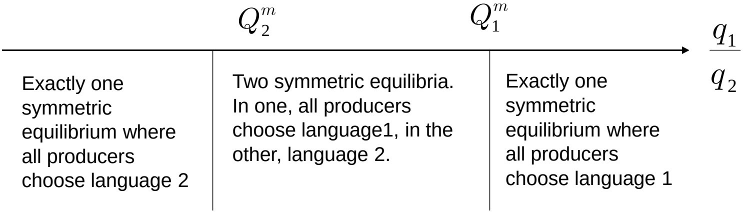
Literary production with one producer IV

- However, there is also the **indirect effect** that works through the learning decision of language-2 speakers. They are less enthusiastic about learning language 1 if language 1 is more accessible. This can be seen from the proportion of readers with mother tongue 2 who learn language 1. This language-learning effect reduces the producers' incentives to employ language 1 following an increase of α_1.

$$R(n_1) = n_1 \left[q_1 + q_2 \left(\alpha_1 + \frac{\bar{c}_1}{C_1} (1 - \alpha_1) \right) \right] + ...$$

Literary production with several producers

A snowball-effect like mechanism might occur: One producer adopts a language and therefore, that language is more attractive to language learners, so that other producers also tend to adopt it.



Non-option demand I

- Limited capacity of actual reading
- q capacity for reading in the overall population: each reader spends 10 days a year on reading
- no learning
- two producers A and B
- A decides on n_1^A and $n_2^A = n^A - n_1^A$
- two languages 1 and 2

$$R^A\left(n_1^A, n_1^B\right) = q_1 \frac{n_1^A}{n_1^A + n_1^B} + q_2 \frac{n_2^A}{n_2^A + n_2^B}$$

$$R^A + R^B = q_1 + q_2$$

Non-option demand II

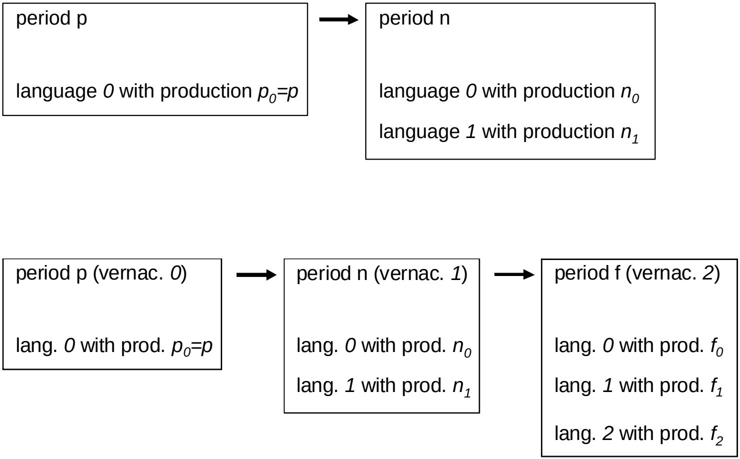
Proposition:
Unique Nash equilibrium

$$\left(n_1^A\right)^* = n^A \frac{q_1}{q_1+q_2}$$
$$\left(n_1^B\right)^* = n^B \frac{q_1}{q_1+q_2}$$

which leads to

$$\frac{\left(n_1^A\right)^* + \left(n_1^B\right)^*}{\left(n_2^A\right)^* + \left(n_2^B\right)^*} = \frac{q_1}{q_2} = \frac{\left(n_1^A\right)^*}{\left(n_2^A\right)^*} = \frac{\left(n_1^B\right)^*}{\left(n_2^B\right)^*}$$

Setup


period p
language *0* with production $p_0=p$
period n
language *0* with production n_0
language *1* with production n_1
period p (vernac. *0*)
lang. *0* with prod. $p_0=p$
period n (vernac. *1*)
lang. *0* with prod. n_0
lang. *1* with prod. n_1
period f (vernac. *2*)
lang. *0* with prod. f_0
lang. *1* with prod. f_1
lang. *2* with prod. f_2

Old-language learning with two periods

Proposition:
In the diachronic model with two time periods p (past) and n (present), the producer in period n does not use language 0 for literary production.

Old-language learning with three periods

current readership

Proposition:
In the diachronic model with three time periods p (past), n (present), and f (future), if producers aim to maximize **current readership**, only, the producers in periods n and f use only their respective vernaculars for literary production.

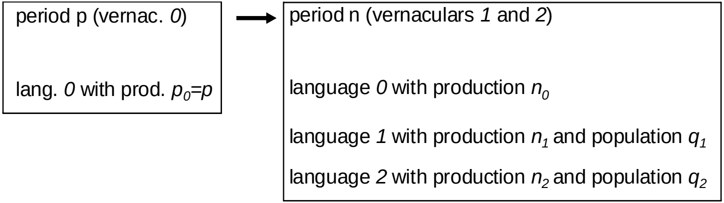
Old-language learning with three periods

long-term readership

Proposition:
In the diachronic model with three time periods p (past), n (present), and f (future), if producers aim to maximize **long-term readership**, the producer in period f uses his vernacular, only. Assume $q_n = q_f$.
We find:

- The producer in period n employs language 0 if C is sufficiently small, and language 1, otherwise.
- The chances for language 0 being used are smaller with increasing literary production ($p_0 < n$) than with decreasing literary production ($p_0 > n$).

A forking model I



A forking model II

Proposition:
In the diachronic forking model with two time periods p (past) and n (present) and no language learning, assume $\alpha < \alpha_0$ (Old French closer to Latin than to Old Spanish) and $q_2 < q_1$. Then, the producer in period n employs language 0 if

- α_0 is relatively large,
- α is small in comparison with α_0 (Old French much closer to Latin than to Old Spanish), and
- the population sizes do not differ too much.

Otherwise, he employs language 2.

A forking model III

Proposition:
If, however, we have $\alpha > \alpha_0$ (Old French closer to Old Spanish than to Latin) and, again, $q_2 < q_1$, the producer in period n employs language 0 if

- C is sufficiently small
- α is relatively large and α_0 is relatively small (Old French much closer to Old Spanish than to Latin), and
- production is decreasing ($p_0 > n$) or only mildly increasing (see article).

Otherwise, he employs language 2.