Ethnicity, Language, and Economy

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Introduction
Introduction 1

- **Ethnically heterogeneous society** is inevitably affected by the socio-economic activities of residents in it
  - Indigenous or immigrant
  - Majorities or minorities
- In a society of ethnic heterogeneity, harmonized integration of various ethnic groups of people is vital for economic success
  → This dissertation aims at providing economic analysis in the domain of ethnic heterogeneity and diversity
Introduction II

Analyses in this dissertation span the following three **spatial scales** of intra- and international socio-economic activities and phenomena

- Within a city
- Between regions within a country
- Between countries

Following two topics are featured in this dissertation

- Ethnolinguistic segregation
- Economic development and the cost of diversity in used languages

Each chapter focuses on

1. **Ethnic segregation in a city**
2. **Regional ethnolinguistic segregation and industrial agglomeration in a country**
3. **Domestic and international linguistic distance and economic development**
Chapter 1

Segregation Patterns in Cities:
Ethnic Clustering without Skill Differences
Motivation 1

- Often observed phenomenon called **segregation**
- **Segregation**: residential separation of the two or more ethnicity groups into different neighborhoods
- Examples of minorities’ residential clustering:
  - Ethnic areas such as Chinatowns
  - New York
  - Tokyo
  - Maghreb immigrants in France (Wacquant, 1993)
  - Turkish immigrants in Germany (Van Grunsven, 1992)
  - Malayans in Singapore (O’Loughlin, 1980)
Motivation II

Figure: Residential distribution by ethnicity in New York
Summary of Chapter 1

- Analysis of residential segregation by introducing the concept of ethnic clustering externality
- City containing two areas:
  - Center and suburb
- Two types of ethnic characteristics:
  - Majority and minority
  - No ethnicity bias in skill levels
- Households endogenously choose their residential locations in the long run
- Stable residential equilibria:
  - When the commuting cost is low, minority residents always cluster, widening the population gap between areas
  - Majority households migrate to a less crowded area to avoid residential congestion caused by minority clustering, thus reducing the population gap
Assumption of no ethnicity biases in skill/income levels

- Previous researches:
  - Based on segregation by the income level differences rather than that by ethnicity differences

- This chapter:
  - NOT based on ethnicity bias in terms of skill/income levels
  - Highly-educated blacks prefer to live with black neighbors of middle- or high-income class rather than to live in white neighbor of the same income levels (Bayer et al., 2014)

- Even without assumption of ethnic biases in skill/income levels, ethnic clustering occurs

- Benefits by ethnic clustering for minorities:
  - Public goods provision based on different preferences by ethnicity (Boustan, 2007)
  - Housing market (Calomiris et al., 1994; Søholt, 2001)
  - Labor market (Dietz, 1999; Munshi, 2003)

- Analyzing the segregation mechanism by introducing the concept of ethnicity preference to minorities’ utility functions
Settings (Population, ethnicity and skill levels)

- Population of the four types of households
  - $\kappa_X L_X$: high-skilled majorities
  - $(1 - \kappa_X) L_X$: low-skilled majorities
  - $\kappa_L X$: high-skilled minorities
  - $(1 - \kappa_L) L_X$: low-skilled minorities

- By normalization, $L_X = 1 > L_X$

- For simplicity, $\kappa_X = \kappa_L = 1/2$
  - Assumption of no ethnicity biases in skill levels
Settings (Geography)

- Closed city including a center and suburb
  - No migration into and out of this economy is allowed
- Center and suburb: production areas and residential areas
  - Center: differentiated good production (high-skilled labor input)
  - Suburb: homogeneous good production (low-skilled labor input)
- Population distribution:
  - $\lambda_{es}$: center-residing ratio of the households with her skill level $s$ and with her ethnic characteristic $e$
  - $1 - \lambda_{es}$: suburb-residing ratio of the households with her skill level $s$ and with her ethnic characteristic $e$
Utility function I

Utility function living in area $j$ with ethnicity characteristic $e$:

$$U_{e}^{j} = \alpha \log M + (1 - \alpha) \log A + \beta \log(H^{j}) + \gamma_{e} \log(X_{e}^{j}) \quad (1)$$

- **Area $j$:** $j = C$ or $S$
  - **C:** Center
  - **S:** Suburb
- **Ethnicity characteristic $e$:** $e = X$ or $x$
  - **X:** Majority
  - **x:** Minority
- **$M$:**
  $$M \equiv \left[ \int_{0}^{n} m(i) \frac{\sigma - 1}{\sigma} \, di \right]^{\frac{\sigma}{\sigma - 1}}, \quad \sigma > 1$$
- **$H_{j}$:** land consumption when living in area $j$
Utility function II

- $X^j_e$: share of the residents belonging to the ethnic group $e$ in area $j$
  - $X^j_e \equiv \frac{N^j_e}{N^j} = \frac{N^j_e}{\sum_{e \in \{x,x\}} N^j_e}$
  - $N^j$: total population residing in area $j$
  - $N^j_e$: population with ethnic characteristic $e$ living in area $j$

**Parameters:**

- $\alpha$: consumption share parameter ($0 < \alpha < 1$)
- $\beta$: residential parameter ($\beta > 0$) → residential congestion parameter
- $\gamma_e$: ethnic preference parameter:
  - $\gamma_e = \begin{cases} 
    \gamma > 0 & \text{if } e = x \\
    0 & \text{otherwise}
  \end{cases}$
- Minority’s preference for residential proximity to the same ethnic group
Budget constraint

- Budget constraint of the household with her skill level \( s \), living in area \( j \) and working in area \( k \):

\[
\int_{0}^{n} p(i)m(i)di + A + r^j H^j = \frac{w_s}{\tau^{jk}} + R^j
\]  

\[ (2) \]

- \( \tau^{jk} = \begin{cases} 
\tau > 1 & \text{if } j \neq k \ (\text{commuter}) \\
1 & \text{otherwise} \ (\text{non-commuter}) 
\end{cases} \]

- \( w_s \): income of the household with her skill level \( s \) \((s = h, l)\)
- Commuters incur commuting costs while non-commuters do not

- Assumption on land:
  - Total supply of land in area \( j \) is unity
  - Each household in area \( j \) owns and consumes the same amount of land
Production

- Homogeneous good sector:
  - CRS $\rightarrow w_i^* = 1$
- Differentiated good sector:
  - IRS
  - Production function to produce $q(i)$: $f + cq(i)$
  - Profit function: $\Pi(i) = [p(i) - cw_h] D(i) - f w_h$
  - Firm maximizes its profit with respect to its price
- Utility maximization of households, profit maximization of firms, zero profit conditions and market clearing conditions
  - Instantaneous equilibrium wage rate for high-skilled workers $w_h^*$
Indirect utility differentials

- Residents in this economy are allowed to migrate between areas in the long run
  - $\lambda$s are no longer treated as fixed
- Indirect utility differential of the household with her ethnicity characteristic $e$ and skill level $s$:
  $$ \Delta V_{es}(\lambda) \equiv V_{es}^C(\lambda) - V_{es}^S(\lambda) $$

- $\lambda \equiv (\lambda_{Xh}, \lambda_{Xl}, \lambda_{xh}, \lambda_{xl})$
- $\Delta V_{es}(\lambda) > 0 \Rightarrow \lambda_{es}^* = 1$ (households $es$ reside only in the center)
- $\Delta V_{es}(\lambda) < 0 \Rightarrow \lambda_{es}^* = 0$ (households $es$ reside only in the suburb)
- $\Delta V_{es}(\lambda) = 0 \Rightarrow \lambda_{es}^* \in (0, 1)$ (households $es$ reside both in the center and suburb)

- (Stable) residential equilibria are investigated by $(\Delta V_{Xh}(\lambda), \Delta V_{Xl}(\lambda), \Delta V_{xh}(\lambda), \Delta V_{xl}(\lambda))$
Residential equilibrium patterns under low commuting costs

- When the commuting cost $\tau$ is low ($1 < \tau X \equiv (1 + 2L_x)^\beta$), two types of residential equilibria emerge
  - **Pattern L$\tau$-mC: Minority clustering in the center**
    \[
    (\lambda^* = \left( \frac{2(\tau \frac{1}{\beta} - L_x)}{\tau^\frac{1}{\beta} + 1}, 0, 1, 1 \right))
    \]
  - **Pattern L$\tau$-mS: Minority clustering in the suburb**
    \[
    (\lambda^* = \left( 1, \frac{1+2L_x-\tau \frac{1}{\beta}}{\tau^\frac{1}{\beta} + 1}, 0, 0 \right))
    \]
  - Perfectly mixed in terms of skill levels
  - Imperfectly mixed (or equivalently, partially segregated) in terms of ethnic characteristics
Illustration of patterns $L_T$-mC and $L_T$-mS

Figure: Patterns of residential equilibrium in the case of low commuting costs
Residential equilibrium patterns under high commuting costs

When the commuting cost is high \( (\tau \geq \tau_X) \), three types of residential equilibria emerge:

- **Pattern \( H_\tau-mD \): Minority and majority dispersion across both areas \( (\lambda^* = (1, 0, 1, 0)) \)
  - Perfectly segregated in terms of skill levels
  - Perfectly mixed in terms of ethnic characteristics

- **Pattern \( H_\tau-mC \): Minority clustering in the center and majority dispersion \( (\lambda^* = (1, 0, 1, 1)) \)

- **Pattern \( H_\tau-mS \): Minority clustering in the suburb and majority dispersion \( (\lambda^* = (1, 0, 0, 0)) \)
  - Imperfectly segregated (or equivalently, partially mixed) in terms of skill levels
  - Imperfectly segregated (partially mixed) in terms of ethnic characteristics
Illustration of patterns $H_{\tau}$-mD, $H_{\tau}$-mC, and $H_{\tau}$-mS

**Figure**: Patterns of residential equilibrium in the case of high commuting costs
Comparison between areas (Ethnic characteristics)

- Center’s minority (majority, resp.) population share of the total minority (majority, resp.) population:

\[
\psi_e \equiv \frac{N_e^C}{\sum_{j \in \{C,S\}} N_e^j}
\]

- Calculating \(\psi_X\)s for each stable equilibrium patterns yields

\[
\Psi_X \equiv \left( \psi_X(L_\tau-mC), \psi_X(L_\tau-mS), \psi_X(H_\tau-mD), \psi_X(H_\tau-mC), \psi_X(H_\tau-mS) \right)
\]

\[
= \left( 1, 0, \frac{1}{2}, 1, 0 \right)
\]

- Calculating \(\Psi_X\)s for each stable equilibrium patterns yields

\[
\Psi_X \equiv \left( \psi_X(L_\tau-mC), \psi_X(L_\tau-mS), \psi_X(H_\tau-mD), \psi_X(H_\tau-mC), \psi_X(H_\tau-mS) \right)
\]

\[
= \left( \frac{1}{\tau^\beta} - L_x, \frac{1 + L_x}{\tau^\beta + 1}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)
\]
Illustration of the center’s share (Minority, majority)

Figure: Center’s share of the total minority/majority population
Interpretation

- Minority:
  - Ethnicity preference in minority households → more likely to cluster in one area
  - When the commuting cost is low, the minority group always clusters
  - Population gap between areas bigger
  - Unequalizer of the population sizes of the two areas

- Majority:
  - Avoiding congestion disutilities caused by minority clustering
  - When the commuting cost is low, majority households migrate to the scarcer area
  - Population gap between areas smaller
  - Equalizer of the population sizes of the two areas
Conclusion

- Segregation *without assuming ethnicity biases in skill levels* was investigated.

- Instead, *ethnic clustering preference in the minority group* was considered.

- Under sufficiently high commuting costs:
  - Minority group does not necessarily cluster in one area.
  - Minority’s dispersed residential patterns can be stable equilibria.
  - No majority households commute and suffer from residential congestion caused by minority clustering.

- Under sufficiently low commuting costs:
  - Minority group always clusters in one area.
  - Majority households can be commuters and split into both areas.
Chapter 2

Which Has Stronger Impacts on Regional Segregation: Industrial Agglomeration or Ethnolinguistic Clustering?
Motivation

▶ Examples of regional segregation can be found around the world
  ▶ Regional (or local) administrative division’s choice of official languages
  ▶ Regional segregation by daily language preferences
  ▶ Example I (Switzerland)

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<thead>
<tr>
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<td>82.9</td>
<td>82.5</td>
<td>83.4</td>
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<td></td>
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<td>1.7</td>
<td>1.5</td>
<td>1.4</td>
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<tr>
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<td>9.4</td>
<td>5.3</td>
<td>3.7</td>
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<tr>
<td></td>
<td>German</td>
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<td>11.1</td>
<td>9.8</td>
<td>8.3</td>
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<tr>
<td></td>
<td>French</td>
<td>1.7</td>
<td>1.9</td>
<td>1.9</td>
<td>1.6</td>
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Time persistent segregation

Example II (Quebec)

Charter of the French language (1977):

French is the only official language in Quebec

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</tr>
</thead>
<tbody>
<tr>
<td>Quebec</td>
<td>79.7</td>
<td>81.6</td>
<td>82.5</td>
<td>81.2</td>
<td>80.7</td>
<td>82.4</td>
<td>81.3</td>
<td>81.2</td>
<td>79.4</td>
<td>78.7</td>
</tr>
<tr>
<td>Canada</td>
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<td>21.6</td>
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</tbody>
</table>

Regional segregation by language exhibits persistence
Extent of communication difficulty between different language speakers

Example III (Catalonia, South Tyrol vs Quebec)

- Catalonia
  - Adoption of a Democratic Spanish Constitution (1978)
  - Both Catalan and Spanish are official languages in Catalonia
- South Tyrol
  - History of triple official language adoption
  - German, Italian, and Ladin were selected as local official languages

- Communication between Catalan and Spanish speakers is easier than that between francophones and anglophones in Quebec
- Communication between German and Italian speakers is easier than that between francophones and anglophones in Quebec
Extent of communication difficulty between different language speakers II

- Example III (Catalonia, South Tyrol vs Quebec, cont’d)

<table>
<thead>
<tr>
<th>Table:</th>
<th>Examples of ethnolinguistic mixing according to different language policies (different values of $\delta$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta$</td>
<td>Region (year: 2008)</td>
</tr>
<tr>
<td>Low</td>
<td>Catalonia</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>South Tyrol</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Quebec (year: 2011)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Catalan and Spanish speakers in Catalonia are more mixed than francophones and anglophones in Quebec
- German and Italian speakers in South Tyrol are more mixed than francophones and anglophones in Quebec
- Another example: Belarus and other former Soviet Union countries
Summary of Chapter 2

- How regional segregation patterns are affected by industrial agglomeration and ethnic clustering is investigated by adding the externality of ethnicity to the model of agglomeration and trade proposed by Ottaviano et al. (2002)

- Economy with two regions

- Two types of ethnic characteristics

- Two types of labor:
  - Worker (mobile in the long run)
  - Farmer (immobile in the long run)

- Workers endogenously choose their residential regions in the long run

- Stable equilibria:
  - Segregation by ethnicity is persistently in equilibrium
  - Ethnic mixing distribution appears only when trade costs are intermediate and ethnic clustering preferences are less intense
Settings (Population distribution)

- Four types of individuals:
  - Two types of ethnicity: $X, x$
  - Two types of labor:
    - Worker (mobile): $L$
    - Farmer (immobile): $A$

- Worker distribution across regions (Regions 1 and 2):
  - $\lambda_X \in [0, 1]$: share of workers with ethnicity $X$ in region 1
  - $\lambda_x \in [0, 1]$: share of workers with ethnicity $x$ in region 2

**Table: Population distribution across regions**

<table>
<thead>
<tr>
<th>Type</th>
<th>Region 1</th>
<th>Region 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer $X$ (immobile)</td>
<td>$A_X = A$</td>
<td>0</td>
</tr>
<tr>
<td>Farmer $x$ (immobile)</td>
<td>0</td>
<td>$A_x = A$</td>
</tr>
<tr>
<td>Worker $X$ (mobile)</td>
<td>$\lambda_X L_X = \lambda_X$</td>
<td>$(1 - \lambda_X)L_X = 1 - \lambda_X$</td>
</tr>
<tr>
<td>Worker $x$ (mobile)</td>
<td>$(1 - \lambda_x)L_X = 1 - \lambda_x$</td>
<td>$\lambda_x L_X = \lambda_x$</td>
</tr>
<tr>
<td>Total</td>
<td>$N_1 = A + 1 + \lambda_X - \lambda_x$</td>
<td>$N_2 = A + 1 + \lambda_x - \lambda_X$</td>
</tr>
</tbody>
</table>
### Utility function 1

\[ U_e(q_0; q(i), i \in [0, n]; N_e) = u(q_0; q(i), i \in [0, n]) + u^E(N_e) \quad (4) \]

- Utility function consists of two parts:
  - \( u(\cdot) \): subutility stemming from consumption of the differentiated good and the homogeneous good supplied in the market
  - \( u^E(\cdot) \): ethnicity clustering preference stemming from the **residential proximity to the individuals of the same ethnicity**

- Ethnicity subutility \((u^E(\cdot))\):
  - Ethnicity subutility for ethnicity \(e \in \{X, x\}\) when located in region 1:
    \[
    u^E_1(N_e) = \frac{\delta}{2} N_{e1} = \begin{cases} 
    \frac{\delta}{2}(A + \lambda x) & \text{if } e = X \\
    \frac{\delta}{2}(1 - \lambda x) & \text{if } e = x
    \end{cases}
    \]
  - \(N_e\): population of the individuals of the same ethnicity \(e\)
  - \(\delta > 0\): ethnicity preference parameter

- Similar when located in region 2
Utility function II

Subutility other than ethnic subutility ($u(\cdot)$): Following Ottaviano et al. (2002),

$$u(q_0; q(i), i \in [0, n]) = \alpha \int_0^n q(i) di - \frac{\beta}{2} \int_0^n [q(i)^2] di - \frac{\gamma}{2} \left[ \int_0^n q(i) di \right]^2 + q_0$$

- $q(i)$: quantity of product $i$
- $q_0$: quantity of the homogeneous good
- Preferences for the differentiated good and the numeraire are identical across individuals (independent of the ethnicity characteristics)
- Parameters:
  - $\alpha > 0$: intensity of preference for product
  - $\beta > 0$: consumers have preference for diversity
  - $\gamma > 0$: substitutability between varieties
Budget constraint

- Each individual is endowed with a unit of labor, inelastically supplies it (with wage $w$)
- Endowed with sufficiently large $q_0$ units of the homogeneous good

$$\int_0^n p(i)q(i)di + q_0 = w + q_0$$
Production I

▪ Production of the homogeneous good:
  ▪ One unit input of $A \rightarrow$ one unit output of $q_0$
  ▪ CRS
  ▪ Perfect competition
  ▪ Chosen as the numeraire
  ▪ Freely traded between regions
  ▪ $w_1^A = w_2^A = 1$

▪ Production of the differentiated goods:
  ▪ Any amount of the output of the differentiated good requires $\phi (= 1)$ units of $L$
    ▪ Labor market clearing
    ▪ Total mass of firms: $n = 2$
    ▪ Mass of firms in region $r$:
      \[
      n_r = \begin{cases} 
      1 + \lambda x - \lambda x & \text{if } r = 1 \\
      1 + \lambda x - \lambda x & \text{if } r = 2
      \end{cases}
      \]
  ▪ IRS
Production II

▶ Production of the differentiated goods (cont’d):
  ▶ Profits for firms in region $r$:

\[
\Pi_r = p_{rr} q_{rr} (p_{rr}) D_r + (p_{rs} - \tau) q_{rs} (p_{rs}) D_s - w_r \quad (r \neq s)
\]

▶ $\tau$: trade cost
  ▶ Profit maximization with respect to price for the market in each region

▶ Assumption on trade costs:
  ▶ Necessity of firms’ prices net of trade costs to be positive regardless of the workers’ distribution in order for prices to be meaningful

▶ $\tau < \tau_{\text{trade}} \equiv \frac{a}{b + c}$
  ▶ Zero-profit condition, instantaneous equilibrium wage $w^*_r$
Indirect utility differential I

► (Total) indirect utility of the individual with ethnicity \( e \) located in region \( r \):

\[ V_r(\lambda_X, \lambda_x; e) = \nu_r(\lambda_X, \lambda_x) + u_r^E(\lambda_e) \]

► Indirect utility differential for ethnicity \( e \):

\[ \Delta V(\lambda_X, \lambda_x; e) \equiv I(e) [V_1(\lambda_X, \lambda_x; e) - V_2(\lambda_X, \lambda_x; e)] \]

\[ = I(e) [\Delta \nu(\lambda_X, \lambda_x) + \Delta u^E(\lambda_e)] \]

► \( I(e) = \begin{cases} 1 & \text{if } e = X \\ -1 & \text{if } e = x \end{cases} \)

► Indicator \( I(e) \rightarrow \) “indirect utility located in the area one’s ethnicity is dominant” minus “that in the area the other ethnicity is dominant”
Indirect utility differential II

- Calculating $\Delta V$,

$$\Delta V_e(\lambda_X, \lambda_x) = [C^* \tau(\tau^* - \tau) + \delta] \lambda_e - C^* \tau(\tau^* - \tau) \lambda_{-e} + \frac{\delta}{2} (A - 1)$$

- $C^* \equiv \frac{b + 2c}{4(b + c)^2} [3b^2 + 2bc(3 + A) + 2c^2(1 + A)]$

- $\tau^* \equiv \frac{2a(3b + 4c)}{3b^2 + 2bc(3 + A) + 2c^2(1 + A)}$

- $\tau^*$: critical value of $tau$ at which a stable agglomeration equilibrium emerges instead of a dispersed one in the absence of ethnic clustering preference
Long-run equilibrium I

- Long-run equilibrium: workers move costlessly between regions
  - \( \lambda \)'s are no longer treated as fixed
  - Investigating whether \( \Delta V_e(\lambda_X, \lambda_x) \geq 0 \)
  - Region 1’s share of the total firms in the economy:
    \[
    \lambda \equiv \frac{n_1}{\sum_{r\in\{1,2\}} n_r} = \frac{1 + \lambda_X - \lambda_x}{2}
    \]

- Assume
  \[
  \tau^* < \tau_{\text{trade}} \tag{5}
  \]

- Implying \( A > 3 \)
  - \( A \) (immobile factor affecting \( u^E \)) is sufficiently large
- Assuming (5), there are two candidates for long-run equilibria:
  - **SD**: segregation in terms of ethnicity/dispersion in terms of industry
  - **MA**: mixing in terms of ethnicity/agglomeration in terms of industry
Long-run equilibrium II

- **SD**: segregation in terms of ethnicity/dispersion in terms of industry
  - Ethnicity \((\lambda_X^*, \lambda_x^*) = (1, 1)\): region 1 is populated by residents with ethnicity \(X\), and region 2 is occupied by residents with ethnicity \(x\)
  - Industry \((\lambda^* = 1/2)\): both regions accommodate workers

- **MA**: mixing in terms of ethnicity/agglomeration in terms of industry
  - (a) region 1 as the industrially core region:
    - Ethnicity \((\lambda_X^*, \lambda_x^*) = (1, 0)\): region 1 accommodates both \(X\) and \(x\) residents, while region 2 accommodates only \(x\) residents
    - Industry \((\lambda^* = 1)\): all workers in the economy are in region 1
  - (b) region 2 as the industrially core region:
    - Ethnicity \((\lambda_X^*, \lambda_x^*) = (0, 1)\): region 2 accommodates both \(X\) and \(x\) residents, while region 1 accommodates only \(X\) residents
    - Industry \((\lambda^* = 0)\): all workers in the economy are in region 2
Long-run equilibrium III

- Assume $\tau^* < \tau_{\text{trade}}$, so that $A > 3$
  - When ethnicity clustering is sufficiently important ($\delta > \delta^*_\text{max}$)
    - Ethnic segregation/industrial dispersion (SD) pattern is the only stable equilibrium configuration
  - When ethnicity clustering is less important ($\delta \leq \delta^*_\text{max}$)
    - Phase I ($\tau > \bar{\tau}$): When the trade cost is high, SD pattern (segregation in terms of ethnicity/dispersion in terms of industry) is the only stable equilibrium
    - Phase II ($\bar{\tau} \leq \tau \leq \bar{\tau}$): When the trade cost is intermediate, SD or MA patterns (mixing in terms of ethnicity/agglomeration in terms of industry) can be stable equilibria
    - Phase III ($\tau < \bar{\tau}$): When the trade cost is low, SD pattern is again the only stable equilibrium
Illustration

Figure: Relationship between the set of equilibria, the level of the ethnicity parameter, and trade costs

Figure: Set of stable spatial equilibria (τ changes)
Interpretation

- When $\delta > \delta_{\text{max}}$
  - Ethnicity clustering is so important that there is no chance of ethnic separation across regions

- When $\delta \leq \delta_{\text{max}}$
  - Phase I ($\tau > \bar{\tau}$; high trade cost)
    - Beneficial for firms to disperse the manufacturing sector into two regions because shipping their output is expensive
    - Due to high trade costs, industrial agglomeration does not weigh much compared with ethnicity clustering utilities
  - Phase II ($\tau \leq \tau \leq \bar{\tau}$; intermediate trade cost)
    - MA and SD pattern are in equilibrium
    - Enjoying the benefits caused by industrial agglomeration without being anxious about a sharp decrease in exports
    - Enjoying the gains of ethnicity clustering and giving up industrial agglomeration benefits
  - Phase III ($\tau < \tau$; low trade cost)
    - MA path disappears, and only the SD path remains
    - (Immobile) farmers sharing the same ethnicity play a role of dispersion force
Social optimum

- Social planner will choose \((\lambda_X, \lambda_x)\) to maximize the sum of individual indirect utilities over the two regions
  - All prices are set equal to marginal cost
- Assuming \(A > 3\)
  - SD (segregation by ethnicity/dispersal industrially) configuration is the social optimum: \((\lambda_X^o, \lambda_x^o) = (1, 1)/\lambda^o = 1/2\)
- When the population of the immobile individuals is large, the ethnicity utility level reached when residing in cluster sharing the same ethnic attributes is high
  - Ethnicity clustering utilities \(>\) industrial agglomeration benefits
  - Only SD pattern is the social optimal configuration
Conclusion

- How regional segregation patterns are affected by industrial agglomeration and ethnic clustering was investigated by adding the ethnic externality into the OTT model
- Segregation by ethnicity is persistent
- Ethnically mixed distributions appear only when trade costs are intermediate
- Ethnicity mixing can occur when the preference for ethnicity clustering is less intense
Chapter 3

Linguistic Distance and Economic Development: Costs of Accessing the Domestic and International Centers
Motivation

▶ In recent years, investigation of impacts on economic and political activities given by ethno-linguistic differences and diversities captures incremental interest and importance

▶ When analyzing economic prosperity and ethno-linguistic diversity, cost of jointing various groups such as between-group communication cost always comes together

▶ Studying impacts of cost borne by ethno-linguistic heterogeneity of a society (communication cost or language barrier) is valuable when compared to results and implications built up on the previous literature

▶ To capture communication cost when a society faces different linguistic groups, we exploit linguistic distance between languages
  ▶ Domestic linguistic distance
  ▶ International linguistic distance
Economic success and access to English communication

Figure: GDP per capita

Figure: Access to English communication
Related literature I

» Economic development and ethno-linguistic diversity
  » As a whole, ethno-linguistic diversity negatively affects economic development

» Economic development and ethno-linguistic diversity for rich countries
  » Alesina and La Ferrara (2005): diversities in ethnicity and language basically give a negative impact on economic success but may impact positively for rich countries
  » Ottaviano and Peri (2006): positive effects of diversity on productivity in U.S. cities
  » Bellini et al. (2013): positive effects of diversity on productivity in European regions
  » Alesina et al. (2013):
    » Birthplace diversity exhibits non-linear relationship with long-run income
    » Richer countries have more merits from birthplace diversity
Related literature II

- Diversity effect from theory side
  - Lazear (1999a,b): models with trade-off between benefits from multi-cultural diversity borne by production complementarity and costs of combining different workers
  - Berliant and Fujita (2012):
    - Cultural diversity and productivity in terms of creating new knowledge investigated
    - More culturally heterogeneous society should enjoy higher productivity than culturally homogeneous ones
Summary of Chapter 3

- Impacts of accessibility to domestic and international communication on the economic development of a nation are investigated
  - Domestic linguistic distance index:
    - Constraints of nationwide communication among speakers of different mother tongues
  - International linguistic distance index:
    - Constraints of the global communication
- Empirical results show that
  - Domestic linguistic distance has a negative impact on the economic development of poor countries
  - Rich countries enjoy positive impacts on the national income if the international linguistic distance is smaller
Linguistic family tree I

- Our linguistic distance index data cover a wide cross-section of countries, where indexes for each country are based on weighted averages of linguistic distances.
- Calculate linguistic distance for each pair of living languages listed in Ethnologue database.
- Languages are categorized in accordance with their similarities of linguistic characteristics, so that dendrograms (linguistic family tree diagrams) can be drawn.
Linguistic family tree II

- Virtual linguistic dendrogram, where Chinese, Mandarin and Chinese, Yue belong to Sino-Tibetan language family, and Hindi, English, French, and Spanish are categorized into Indo-European language family
- Spanish and French wear more similarities than Chinese, Mandarin
- How to give a quantitative value to an abstract notion of linguistic similarity to obtain standardized metric?
Quantification of linguistic similarity

- $e(i, j)$: Number of shared edges between languages $i$ and $j$
- $g(i)$: Generation where language $i$ belongs
- $g_{\text{max}}$: Maximum number of $g(i)$ for all existing languages $i$ in the world
- similarity($i, j$) = $e(i, j)/g_{\text{max}}$
Linguistic distance (Definition)

- $\tau(i, j)$: Linguistic distance between languages $i$ and $j$
  - similarity$(i, j)$ $\uparrow \rightarrow \tau(i, j) \downarrow$

$$\tau(i, j) = 1 - [\text{similarity}(i, j)]^\delta = 1 - \left[ \frac{e(i, j)}{g_{\text{max}}} \right]^\delta$$

- $\delta \in (0, 1)$: Parameter determining how fast the linguistic distance declines as the number of shared edges increases
- Assume $\tau(i, j) = \tau(j, i)$ for all languages $i$ and $j$
- Assume $\tau(i, i) = 0$ for all $i$
- $\tau(i, j)$ is a standardized metric (i.e., $\tau(i, j) \in [0, 1]$)
Domestic/international linguistic centers

- Language status: Notion proposed in Ethnologue as the criteria, which ranges from status 0 to 10 according to importance or usages of languages
  - Status 0 (international): Languages widely used between nations in trade, knowledge exchange, and international policy
  - Status 1 (national languages): Languages used in education, work, mass media, and government at the nationwide level
- **Domestic linguistic center(s): National language(s)** (status 1 languages)
- **International linguistic center: English** (one of the status 0 languages)
Domestic linguistic distance index (Single domestic center case)

- **Domestic linguistic distance index**: population weighted averages of linguistic distances

\[
DLD(i) = \sum_{j=1}^{K(i)} s_j(i) \tau_{j,c(i)}
\]  

- Country \( i \) with a population of \( N(i) \)
- Partitioned into \( K(i) \) distinct language groups according to their language use
- \( N_j(i) \): population of language group \( j \)
- \( N(i) = \sum_{j=1}^{K(i)} N_j(i) \)
- \( s_j(i) \): Population share of group \( j \) in country \( i \) (\( s_j(i) = N_j(i)/N(i) \))
- \( \tau_{j,c(i)} \): Linguistic distance between language \( j \) and the domestic central language \( c(i) \)
International linguistic distance index (Single domestic center case)\(^1\)

- Language \(C\): English is adopted as the central language of the world
  - By acquiring English, worldwide communication is allowed
- Two possibilities for the **international linguistic distance index**:  
  
  \[
  ILD_{PC}(i) = \sum_{j=1}^{K(i)} s_j(i)\tau_{j,c} \tag{7}
  \]
  
  \[
  ILD_{CC}(i) = \sum_{j=1}^{K(i)} s_j(i)\tau_{c(i),c} = \tau_{c(i),c} \tag{8}
  \]

- \(ILD_{PC}(i)\): Each person in group \(j\) in country \(i\) incurs linguistic distance cost to access the international center aside of access cost of the domestic center in country \(i\)
- \(ILD_{CC}(i)\): Linguistic distance between the domestic and international central languages
International linguistic distance index (Single domestic center case) II

Figure: Image of $ILD_{PC}$

Figure: Image of $ILD_{CC}$
Linguistic distance indexes (Multiple domestic linguistic center case)

- $DLD/ILD_{CC}$ indexes for multinational-language country are the weighted average of the weighted averages of the domestic linguistic distances to status 1 languages

\[
DLD(i) = \sum_{c(i) \in C(i)} \gamma_{c(i)} \sum_{j=1}^{K(i)} s_j(i) \tau_{j,c(i)}
\]

\[
ILD_{CC}(i) = \sum_{c(i) \in C(i)} \gamma_{c(i)} \sum_{j=1}^{K(i)} s_j(i) \tau_{c(i),c}
\]

- $C(i)$: Set of status 1 languages $(c(i))$ in country $i$
- $\gamma_{c(i)} = N_{c(i)}/\sum_{l \in C(i)} N_l$
- Note that no modification is necessary for $ILD_{PC}$
Introduction

Chapter 1

Chapter 2

Chapter 3

References

Model specification

- **Our main interest:** Relationship between domestic and international distances and economic success

\[
\ln \text{GDP/capita}_i = \alpha + \beta_D DLD_i + \beta_I ILD_i + \mathbf{x}_{\text{control},i} \beta_{\text{control}} + \epsilon_i \tag{11}
\]

- **Dependent variable:** GDP per capita (output-side, year 2011) at real PPP from the Penn World Tables 8.0 (Feenstra et al., 2013)

- **Vector of control variables** \( \mathbf{x}_{\text{control},i} \)
  - Market size: Population size, land area size, landlockedness
  - Education: Years of schooling
  - Trade: Trade openness (exports + imports share of the GDP in real PPP prices)
  - Geography: Absolute latitude, coastal population, mean temperature, mean precipitation
  - Institutions: Quality of institutions, property rights index, civil liberal index, legal origin
  - Others: Agricultural suitability (mean), agricultural suitability (std. dev.)
**DLD and Africa**

Table: High correlation between DLD($\delta_D$) indexes and Sub-Saharan African countries

<table>
<thead>
<tr>
<th>Continent</th>
<th>$\delta_D = 0.1$</th>
<th>$\delta_D = 0.2$</th>
<th>$\delta_D = 0.3$</th>
<th>$\delta_D = 0.4$</th>
<th>$\delta_D = 0.5$</th>
<th>$\delta_D = 0.6$</th>
<th>$\delta_D = 0.7$</th>
<th>$\delta_D = 0.8$</th>
<th>$\delta_D = 0.9$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>0.766</td>
<td>0.757</td>
<td>0.744</td>
<td>0.730</td>
<td>0.716</td>
<td>0.702</td>
<td>0.689</td>
<td>0.677</td>
<td>0.667</td>
</tr>
<tr>
<td>Latin America</td>
<td>-0.192</td>
<td>-0.219</td>
<td>-0.240</td>
<td>-0.258</td>
<td>-0.272</td>
<td>-0.283</td>
<td>-0.292</td>
<td>-0.300</td>
<td>-0.306</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>-0.128</td>
<td>-0.118</td>
<td>-0.109</td>
<td>-0.100</td>
<td>-0.092</td>
<td>-0.085</td>
<td>-0.080</td>
<td>-0.075</td>
<td>-0.071</td>
</tr>
</tbody>
</table>

- Occasionally, continent dummy variables are adopted as controls in such contexts
- *DLD* index has high correlation with Sub-Saharan continent dummy
  - Drop continent dummy variables $\rightarrow$ spatial dependences among observations (Moran’s *I* statistics)
- Empirical analysis in a **spatial econometrics framework, which resolves spatial dependences** among observations
- Cross country comparison of economic growth using spatial econometrics tool:
Spatial econometrics framework I

- Spatial autoregressive (SAR) model:

\[ y = \rho Wy + \alpha \nu + X \beta + \epsilon \]  

- \( y \): \( n \) by 1 observed vector of GDP/capita
- \( x_i = (DLD_i, ILD_i, x_{\text{control},i}) \): \( i \)-th row of the \( n \) by \( k \) explanatory variable matrix, other than the intercept vector
- \( W \): inverse distance spatial weight matrix without cut-off (row standardized)
- \( \epsilon \): \( n \) by 1 disturbance vector (normally distributed \( \epsilon \sim N(0, \sigma^2 I_n) \))
- Spatial Durbin model (SDM), which was our first best option, was not tractable due to multicollinearity in \( X \) and \( WX \) (especially \( DLD \))
- SEM, SAC(SARAR) models are inappropriate statistically and conceptually
Spatial econometrics framework II

- OLS model \( y_i = \alpha + \sum_{r=1}^{k} x_{r,i} \beta_r + \epsilon_i \): impact on \( y_i \) given by a change in \( x_{r,i} \) is \( \frac{\partial y_i}{\partial x_{r,i}} = \beta_r \) for all \( i \) and \( r \)
- SAR model: impact on \( y_i \) given by a change in \( x_{r,i} \) is \( \frac{\partial y_i}{\partial x_{r,i}} \neq \beta_r \) (Le Sage and Pace, 2009)
  - Direct effect:
    \[
    \frac{\partial y_i}{\partial x_{r,i}} = S_r(W)_{ii} \quad (\neq \beta_r) \tag{13}
    \]
  - \( S_r(W) \equiv (I_n - \rho W)^{-1} \beta_r \)
  - \( S(W)_{ii} \): \((i, i)\)-th element of \( n \) by \( n \) matrix \( S(W) \)
  - Average direct effect:
    \[
    \bar{M}(r)_{\text{direct}} = n^{-1} \text{tr}(S_r(W)) \tag{14}
    \]
  - Average direct effect: interpreted as a counterpart of the OLS coefficients
- Reverse causality:
  - GDP/capita: year 2011
  - Linguistic distance data: year 2009, population size, years of schooling, trade openness, quality of institution, property rights, and civil liberality: year 2010
**OLS results** \((\delta_D, \delta_I) = (0.8, 0.6)\)

**Table:** Linguistic distance and economic development, OLS results

<table>
<thead>
<tr>
<th>Sample</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ILD</strong></td>
<td>Full</td>
<td>Full</td>
<td>Poor</td>
<td>Poor</td>
<td>Rich</td>
<td>Rich</td>
</tr>
<tr>
<td><strong>DLD</strong> ((\delta_D = 0.8))</td>
<td>(\text{ILD}_{PC})</td>
<td>(\text{ILD}_{CC})</td>
<td>(\text{ILD}_{PC})</td>
<td>(\text{ILD}_{CC})</td>
<td>(\text{ILD}_{PC})</td>
<td>(\text{ILD}_{CC})</td>
</tr>
<tr>
<td>(DLD)</td>
<td>-0.484**</td>
<td>-0.488**</td>
<td>-0.636***</td>
<td>-0.725***</td>
<td>0.575**</td>
<td>0.431*</td>
</tr>
<tr>
<td></td>
<td>(0.230)</td>
<td>(0.233)</td>
<td>(0.182)</td>
<td>(0.212)</td>
<td>(0.223)</td>
<td>(0.252)</td>
</tr>
<tr>
<td><strong>ILD</strong> ((\delta_I = 0.6))</td>
<td>0.021</td>
<td>-0.016</td>
<td>-0.553</td>
<td>-0.161</td>
<td>-0.613**</td>
<td>-0.494**</td>
</tr>
<tr>
<td></td>
<td>(0.238)</td>
<td>(0.244)</td>
<td>(1.019)</td>
<td>(0.264)</td>
<td>(0.240)</td>
<td>(0.214)</td>
</tr>
<tr>
<td>Control</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>108</td>
<td>108</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.829</td>
<td>0.829</td>
<td>0.688</td>
<td>0.688</td>
<td>0.715</td>
<td>0.708</td>
</tr>
</tbody>
</table>


*** p<0.01, ** p<0.05, * p<0.1
SAR results \(((\delta_D, \delta_I) = (0.8, 0.6))\)

Table: Linguistic distance and economic development, SAR results (average direct effect), inverse distance spatial weight matrix (row standardized)

<table>
<thead>
<tr>
<th>Sample</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full</td>
<td>Full</td>
<td>Poor</td>
<td>Poor</td>
<td>Rich</td>
<td>Rich</td>
</tr>
<tr>
<td>(ILD)</td>
<td>(ILD_{PC})</td>
<td>(ILD_{CC})</td>
<td>(ILD_{PC})</td>
<td>(ILD_{CC})</td>
<td>(ILD_{PC})</td>
<td>(ILD_{CC})</td>
</tr>
<tr>
<td>Dependent variable (log)</td>
<td>GDP/capita</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DLD) ((\delta_D = 0.8))</td>
<td>-0.425**</td>
<td>-0.427*</td>
<td>-0.623***</td>
<td>-0.715***</td>
<td>0.543**</td>
<td>0.379</td>
</tr>
<tr>
<td></td>
<td>(0.195)</td>
<td>(0.217)</td>
<td>(0.207)</td>
<td>(0.209)</td>
<td>(0.255)</td>
<td>(0.286)</td>
</tr>
<tr>
<td>(ILD) ((\delta_I = 0.6))</td>
<td>0.117</td>
<td>-0.010</td>
<td>-0.531</td>
<td>-0.164</td>
<td>-0.641**</td>
<td>-0.569**</td>
</tr>
<tr>
<td></td>
<td>(0.324)</td>
<td>(0.223)</td>
<td>(1.083)</td>
<td>(0.268)</td>
<td>(0.280)</td>
<td>(0.273)</td>
</tr>
</tbody>
</table>


*** p<0.01, ** p<0.05, * p<0.1
Interpretation of results for poor countries (<median of GDP/capita)

- **DLD** has significantly negative impact on output-side GDP per capita
  - Domestic linguistic distance roots deeply at colonized experience since colonizer countries forced colonized ones to use the institutional languages
  - Once languages are mastered, they are sublimated into internalized knowledge, and the ability to use those languages can never be completely separated from the users
  - Socially high status elites have mastered colonizers’ language → Persistence of their language should be much stronger

- **ILD** does not have significant impacts
  - For developing countries, only a small number of elites is forced to acquire English but the most may not
  - Firms may prefer to build branches in sufficiently developed nations, simply because those behind countries tend to lack social infrastructure or insufficient understanding of instructions even in national languages
Interpretation of results for rich countries (≥ median of GDP/capita) and full sample

- **Rich countries (≥ median of GDP/capita)**
  - *DLD* shows positive impact on GDP/capita
    - Benefits from ethno-linguistic diversity hidden behind *DLD* give positive impact on economic performance for rich countries
    - Matches the implications in the previous literature
  - *ILD* significantly decreases GDP/capita
    - Accessibility to world-wide communication is a key determinant of economic performance for sufficiently developed countries
    - Successive past and present greatest powers of the world (British Empire and US) have used English as national languages
      - English has continuously been endowed with the most powerful position among all existing languages of the world

- **Full sample of countries**
  - *DLD* gives significantly negative impact on national income
  - Coherent to what previous literature on ethnic/linguistic/cultural diversity and economic performance have found
Results on a full range of the linguistic distance parameters

- Since linguistic distance parameters can take various values in the range they are defined, we vary the parameter values and rerun regressions
- $DLD$ matrices: comparison of average direct effects of $DLD$ should be made unilaterally row by row (i.e., left to right), since given a certain value of $\delta_I$, behavior of $DLD$ effects is determined by the change of $\delta_D$
- $ILD$ matrices: comparison of average direct effects should be made unilaterally column by column (top to bottom)
- $ILD_{PC}$ example
## Results (Poor subsample, $DLD$, full range of $\delta$)

Table: $DLD$ and economic development on a full range of $\delta_D$ and $\delta_I$, subsample of poor countries, $ILD_{PC}$ international linguistic distance index, SAR results with inverse distance spatial weight matrix (row standardized)

<table>
<thead>
<tr>
<th>$\delta_I$ $\backslash$ $\delta_D$</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>-0.548***</td>
<td>-0.567***</td>
<td>-0.591***</td>
<td>-0.611***</td>
<td>-0.621***</td>
<td>-0.624***</td>
<td>-0.608***</td>
<td>-0.636***</td>
<td>-0.631***</td>
</tr>
<tr>
<td></td>
<td>(0.1808)</td>
<td>(0.1827)</td>
<td>(0.1912)</td>
<td>(0.2059)</td>
<td>(0.2043)</td>
<td>(0.2038)</td>
<td>(0.1953)</td>
<td>(0.2063)</td>
<td>(0.2064)</td>
</tr>
<tr>
<td>0.2</td>
<td>-0.532***</td>
<td>-0.563***</td>
<td>-0.588***</td>
<td>-0.591***</td>
<td>-0.610***</td>
<td>-0.628***</td>
<td>-0.631***</td>
<td>-0.634***</td>
<td>-0.639***</td>
</tr>
<tr>
<td></td>
<td>(0.1763)</td>
<td>(0.1821)</td>
<td>(0.1878)</td>
<td>(0.1941)</td>
<td>(0.2136)</td>
<td>(0.2059)</td>
<td>(0.2065)</td>
<td>(0.2037)</td>
<td>(0.2162)</td>
</tr>
<tr>
<td>0.3</td>
<td>-0.543***</td>
<td>-0.572***</td>
<td>-0.591***</td>
<td>-0.612***</td>
<td>-0.612***</td>
<td>-0.624***</td>
<td>-0.622***</td>
<td>-0.622***</td>
<td>-0.628***</td>
</tr>
<tr>
<td></td>
<td>(0.1770)</td>
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<td>(0.1915)</td>
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<td>(0.2019)</td>
<td>(0.2079)</td>
<td>(0.1972)</td>
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<tr>
<td>0.4</td>
<td>-0.538***</td>
<td>-0.575***</td>
<td>-0.578***</td>
<td>-0.597***</td>
<td>-0.621***</td>
<td>-0.625***</td>
<td>-0.631***</td>
<td>-0.628***</td>
<td>-0.641***</td>
</tr>
<tr>
<td></td>
<td>(0.1822)</td>
<td>(0.1845)</td>
<td>(0.1920)</td>
<td>(0.1967)</td>
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<td>(0.2088)</td>
<td>(0.1975)</td>
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<td>0.5</td>
<td>-0.539***</td>
<td>-0.562***</td>
<td>-0.599***</td>
<td>-0.591***</td>
<td>-0.610***</td>
<td>-0.621***</td>
<td>-0.634***</td>
<td>-0.628***</td>
<td>-0.632***</td>
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<td>(0.1834)</td>
<td>(0.1879)</td>
<td>(0.1957)</td>
<td>(0.1929)</td>
<td>(0.2049)</td>
<td>(0.2016)</td>
<td>(0.2013)</td>
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<td>(0.2121)</td>
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<tr>
<td>0.6</td>
<td>-0.544***</td>
<td>-0.555***</td>
<td>-0.601***</td>
<td>-0.602***</td>
<td>-0.610***</td>
<td>-0.622***</td>
<td>-0.635***</td>
<td>-0.623***</td>
<td>-0.627***</td>
</tr>
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<td>(0.1910)</td>
<td>(0.1924)</td>
<td>(0.1987)</td>
<td>(0.1989)</td>
<td>(0.2087)</td>
<td>(0.2114)</td>
<td>(0.2072)</td>
<td>(0.2088)</td>
</tr>
<tr>
<td>0.7</td>
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<td>-0.559***</td>
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This table shows average direct effects of $DLD$ on a full range of linguistic distance indexes at different combinations of $\delta_D$ and $\delta_I$. GDP/capita is the dependent variable. All results include the full vector of controls. Subsample of poor countries. $ILD_{PC}$ international linguistic distance index. SAR model. Inverse distance spatial weight matrix (row standardized). Standard errors are in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Results (Rich subsample, *DLD*, full range of $\delta$)

Table: *DLD* and economic development on a full range of $\delta_D$ and $\delta_I$, subsample of rich countries, $ILD_{PC}$ international linguistic distance index, SAR results with inverse distance spatial weight matrix (row standardized).

<table>
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This table shows average direct effects of *DLD* on a full range of linguistic distance indexes at different combinations of $\delta_D$ and $\delta_I$. GDP/capita is the dependent variable. All results include the full vector of controls. Subsample of rich countries. $ILD_{PC}$ international linguistic distance index. SAR model. Inverse distance spatial weight matrix (row standardized). Standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1
## Results (Rich subsample, $ILD_{PC}$, full range of $\delta$)

Table: $ILD_{PC}$ and economic development on a full range of $\delta_D$ and $\delta_I$, subsample of rich countries, $ILD_{PC}$ international linguistic distance index, SAR results with inverse distance spatial weight matrix (row standardized)

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This table shows average direct effects of $ILD_{PC}$ on a full range of linguistic distance indexes at different combinations of $\delta_D$ and $\delta_I$. GDP/capita is the dependent variable. All results include the full vector of controls. Subsample of rich countries. $ILD_{PC}$ international linguistic distance index. SAR model. Inverse distance spatial weight matrix (row standardized). Standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1
Results (Full sample, \textit{DLD}, full range of $\delta$)

Table: \textit{DLD} and economic development on a full range of $\delta_D$ and $\delta_I$, full sample of countries, \textit{ILD}_{PC} international linguistic distance index, SAR results with inverse distance spatial weight matrix (row standardized)

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<td>-0.419**</td>
<td>-0.423**</td>
</tr>
<tr>
<td></td>
<td>(0.1903)</td>
<td>(0.1921)</td>
<td>(0.2041)</td>
<td>(0.1912)</td>
<td>(0.1961)</td>
<td>(0.2014)</td>
<td>(0.1866)</td>
<td>(0.2027)</td>
<td>(0.2000)</td>
</tr>
<tr>
<td>0.9</td>
<td>-0.420**</td>
<td>-0.429**</td>
<td>-0.446**</td>
<td>-0.435**</td>
<td>-0.429**</td>
<td>-0.428**</td>
<td>-0.409**</td>
<td>-0.424**</td>
<td>-0.417**</td>
</tr>
<tr>
<td></td>
<td>(0.1882)</td>
<td>(0.1875)</td>
<td>(0.1877)</td>
<td>(0.1951)</td>
<td>(0.1960)</td>
<td>(0.1904)</td>
<td>(0.1999)</td>
<td>(0.1925)</td>
<td>(0.1983)</td>
</tr>
</tbody>
</table>

Table shows average direct effects of \textit{DLD} on a full range of linguistic distance indexes at different combinations of $\delta_D$ and $\delta_I$. GDP/capita as the dependent variable. All results include the full vector of controls. Full country sample. \textit{ILD}_{PC} international linguistic distance index. SAR model. Inverse distance spatial weight matrix (row standardized). Standard errors are in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Interpretation of the results I

- All matrices show expected results
- Even when poor and rich subsamples are merged into a full sample, in total, negative impacts of domestic distance on economic development survive
- Careful investigation of results for rich subsample, $ILD_{PC}$, full range of $\delta$
  - Low $\delta_i \rightarrow$ all countries whose residents' mother tongue belongs to Indo-European language family have small $ILD_{PC}$
  - High $\delta_i \rightarrow$ only countries whose residents' mother tongue is English have smaller $ILD_{PC}$

![Image of high/low $\delta_i$s](image)

**Figure:** Image of high/low $\delta_i$s
Interpretation of the results II

- If easiness of acquiring English for individuals whose mother tongue is an Indo-European language compared to those with non-Indo-European mother tongue were more valuable in explaining GDP differences, lower $\delta_i$ should result in $ILD$ that has higher explanatory power.

- If the benefits enjoyed by individuals whose mother tongue is English, who do not need to devote effort to mastering English as a second language, were more important in explaining them, higher $\delta_i$ should lead to $ILD$ of higher explanatory power.

- The results that $ILD$ with larger $\delta_i$ is more significant and has stronger impact on GDP/capita $\rightarrow$ capability of using English as the first language is advantageous.
Robustness checks

- $ILD_{cc}$
- Spatial weight matrix: Row standardized contiguity matrix, spectral standardized inverse distance matrix
- Samples restricted to mono-official-language countries
- “Immigrants” (reported in Ethnologue) included linguistic distance indexes
Conclusion

- Impacts of domestic and international linguistic distances on the cross-country income difference are investigated.

- For poor countries such as African nations, domestic linguistic distance significantly gives negative impact on economic development.

- Rich countries tend to have positive impacts of domestic linguistic distance (hidden effect by benefits of diversity).

- As for international linguistic distance, rich countries such as English-spoken or European nations enjoy positive impact of good accessibility to world-wide communication, while poor countries do not.

- Especially, English speakers as his/her mother tongue are highly advantaged in economic activities.


Reference II


