Effects of demographic and educational changes on the labor markets of Brazil and Mexico

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Research questions

- **Main objective**: estimate the impact of demographic and educational changes on earnings in Brazil and Mexico:
  
  - What are the effects of changing age and educational compositions on male earnings at the *aggregate level*?
  
  - How does the concentration of skilled workers affect the private and social returns to education at the *individual level*?

- **Within the labor force** (15–64 years of age), the population is getting older and better educated with regional variation.

- Age and education increase earnings.

- Larger proportion of older and more educated males causes:
  
  - Negative impacts on earnings of competing workers.
  
  - Greater knowledge and economic dynamism.
Cohort size

- **Human capital:** schooling and work experience have positive impacts on earnings (Mincer 1974).

- **Baby boom:** large cohorts of better educated individuals entered the U.S. labor market, decreasing their relative earnings.
  (Berger 1985; Bloom and Freeman 1986; Bloom, Freeman, and Korenman 1987; Easterlin 1978; Freeman 1979; Sapozknikov and Triest 2007; Welch 1979)

- Larger cohorts also had positive impacts on labor outcomes.

- Effects of cohort size on the labor market have been estimated for several developed countries.
  (Biagi and Lucifora 2008; Borjas 2003; Brunello 2010; Korenman and Neumark 2000; Skans 2005)
Concentration of human capital

- **Social returns to education**: concentration of well-educated people benefits everyone else in the population.
  (Acemoglu 1996; Glaeser 2011; Moretti 2011)

- **Other positive impacts**: concentration also generates greater knowledge and economic dynamism.
  (Moretti 2004a, 2004b; Glaeser 2011; Berry and Glaeser 2011)

- **Several studies for developed countries**, but much less is known about developing countries.
  (Queiroz and Golgher 2008; Amaral et al. 2013; Rigotti 2006)
Main contribution

- Few studies have addressed how demographic and educational compositions affect earnings, as well as private and social returns to education in developing countries.

- Contributes to the literature on demographic change in developing countries by predicting earnings using:
  
  - Variations in age-education composition.
  
  - Regional differences.

- This project is part of a broader research agenda dealing with the effects of population changes on demographic, social, and economic outcomes.
Brazil & Mexico

- **Fertility decline** is contributing to changes in age composition (IBGE 2012; CONAPO 2004, 2014).

<table>
<thead>
<tr>
<th>Total Fertility Rate</th>
<th>1970</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>5.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>6.8</td>
<td>2.3</td>
</tr>
</tbody>
</table>

- **Educational expansion** began late and has a long way to go (Barro and Lee 2001; Marcílio 2001, 2005; Rios-Neto and Guimarães 2010).

- Improvement in educational attainment coincides with decline in family size and school-age children (Lam and Marteleto 2005, 2008).

- These countries have data that captures information on:
  - Population aging.
  - Educational improvement.
  - Geographic variation.
Male educational composition
Brazil, 1970–2010

Male educational composition
Mexico, 1960–2010

Brazilian micro-data

- **Minimum comparable areas**: 502 micro-regions.
- **Age** in years is categorized into four groups:
  - Youths (15–24).
  - Young adults (25–34).
  - Experienced adults (35–49).
  - Older adults (50–64).
- **Education**: four groups indicating years of schooling:
  - Incomplete first phase of primary school (0–3).
  - No further than primary school (4–8).
  - Secondary school (9–11).
  - At least some university (12+).
- **Earnings** from main occupation: converted to Jan. 2002.
Mexican micro-data

- **Mexican Censuses:** 1990, 2000, and 2010.
- **Minimum comparable areas:** 2,456 municipalities.
- **Age** in years is categorized into four groups:
  - Youths (15–24).
  - Young adults (25–34).
  - Experienced adults (35–49).
  - Older adults (50–64).
- **Education:** four groups indicating years of schooling:
  - No education (0).
  - Primary school (1–6).
  - Secondary school (7–12).
  - At least some university (13+).
- **Earnings** from all occupations.
What are the effects of changing age and educational compositions on male earnings at the aggregate level?
Aggregate-level data

- **Database** is aggregated by census years, micro-regions, and age-education groups:
  - Brazil: 5 years * 502 micro-regions * 16 age-education groups.
  - Mexico: 3 years * 2,456 municipalities * 16 age-education groups.

- Cells with less than 25 people receiving income were excluded:
  - Brazil: 32,201 observations remained.
  - Mexico: 82,604 observations remained.

- Only male population: labor force participation is not driven by level of earnings, fertility decline, and changes in educational attainment.
# Data setup

<table>
<thead>
<tr>
<th>Year</th>
<th>Area</th>
<th>Age-education group</th>
<th>Log of mean earnings ( \log(Y_{git}) )</th>
<th>Distr. of male pop.</th>
<th>P11</th>
<th>P12</th>
<th>P13</th>
<th>P14</th>
<th>...</th>
<th>P44</th>
<th>Num. of obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>110006</td>
<td>15–24 years &amp; 0–3 educ.</td>
<td>5.80</td>
<td>0.221</td>
<td>0.221</td>
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<td>0</td>
<td>2,016</td>
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<tr>
<td>1970</td>
<td>110006</td>
<td>15–24 years &amp; 4–8 educ.</td>
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<td>15–24 years &amp; 9–11 educ.</td>
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<td>62</td>
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<td>1970</td>
<td>110006</td>
<td>15–24 years &amp; 12+ educ.</td>
<td>7.58</td>
<td>0.001</td>
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<td>0</td>
<td>11</td>
</tr>
<tr>
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<td>...</td>
</tr>
<tr>
<td>1970</td>
<td>110006</td>
<td>50–64 years &amp; 12+ educ.</td>
<td>7.91</td>
<td>0.002</td>
<td>0</td>
<td>0</td>
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<td>...</td>
<td>0.002</td>
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<td>15</td>
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<td>...</td>
</tr>
</tbody>
</table>
## Fixed effects models

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Baseline model</th>
<th>Composition model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logarithm of the mean real monthly earnings by age-education group, area, and time</td>
<td>( \log(Y_{git}) )</td>
<td>( \log(Y_{git}) )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Baseline model</th>
<th>Composition model</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 age-education indicators * time</td>
<td>((G_{11} - G_{44}) * \theta_t)</td>
<td>((G_{11} - G_{44}) * \theta_t)</td>
</tr>
<tr>
<td>Distribution of male population into 16 age-education groups * time</td>
<td>((P_{11} - P_{44}) * \theta_t)</td>
<td>((P_{11} - P_{44}) * \theta_t)</td>
</tr>
<tr>
<td>Area-time fixed effects</td>
<td>( \alpha_{it} )</td>
<td>( \alpha_{it} )</td>
</tr>
</tbody>
</table>
Estimating the impacts of relative group size on male earnings

- Baseline model:
  - Effects of age-education indicators ($G_{11}$–$G_{44}$).

- Composition model:
  - Effects of age-education indicators ($G_{11}$–$G_{44}$).
  - Effects of age-education-group proportions ($P_{11}$–$P_{44}$).
Effects of age-education indicators \((G_{11}-G_{44})\)

Baseline model, Brazil, 2010

Effects of age-education indicators \((G_{11} - G_{44})\)
Baseline model, Mexico, 2010

Effects of age-education indicators ($G_{11} - G_{44}$)
Composition model, Brazil, 2010

Effects of age-education indicators ($G_{11} - G_{44}$)  
Composition model, Mexico, 2010

Effects of group proportions \( (P_{11}–P_{14}) \) on earnings, Brazil, 1970–2010

15–24 years

Effects of group proportions ($P_{21} - P_{24}$) on earnings, Brazil, 1970–2010

25–34 years

Effects of group proportions ($P_{31} - P_{34}$) on earnings, Brazil, 1970–2010
35–49 years

Effects of group proportions ($P_{41} - P_{44}$) on earnings, Brazil, 1970–2010

50–64 years

Effects of group proportions (\(P_{11} - P_{14}\)) on earnings, Mexico, 1990–2010

15–24 years

Effects of group proportions ($P_{21} - P_{24}$) on earnings, Mexico, 1990–2010

25–34 years

Effects of group proportions ($P_{31}–P_{34}$) on earnings, Mexico, 1990–2010

35–49 years

Effects of group proportions ($P_{41} - P_{44}$) on earnings, Mexico, 1990–2010

50–64 years

Robustness checks

- Extra models included as independent variables:
  - Cross effects.
  - Population size of micro-regions.
  - Female workers.
  - Internal migration.

- **Original impacts** of distribution of males into age-education groups ($P_{11} - P_{44}$) remained negative and significant.
How does the concentration of skilled workers affect the private and social returns to education at the individual level?
Individual data analysis

- **Males in the labor force:** working or looking for a job.

- **Two sets of analysis:** aged 15–60 (shown here) and 30–50 (prime age adults).

- **Education:** (1) less than primary; (2) primary completed; (3) secondary completed; (4) university completed.

- **Dependent variable:** logarithm of individual earnings.

- **Variables of interest:**
  
  - **Years of schooling:** measure private returns to education.
  
  - **Concentration of educated workers (undergraduates):** measures social returns to education.
Estimation procedure

- The spatial distribution of the more educated population is associated with unobserved factors which in turn can be correlated with the level of income (Moretti 2004a, 2004b):
  - The level of education becomes endogenous.

- The alternative needed to solve this problem is to use instruments to estimate the stock of skilled labor in localities:
  - Lagged explanatory variables.

- The models are estimated for the overall population, as well as by income quantiles (25th, 50th, 75th).
Two-stage least squares model

- Estimating the proportion of skilled workers by area:

  \[ P(t) = \beta_0 + \beta_1 L_{1(t-n)} + \beta_2 L_{2(t-n)} + \beta_3 L_{3(t-n)} + e \]

  - \( P(t) \): proportion of workers with high educational level (undergraduates) in time \( t \) for each investigated area.
  - \( L_{1(t-n)} \): enrollment rate in high school in the previous census.
  - \( L_{2(t-n)} \): young-age-dependency ratio in the previous census.
  - \( L_{3(t-n)} \): local average earnings in the previous census.

- Estimating private and social returns to education:

  \[ \log(Y) = \beta_0 + \beta_n X_n + e \]

  - \( \log(Y) \): logarithm of individual earnings.
  - \( X_n \): years of schooling; proportion of undergraduates; age; migrant; urbanization rate; unemployment rate; region.
### Private returns to education, 2000 and 2010

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Brazil, 2000</th>
<th>Brazil, 2010</th>
<th>Mexico, 2000</th>
<th>Mexico, 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than primary</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Primary</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.3</td>
<td>1.8</td>
<td>1.9</td>
<td>1.7</td>
</tr>
<tr>
<td>University</td>
<td>5.4</td>
<td>4.2</td>
<td>3.5</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Source: Brazilian and Mexican Demographic Censuses.
Social returns to education by income quantile, 2000 and 2010

Source: Brazilian and Mexican Demographic Censuses.
Cohort size

- **In line with previous studies:** larger cohort-education size generally depresses earnings.

- **Men with low education:** these groups are decreasing over time, but their earnings are not increasing.

- **Secondary school:** groups are increasing over time and experiencing negative impacts on earnings.

- **Time:** effects are becoming less negative over the years.
  - However, effects for secondary-school groups are more negative in Brazil in 2010, compared to 2000.
Concentration of human capital

- **Positive effects** of the concentration of skilled workers on earnings:
  - Decrease for **Mexico** along the income distribution.
  - Increase for **Brazil** along the income distribution.

- **Time:** in both countries, effects decreased from 2000 to 2010, which might be related to educational progress.

- **Income inequality:** might increase in Brazil, because the concentration of human capital is more beneficial to the highest income quantile than lower quantiles:
  - In the U.S., concentration of human capital has been more beneficial to lower income quantiles.
Implications

- Reduction in income inequality:
  - More better-educated men: negative impacts reduced differentials in relation to lower-educated men.
  - Fewer younger men: smaller negative impacts on their earnings prevented greater disparities in relation to older men.

- Increase in income inequality:
  - Concentration of human capital: higher positive impacts on the highest quantile might be a consequence of educational improvement in certain localities.

- Public policies:
  - Demand for education: improve educational levels in areas that still have large proportions of people with low-education.
  - Decentralize college education: recent Brazilian policies might generate positive impacts for the whole country.
Research agenda

- Other countries (IPUMS-International): India, Indonesia, South Africa, Chile, and Argentina.

- Models by sectors: estimate impacts of composition on earnings of workers with:
  - Formal employment.
  - Informal employment.
  - Self employment.

- Occupational profile and labor force participation: analyze how adults and elderly labor supply are changing over time and across regions in Mexico and Brazil.