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

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# Outline

- Research question and background.
- Data and methods.
- Results.
- Final considerations and research agenda.

# Research questions

- **Main objective:** estimate the impact of demographic and educational changes on the earnings and returns to schooling of workers 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 social and private 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.

(Autor, Katz, and Krueger, 1998; Katz and Autor, 1999; Katz and Murphy, 1992; Shimer, 2001)

- 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 social and private 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.

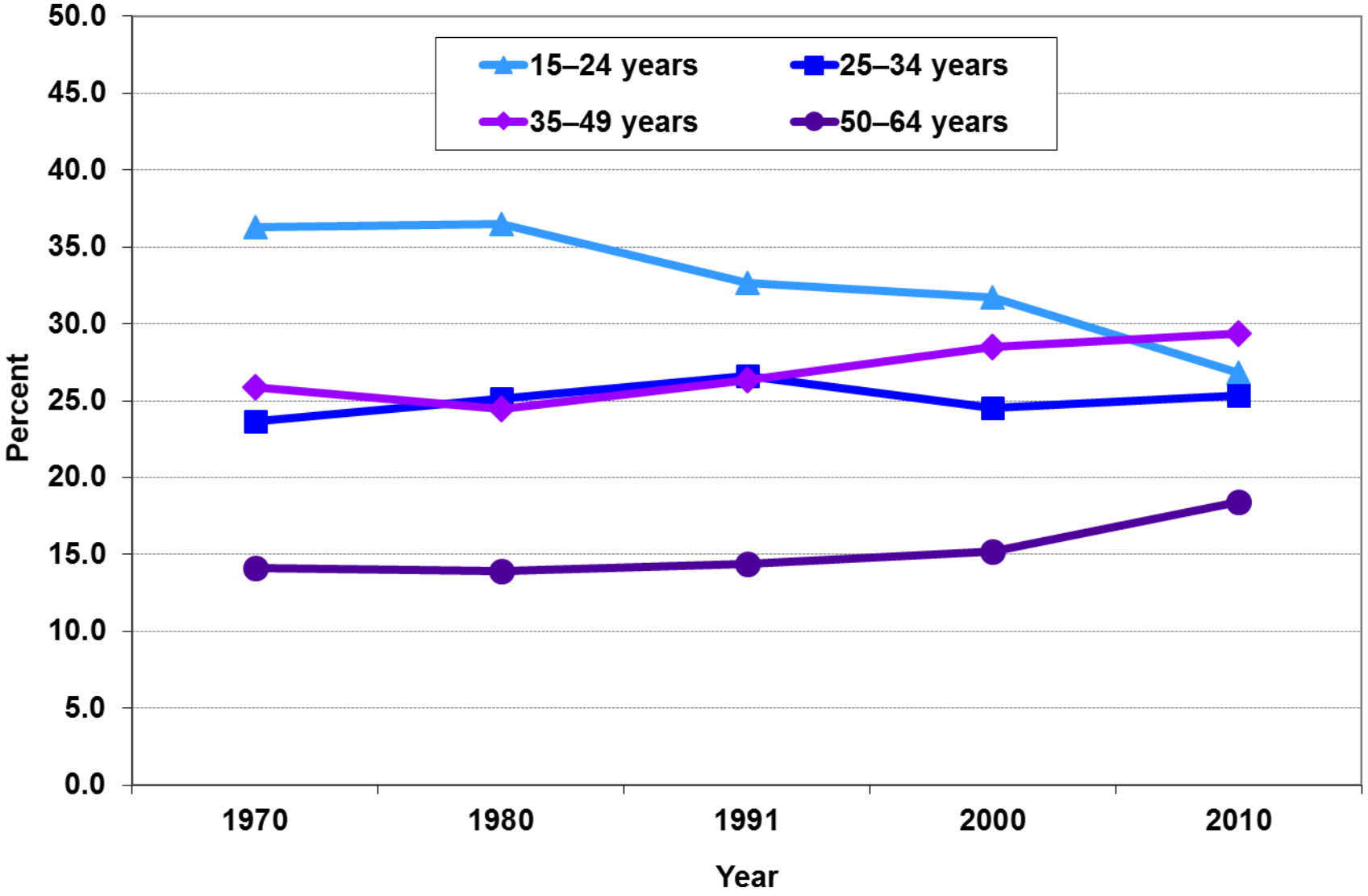
  - Regional differences.

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

# Brazil & Mexico

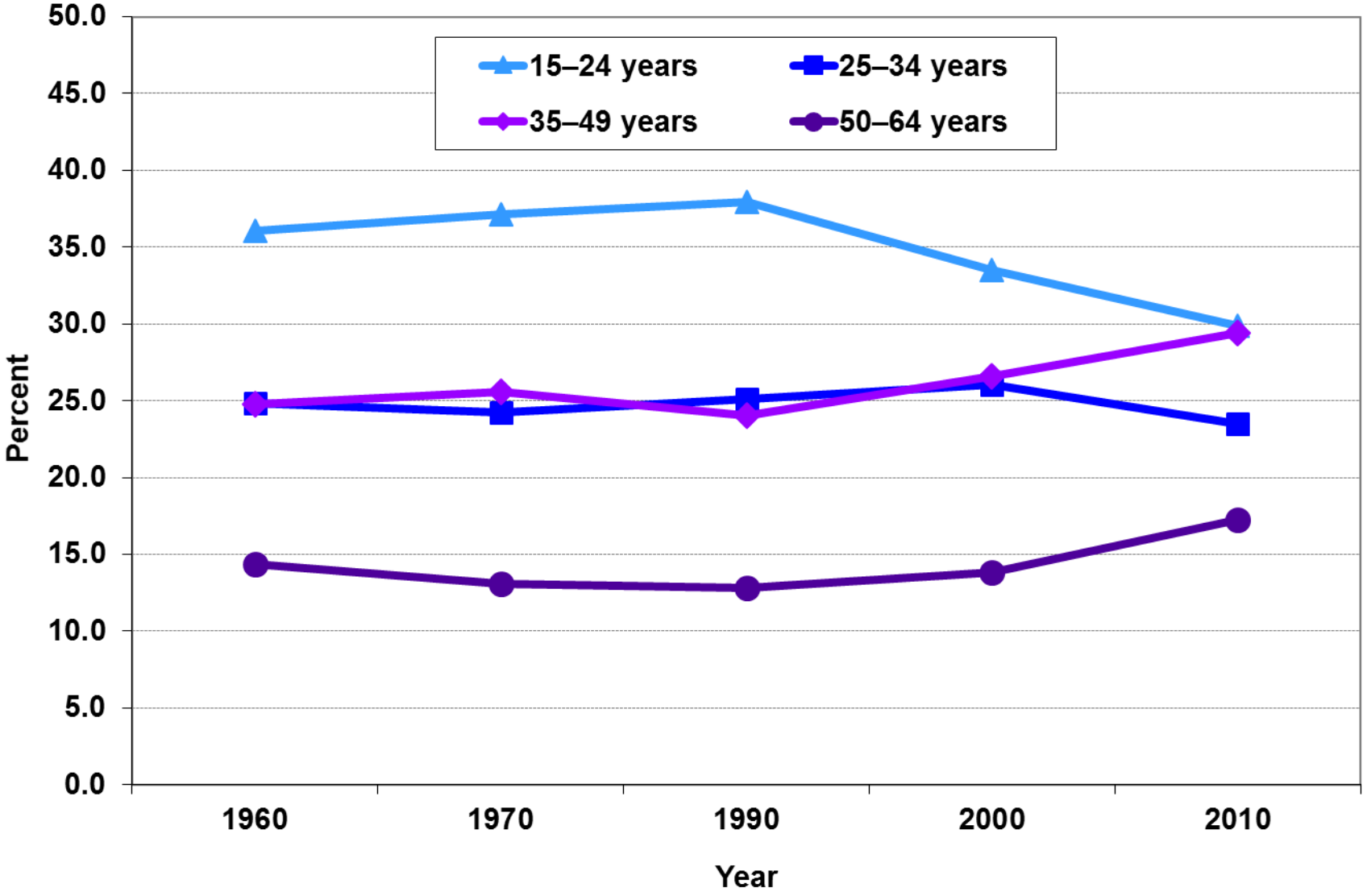
- **Fertility decline and population aging** are contributing to changes in age and education composition (IBGE, 2012; CONAPO, 2004, 2014).
- **Educational expansion** began late and has a long way to go (Barro and Lee, 2001; Marcílio, 2001, 2005; Rios-Neto and Guimarães, 2010).
- Improvement in educational 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 age composition Brazil, 1970–2010



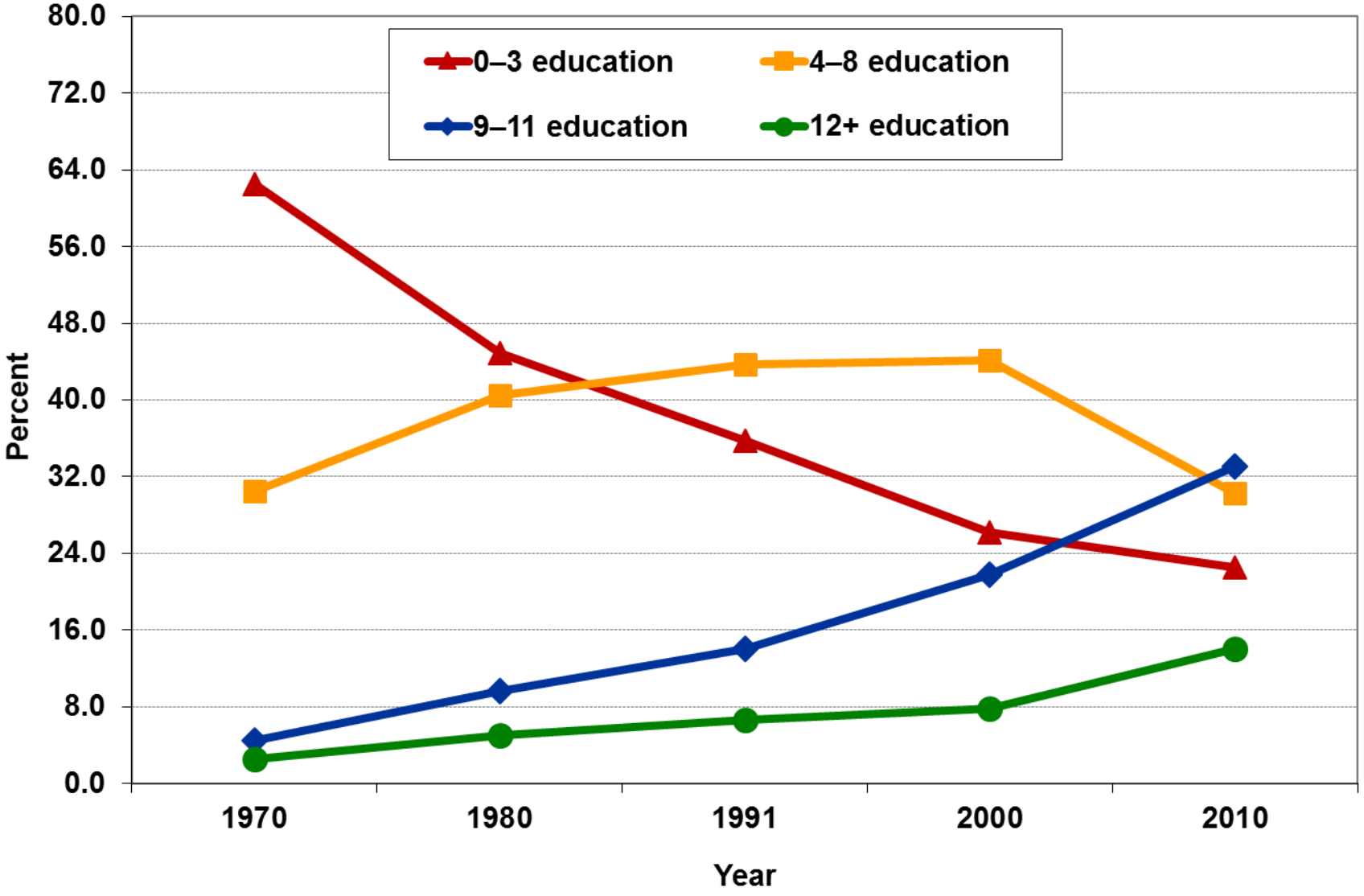

Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

# Male age composition Mexico, 1960–2010



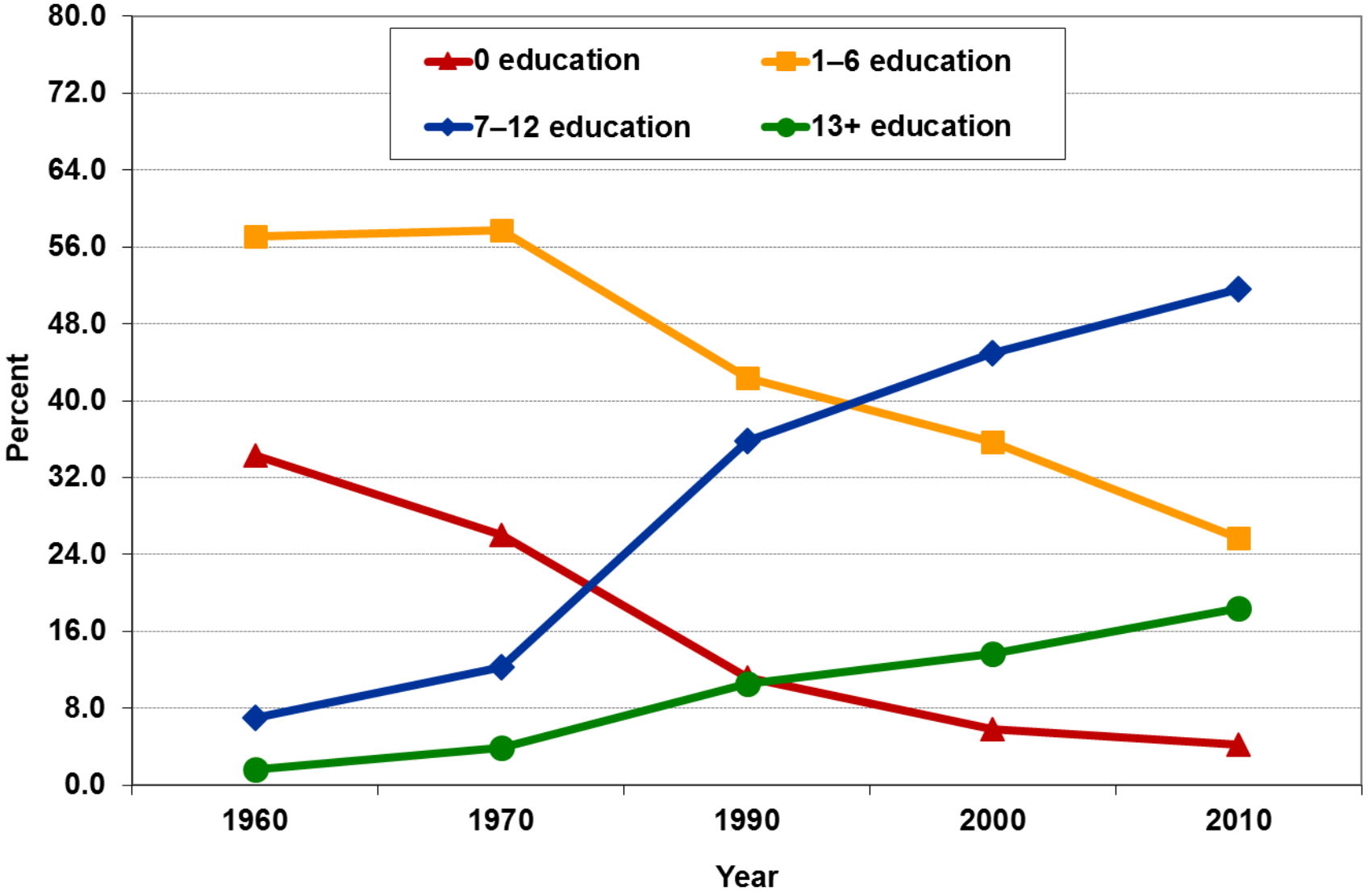

Source: 1960, 1970, 1990, 2000, and 2010 Mexican Demographic Censuses.

# Male educational composition Brazil, 1970–2010




Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

# Male educational composition Mexico, 1960–2010




Source: 1960, 1970, 1990, 2000, and 2010 Mexican Demographic Censuses.

# Brazilian micro-data

- **Brazilian Censuses**: 1970, 1980, 1991, 2000, and 2010.
- **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

| Year | Area | Age-education group<br>G11–G44 | Log of mean earnings<br>$\log(Y_{git})$ | Distr. of male pop.<br>P11–P44 | P11 | P12 | P13 | P14 | ... | P44 | Num. of obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | 110006 | 15–24 years & 0–3 educ. | 5.80 | 0.221 | 0.221 | 0 | 0 | 0 | ... | 0 | 2,016 |
| 1970 | 110006 | 15–24 years & 4–8 educ. | 6.02 | 0.102 | 0 | 0.102 | 0 | 0 | ... | 0 | 927 |
| 1970 | 110006 | 15–24 years & 9–11 educ. | 6.57 | 0.007 | 0 | 0 | 0.007 | 0 | ... | 0 | 62 |
| 1970 | 110006 | 15–24 years & 12+ educ. | 7.58 | 0.001 | 0 | 0 | 0 | 0.001 | ... | 0 | 11 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1970 | 110006 | 50–64 years & 12+ educ. | 7.91 | 0.002 | 0 | 0 | 0 | ... | ... | 0.002 | 15 |
| ... | ... | ... | ... | ... | ... | ... | ... | | ... | ... | ... |

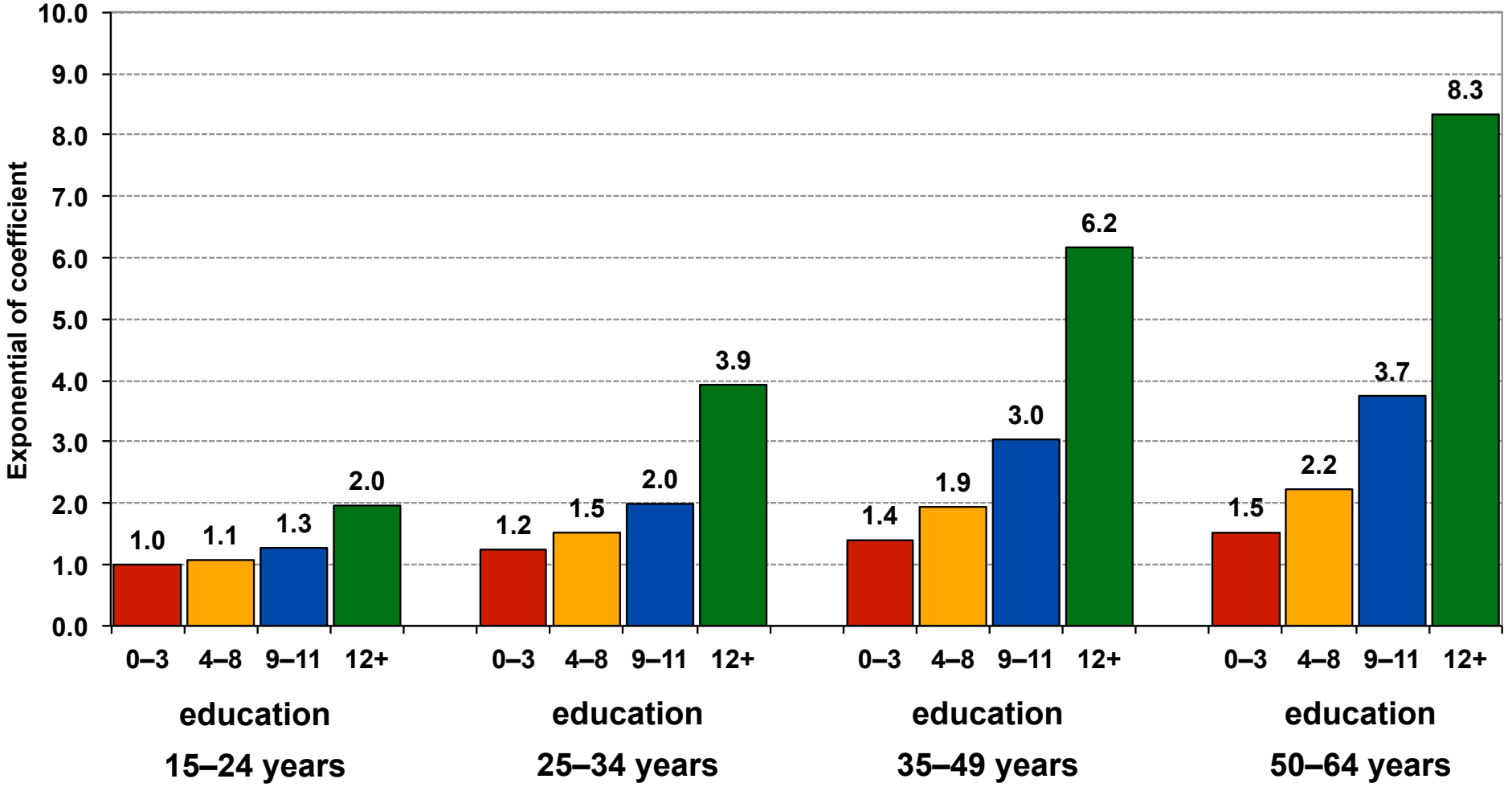
# Fixed effects models

| | Baseline model | Composition model |
|---|---|---|
| **Dependent variable** | | |
| Logarithm of the mean real monthly earnings by age-education group, area, and time | $\log(Y_{git})$ | $\log(Y_{git})$ |
| **Independent variables** | | |
| 16 age-education indicators * time | $(G_{11}–G_{44}) * \theta_t$ | $(G_{11}–G_{44}) * \theta_t$ |
| Distribution of male population into 16 age-education groups * time | | $(P_{11}–P_{44}) * \theta_t$ |
| Area-time fixed effects | $\alpha_{it}$ | $\alpha_{it}$ |

# Estimating the impacts of relative group size on male earnings

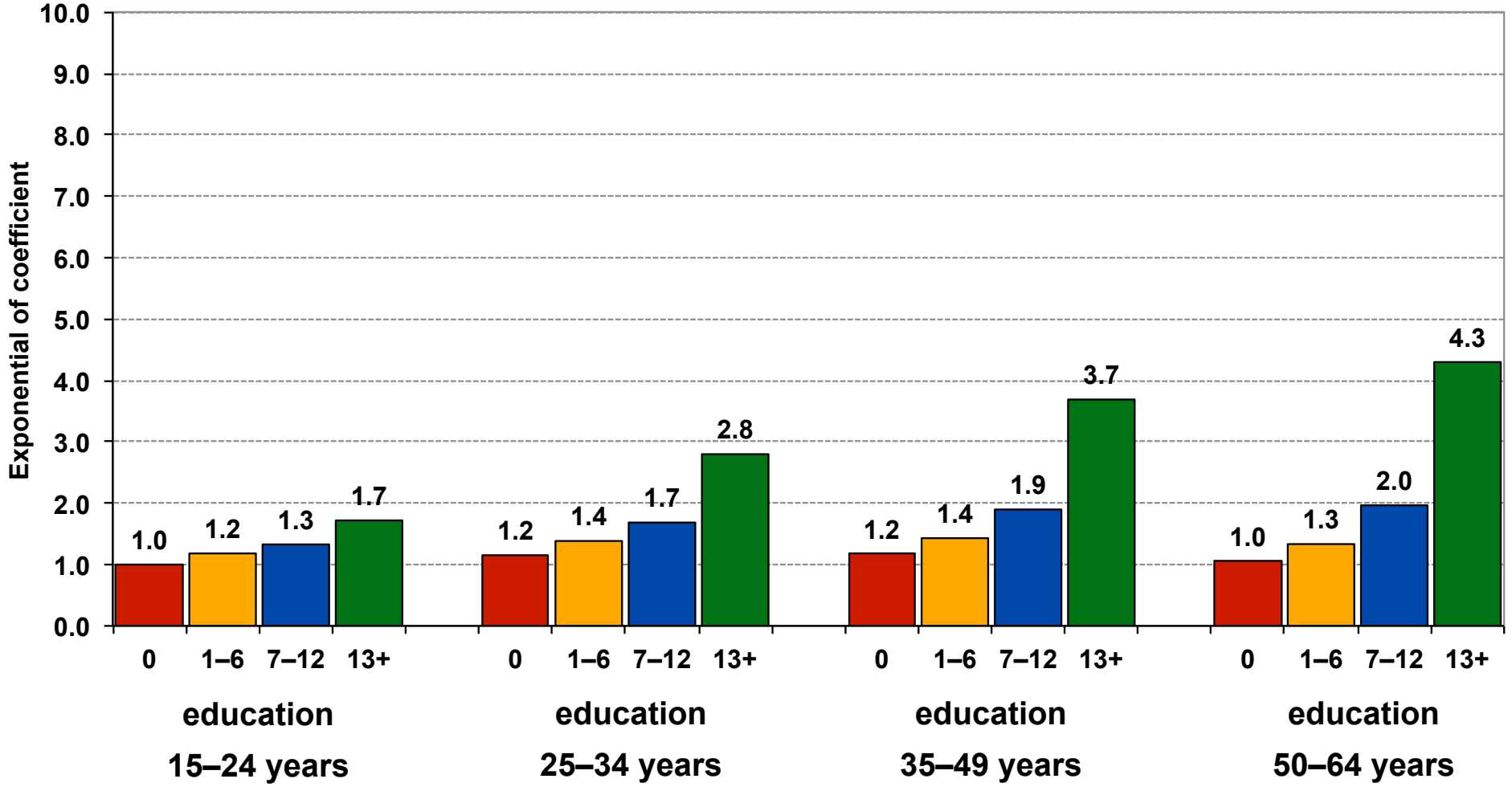
- **Baseline model:**
  - Effects of age-education indicators ($G_{11}$–$G_{44}$).
- **Composition model:**
  - Effects of age-education indicators ($G_{11}$–$G_{44}$).
  - Effects of age-education-group proportions ($P_{11}$–$P_{44}$).

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



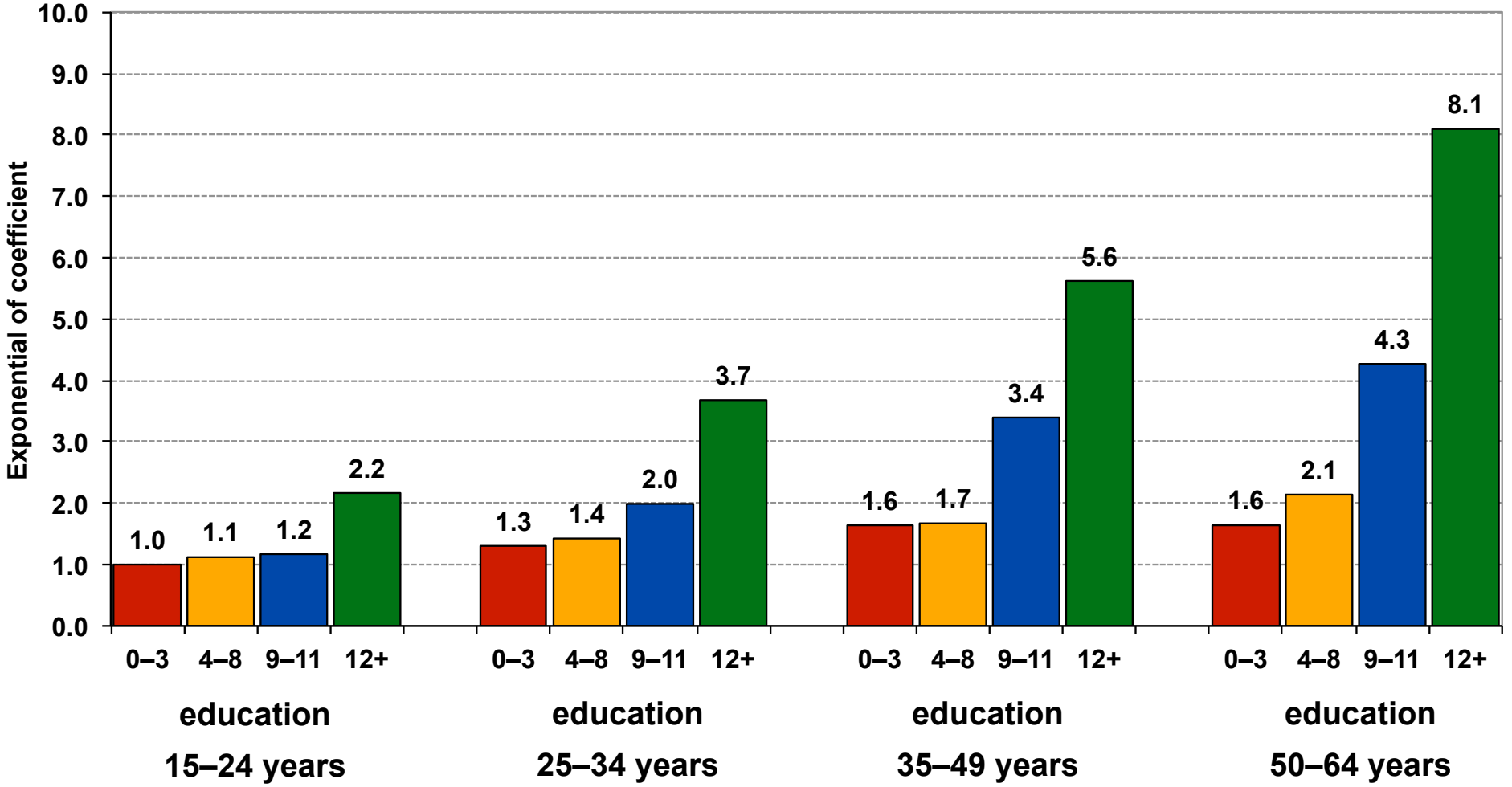

Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

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



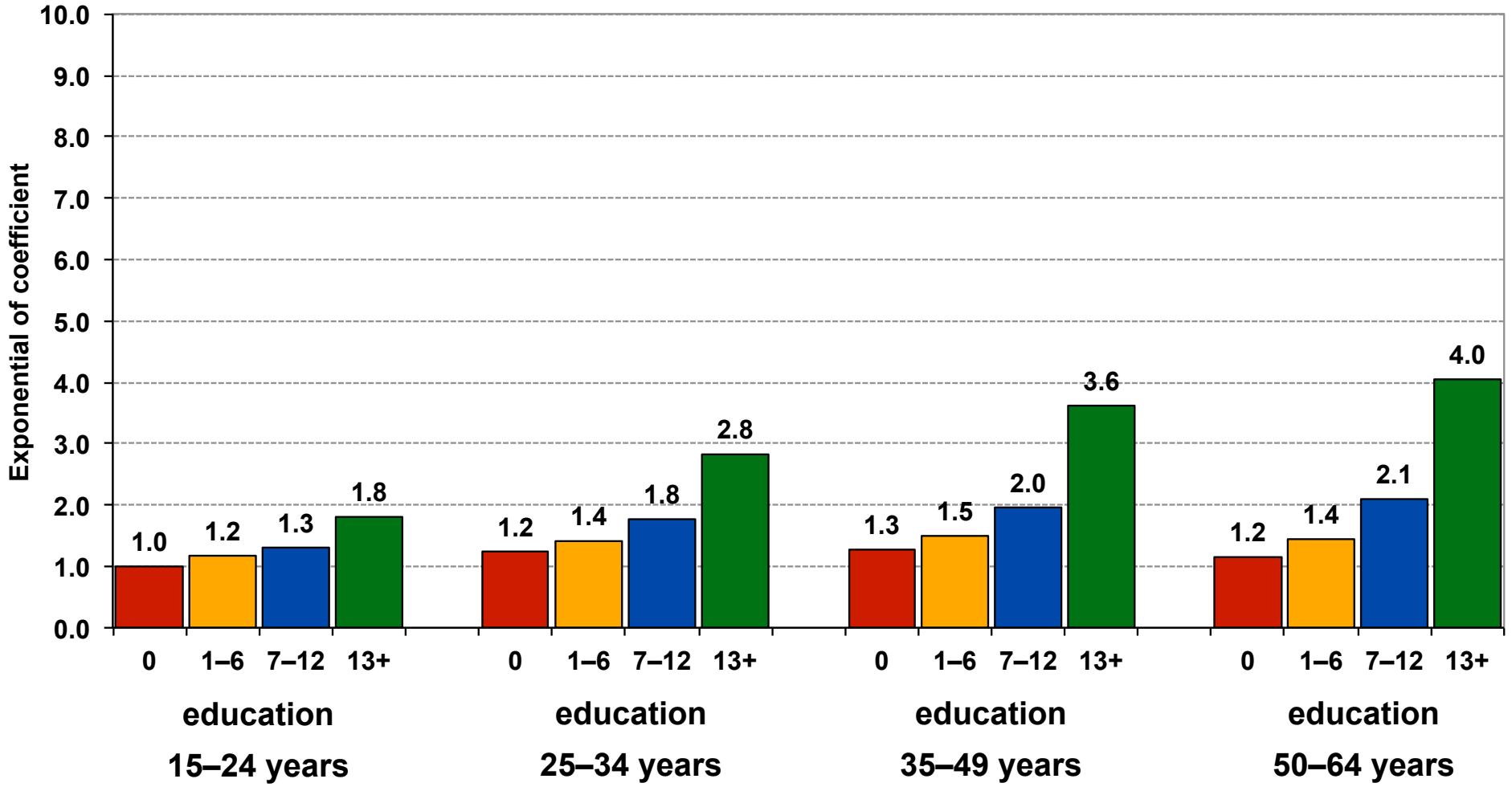

Source: 1990, 2000, and 2010 Mexican Demographic Censuses.

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




Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

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

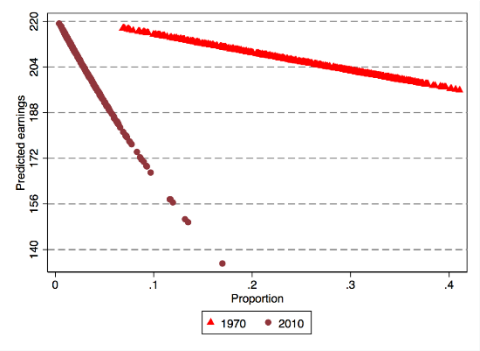



Source: 1990, 2000, and 2010 Mexican Demographic Censuses.

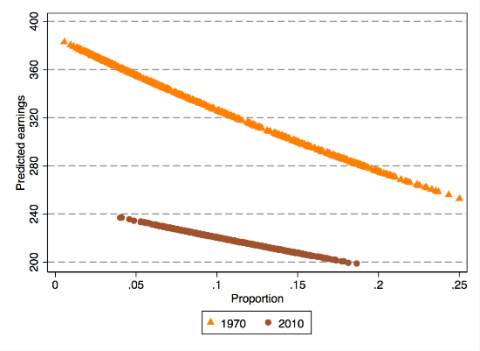
# Effects of group proportions in 502 areas ($P_{11}$–$P_{24}$), Brazil, 1970 and 2010

## 15–24 years

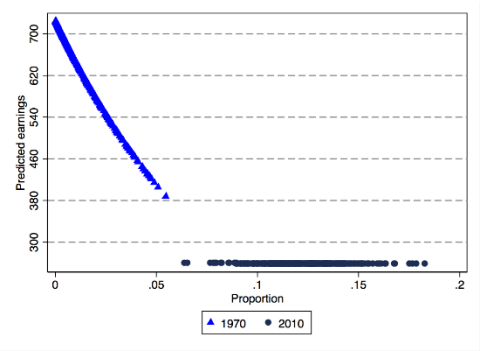
### 0–3 education



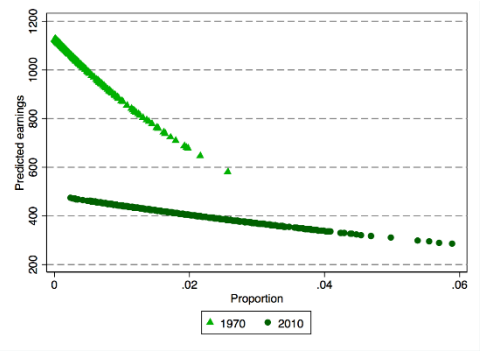

### 4–8 education




### 9–11 education

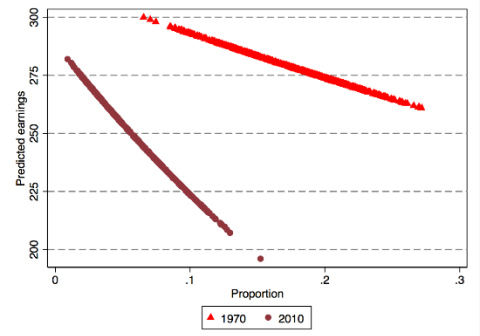



### 12+ education

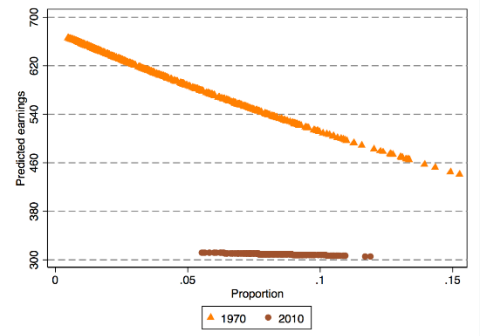



## 25–34 years

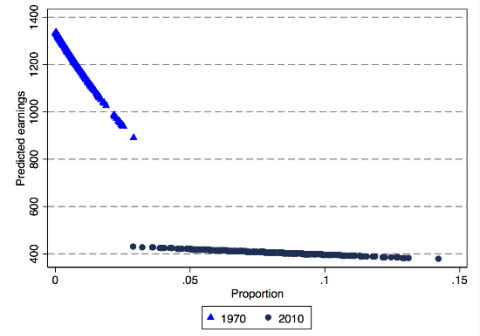
### 0–3 education



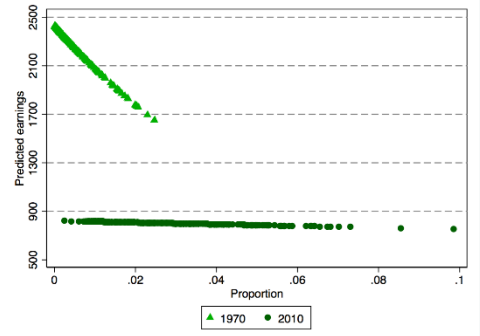

### 4–8 education




### 9–11 education




### 12+ education

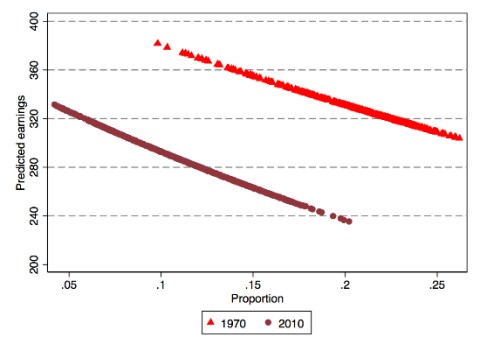



Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

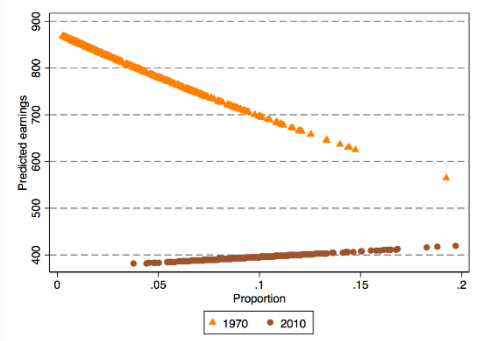
# Effects of group proportions in 502 areas ($P_{31}$–$P_{44}$), Brazil, 1970 and 2010

## 35–49 years

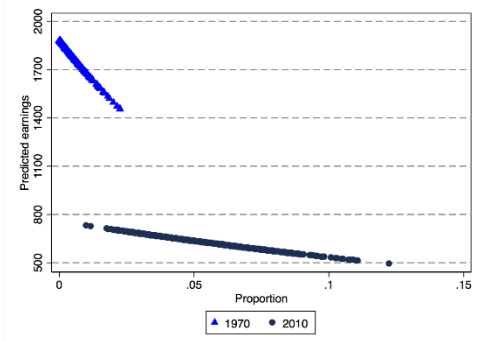
### 0–3 education



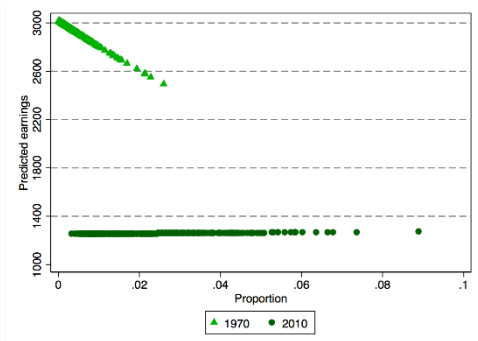

### 4–8 education




### 9–11 education

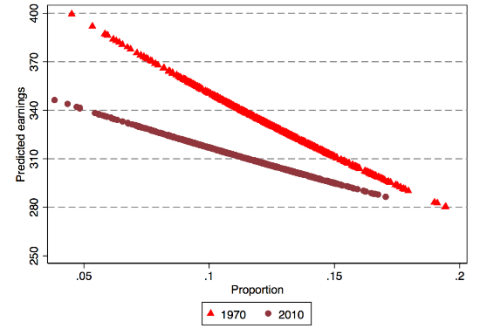



### 12+ education

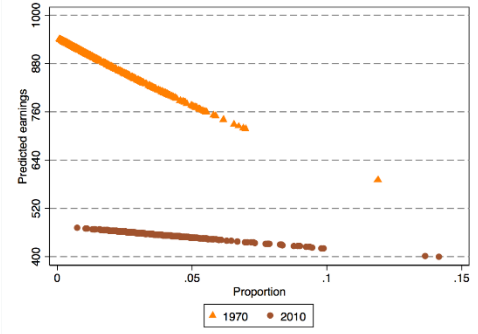



## 50–64 years

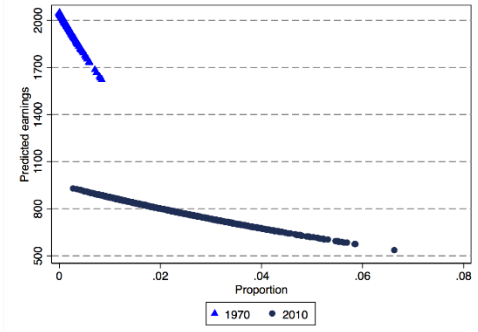
### 0–3 education



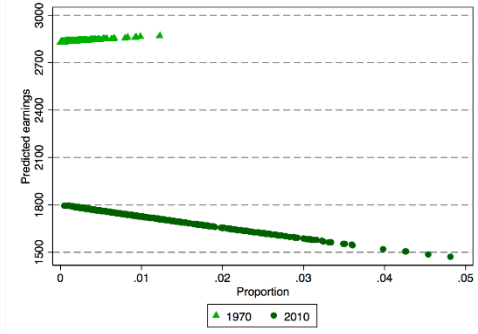

### 4–8 education




### 9–11 education




### 12+ education

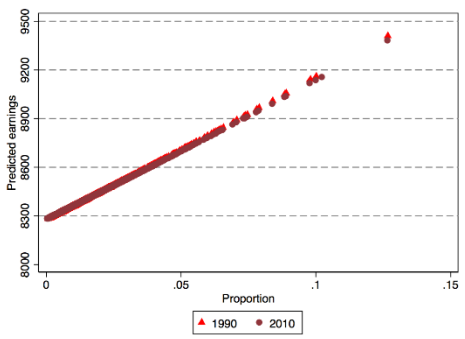



Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

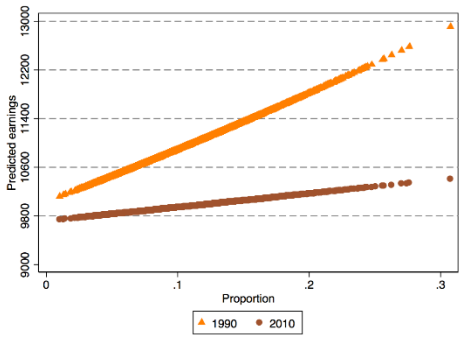
# Effects of group proportions in 2,456 areas ($P_{11}$–$P_{24}$), Mexico, 1990 and 2010

## 15–24 years

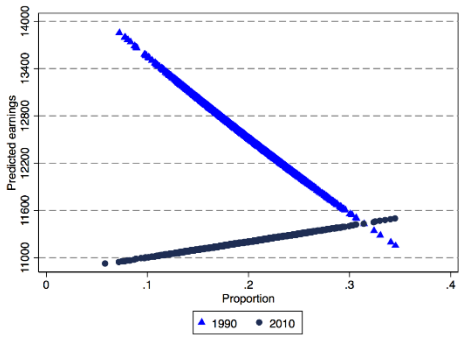
### 0 education



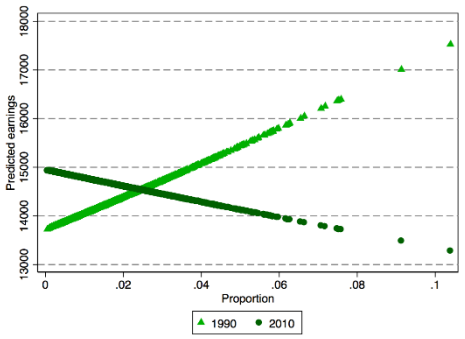

### 1–6 education




### 7–12 education

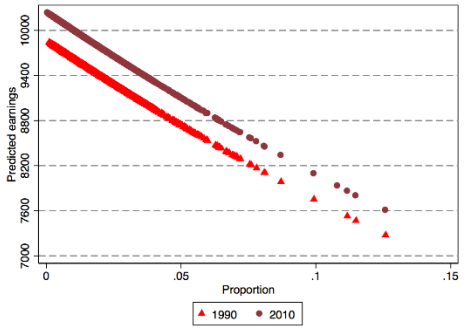



### 13+ education

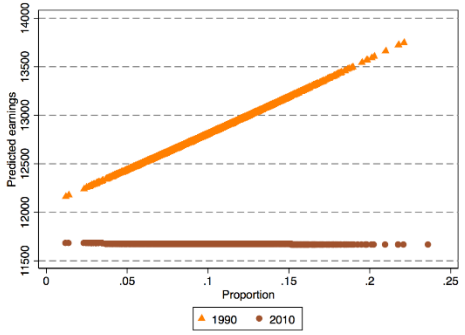



## 25–34 years

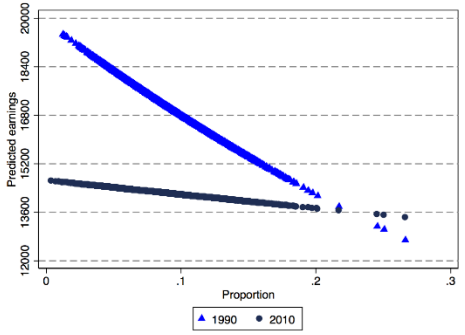
### 0 education



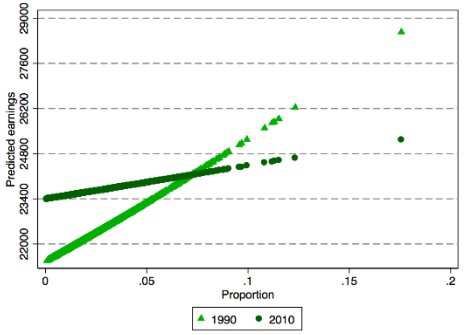

### 1–6 education




### 7–12 education




### 13+ education

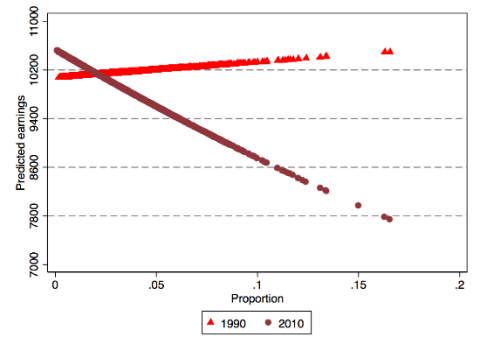



Source: 1990, 2000, and 2010 Mexican Demographic Censuses.

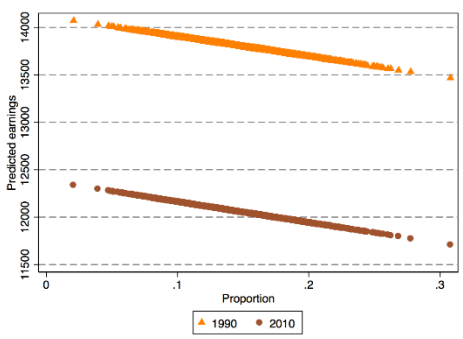
# Effects of group proportions in 2,456 areas ($P_{31}$–$P_{44}$), Mexico, 1990 and 2010

## 35–49 years

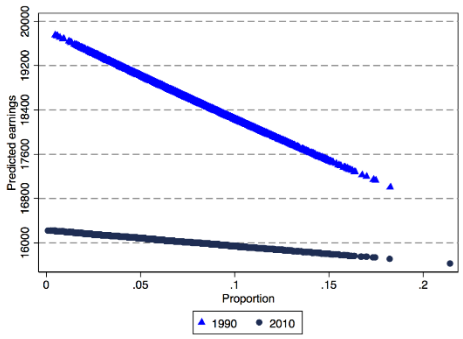
### 0 education



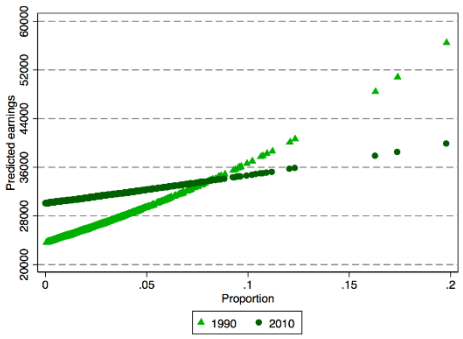

### 1–6 education




### 7–12 education

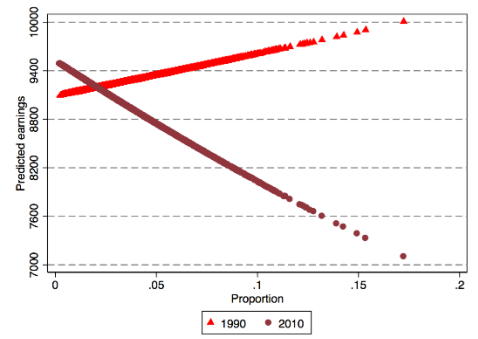



### 13+ education

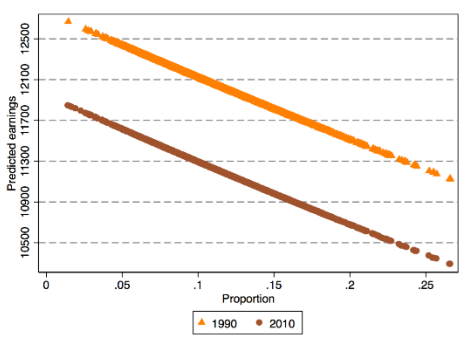



## 50–64 years

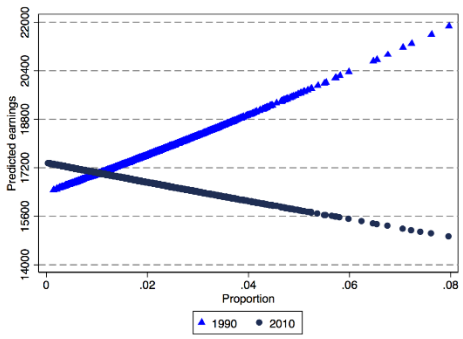
### 0 education



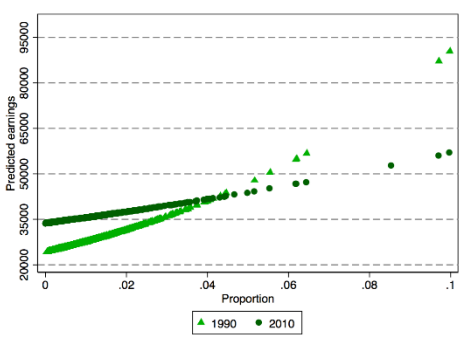

### 1–6 education




### 7–12 education




### 13+ education




Source: 1990, 2000, and 2010 Mexican Demographic Censuses.

# How does the concentration of skilled workers affect the social and private 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:** log of individual labor income.
- Variables of interest:
  - **Years of schooling:** measures 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:**

$$P_{(t)} = \beta_0 + \beta_1 L_{1(t-n)} + \beta_2 L_{2(t-n)} + \beta_3 L_{3(t-n)} + e$$

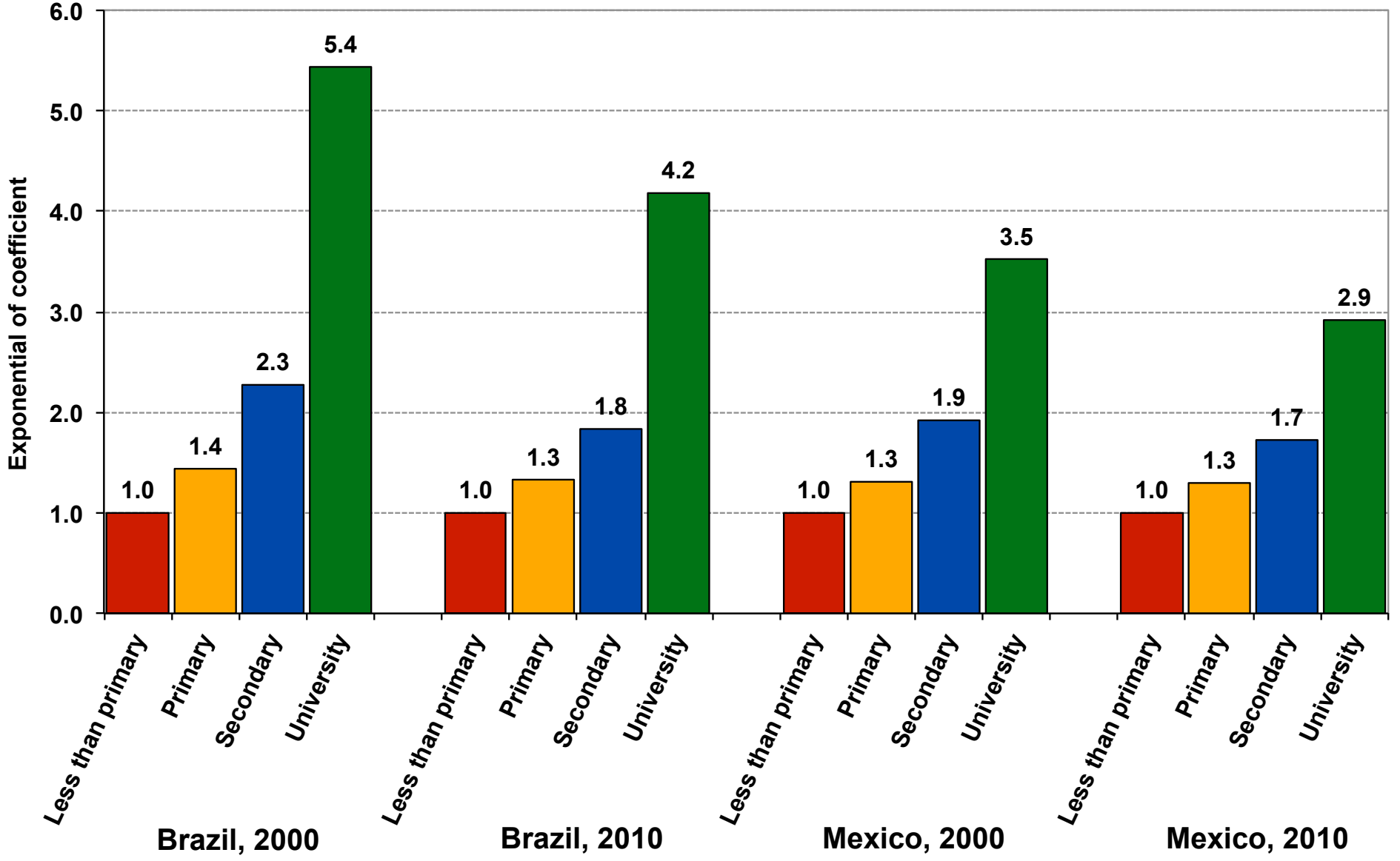
  - $P_{(t)}$: proportion of workers with high educational level (undergraduates) in time *t* for each investigated area.
  - $L_{1(t-n)}$: enrollment rate in high school in the previous census.
  - $L_{2(t-n)}$: young-age-dependency ratio in the previous census.
  - $L_{3(t-n)}$: local average earnings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

- **Estimating private and social returns to education:**

$$log(Y_{git}) = \beta_0 + \beta_1 X_1 + e_{git}$$

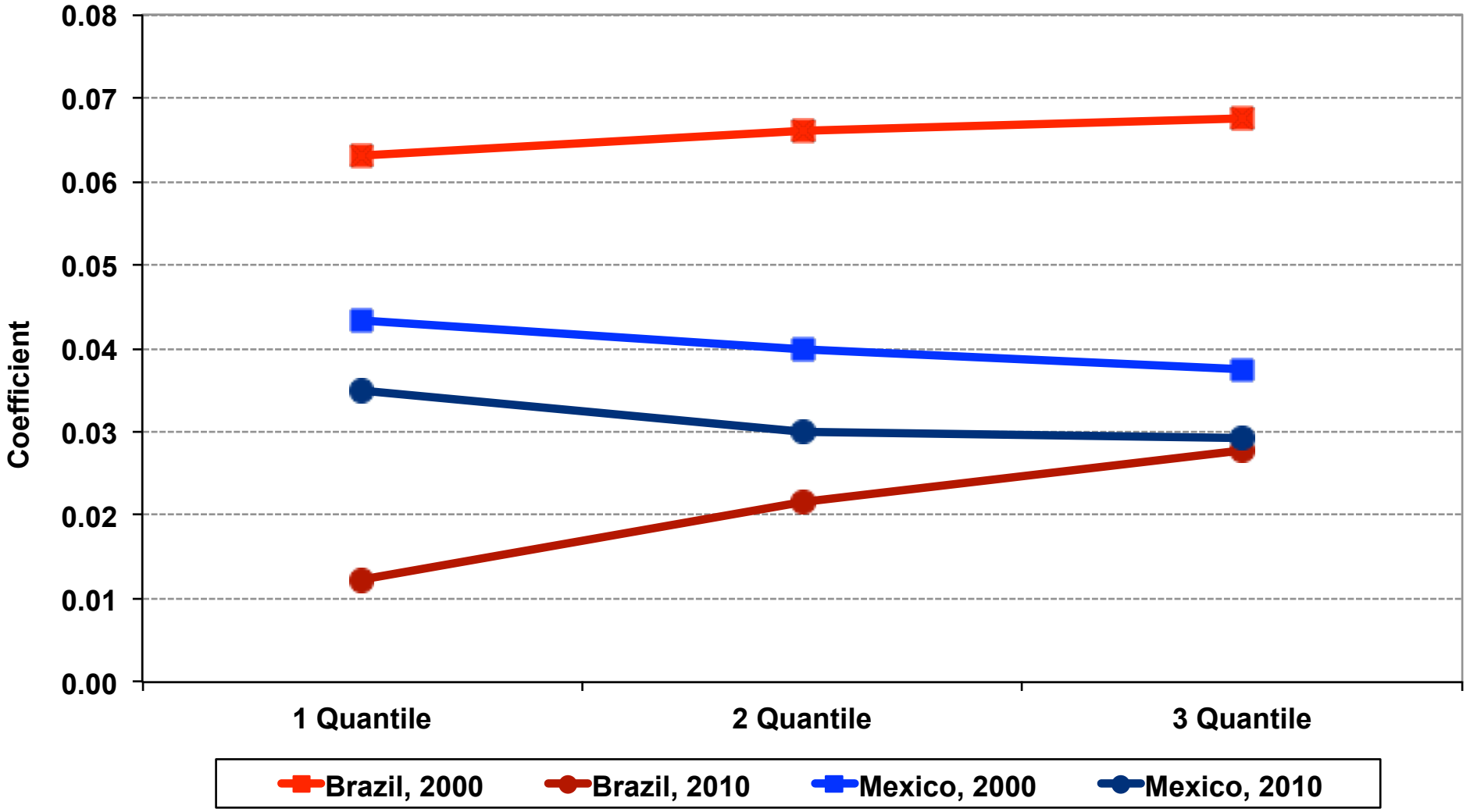
  - $log(Y_{git})$: logarithm of individual earnings.
  - Two main variables of interest are individual schooling and proportion of workers with high educational level.

# Private returns to education, 2000 and 2010




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.