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

Ernesto F. L. Amaral
RAND Corporation
eamaral@rand.org

Bernardo L. Queiroz
Universidade Federal de Minas Gerais
lanza@cedeplar.ufmg.br

Júlia A. Calazans
Universidade Federal de Minas Gerais
jucalazans@cedeplar.ufmg.br

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.

(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 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.

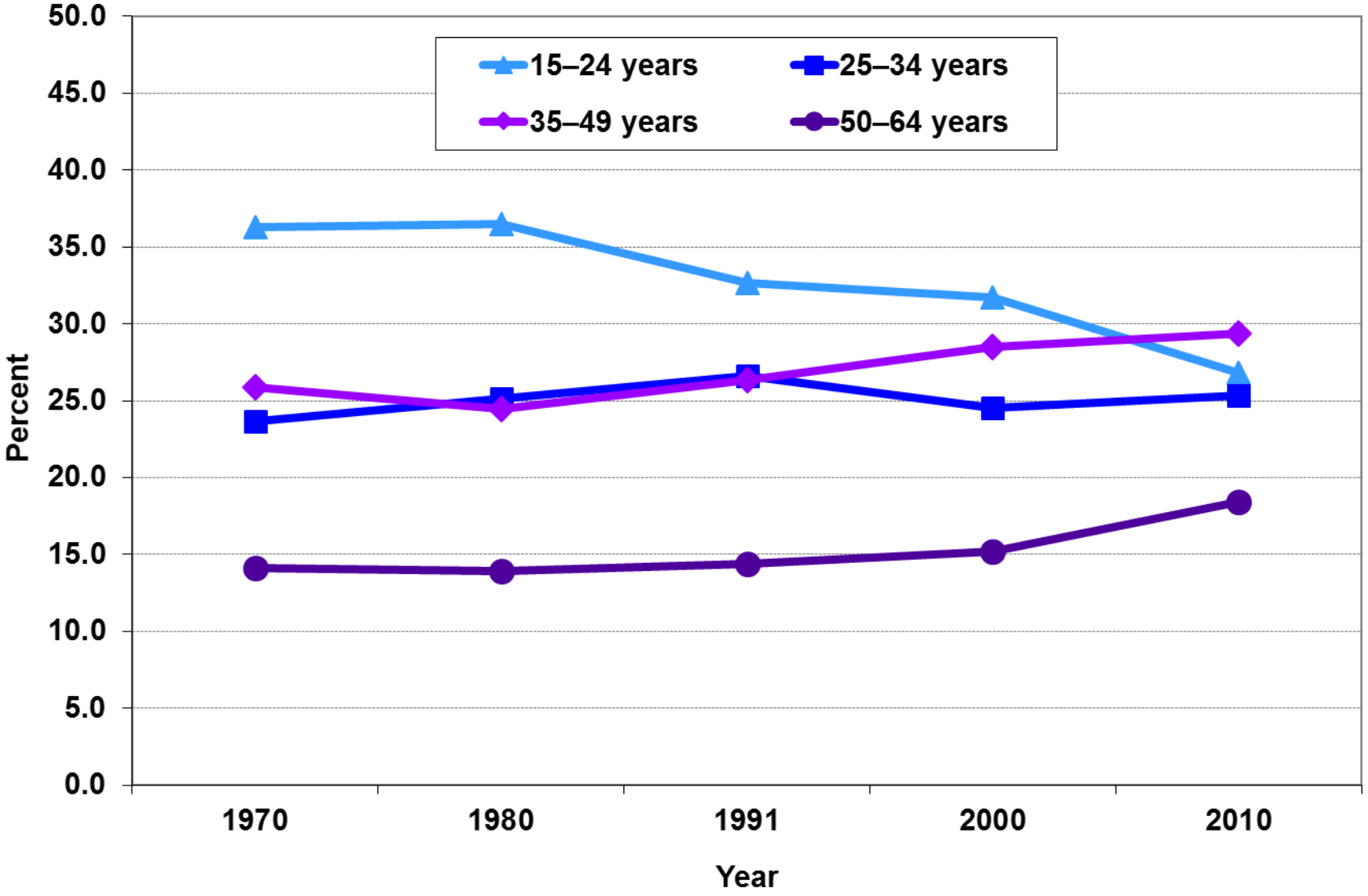
Brazil & Mexico

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

Total Fertility Rate	1970	2010
Brazil	5.8	1.9
Mexico	6.8	2.3

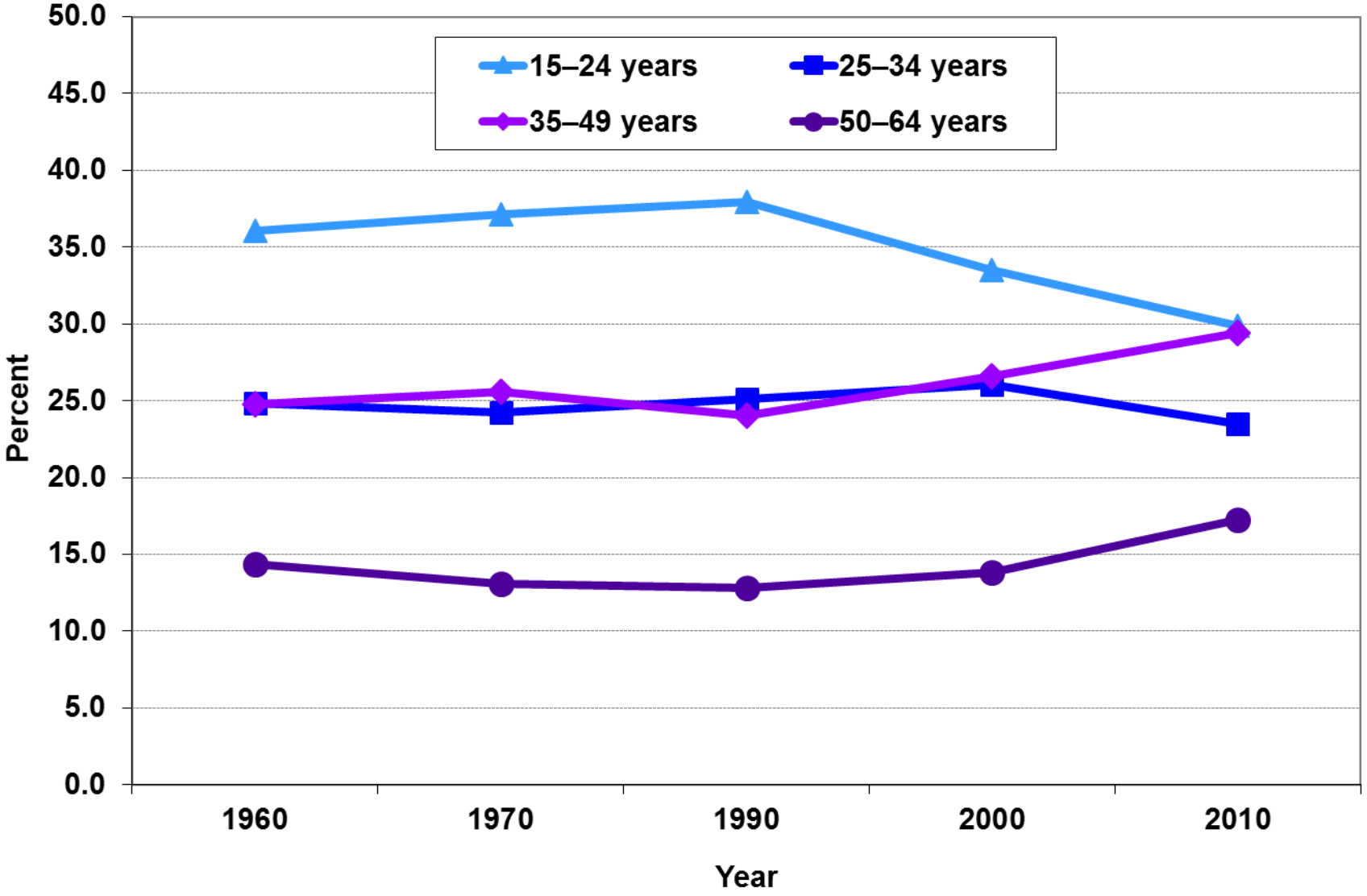
- **Educational expansion** began late and has a long way to go (Barro and Lee 2001; Marcílio 2001, 2005; Rios-Neto and Guimarães 2010).
- Improvement in educational attainment coincides with decline in family size and school-age children (Lam and Marteleto 2005, 2008).
- These countries have data that captures information on:
  - Population aging.
  - Educational improvement.
  - Geographic variation.

Male age composition Brazil, 1970–2010



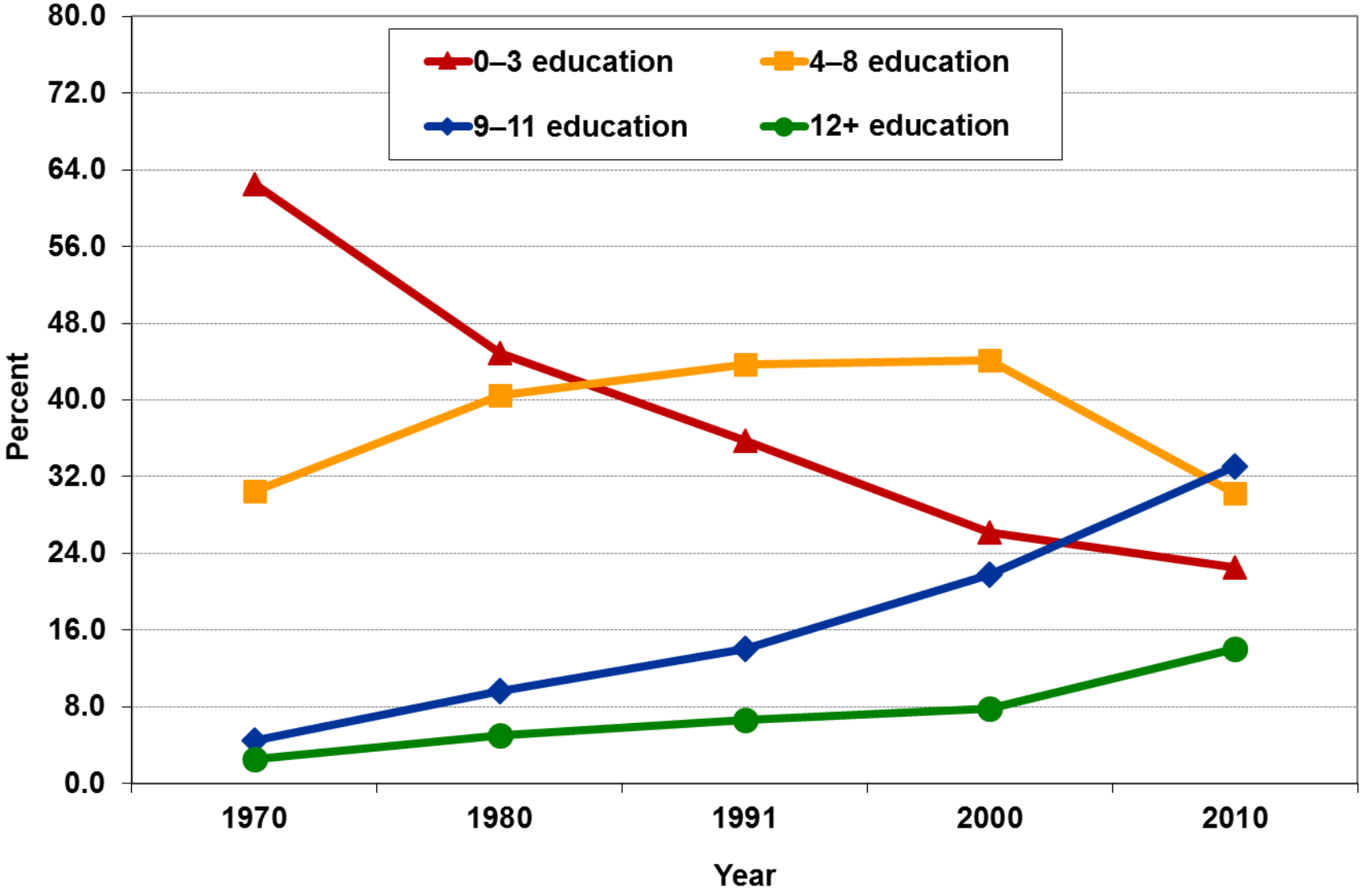
Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

Male age composition Mexico, 1960–2010



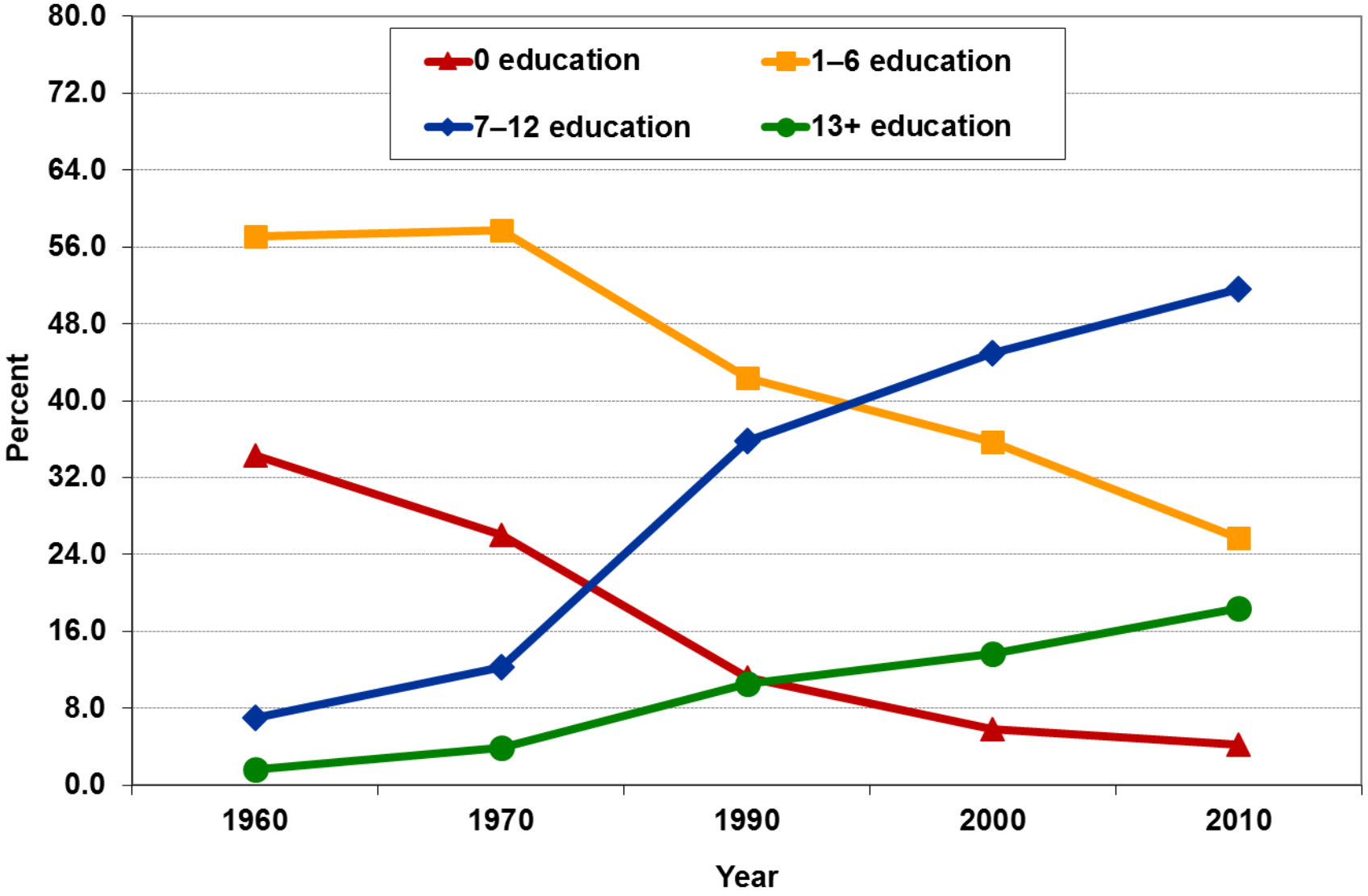
Source: 1960, 1970, 1990, 2000, and 2010 Mexican Demographic Censuses.

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 G11–G44	Log of mean earnings $\log(Y_{git})$	Distr. of male pop. 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
...	...	...	...	...	...	...	...		...	...	...

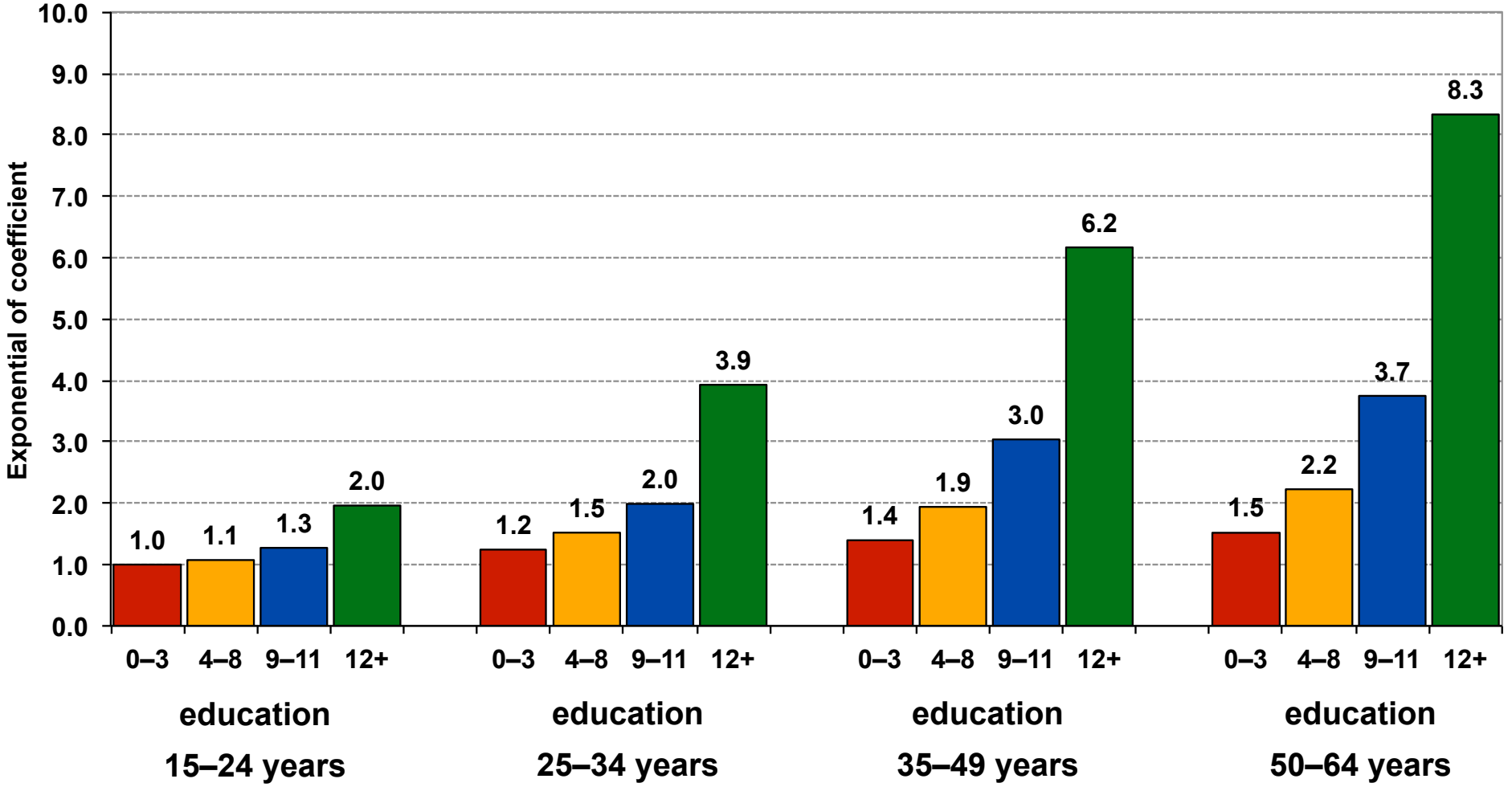
Fixed effects models

	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	α_{it}	α_{it}

Estimating the impacts of relative group size on male earnings

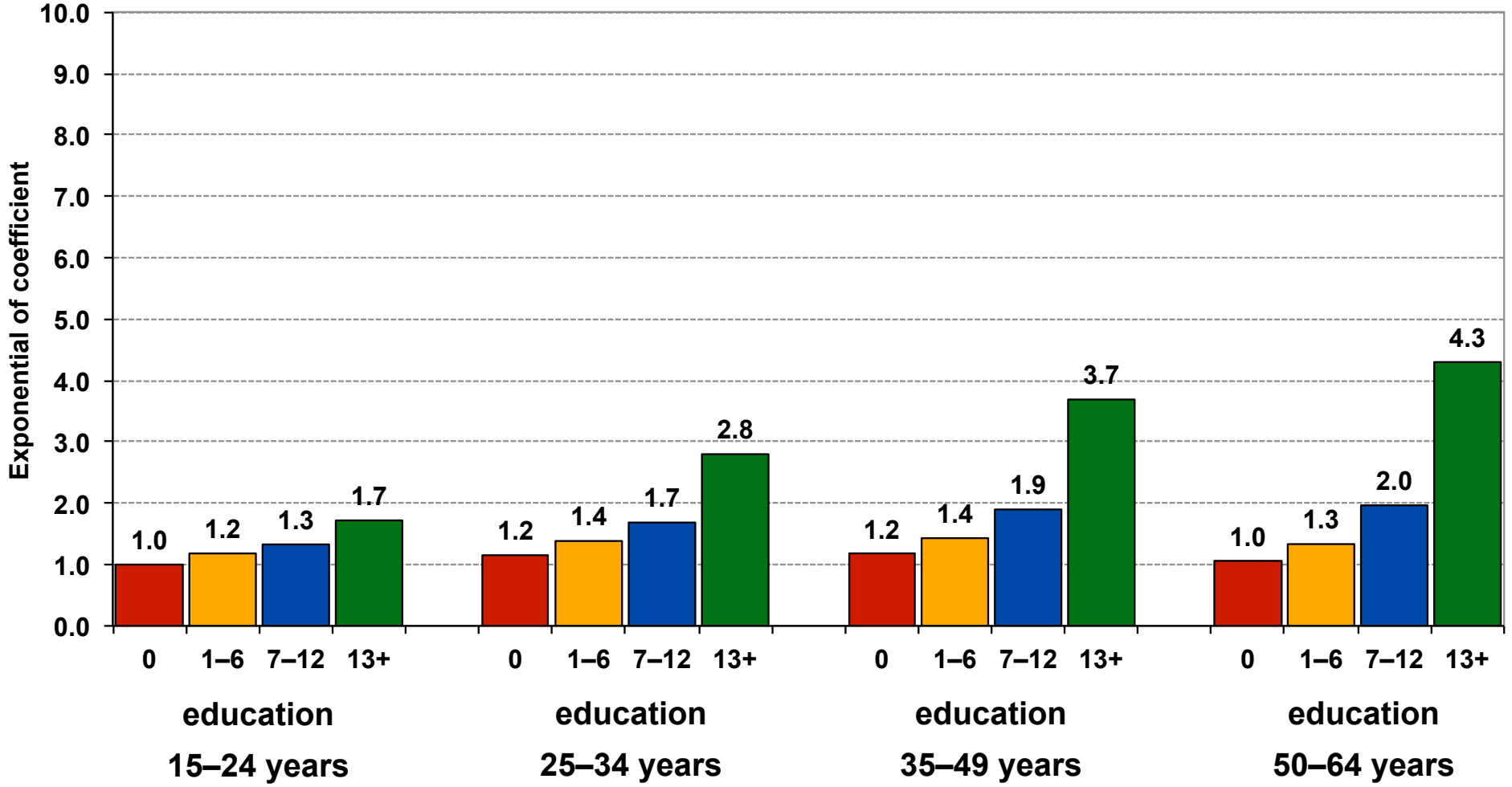
- **Baseline model:**
  - Effects of age-education indicators (G_{11}–G_{44}).
- **Composition model:**
  - Effects of age-education indicators (G_{11}–G_{44}).
  - Effects of age-education-group proportions (P_{11}–P_{44}).

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



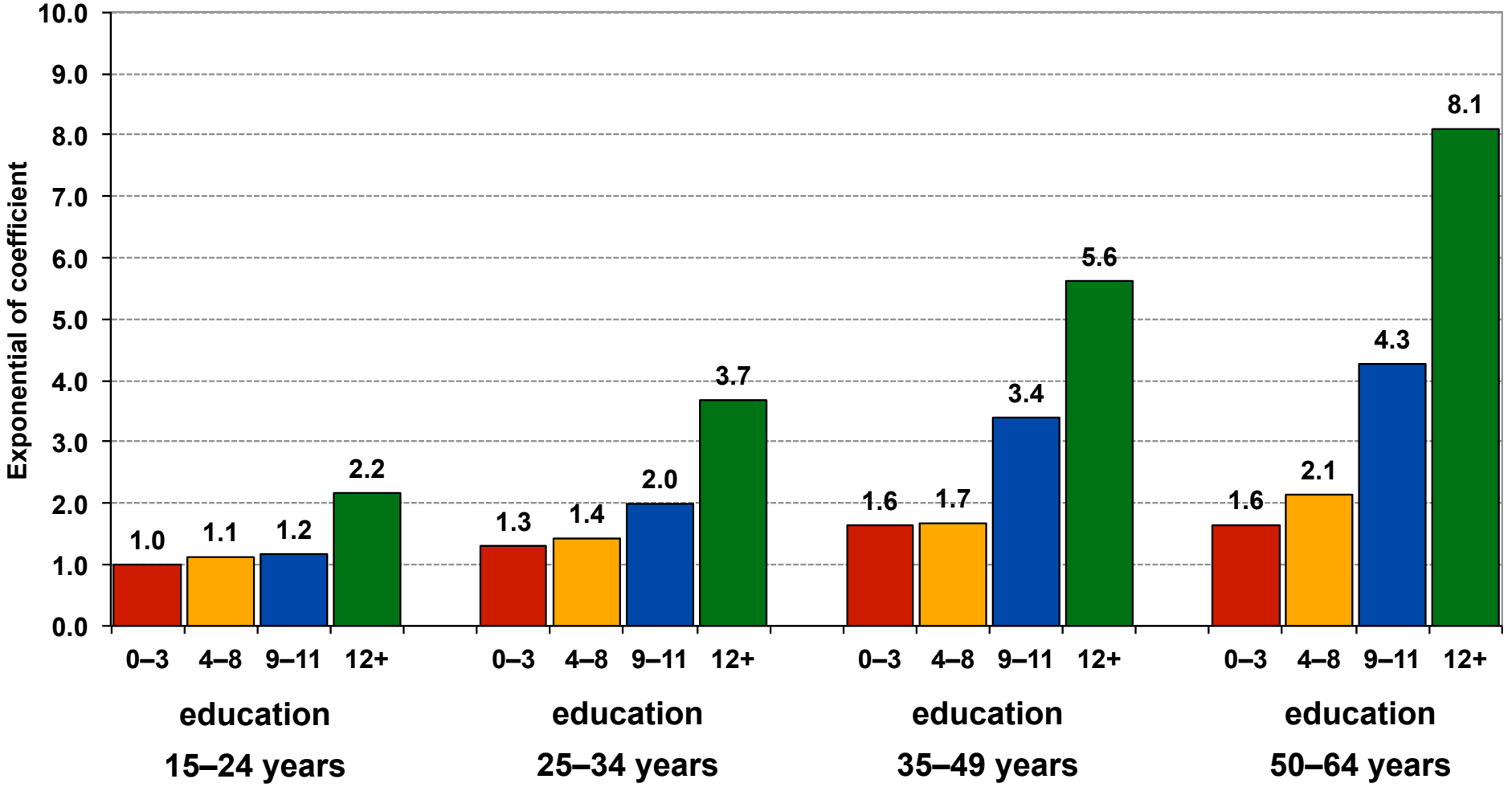
Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

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



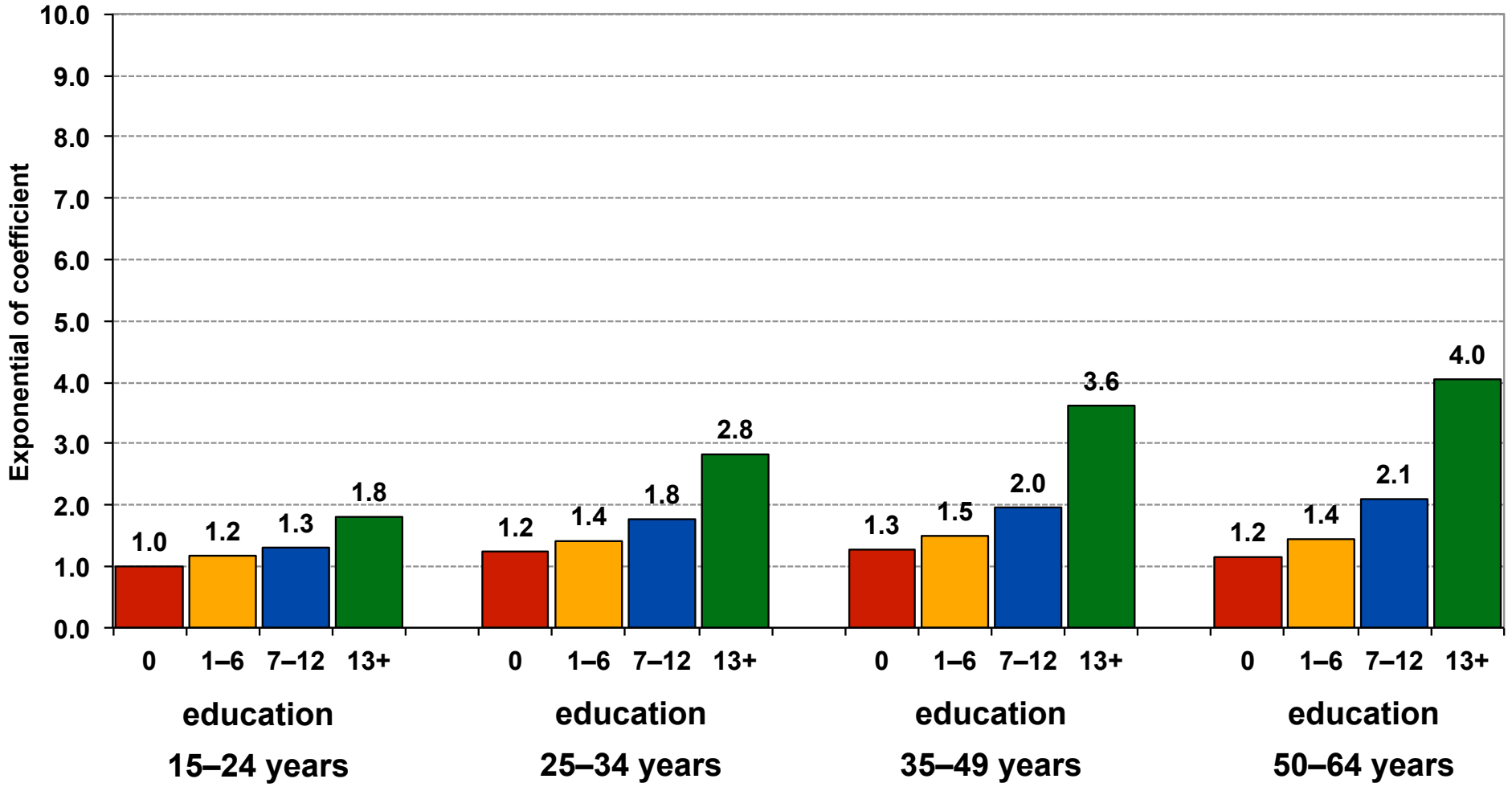
Source: 1990, 2000, and 2010 Mexican Demographic Censuses.

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



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

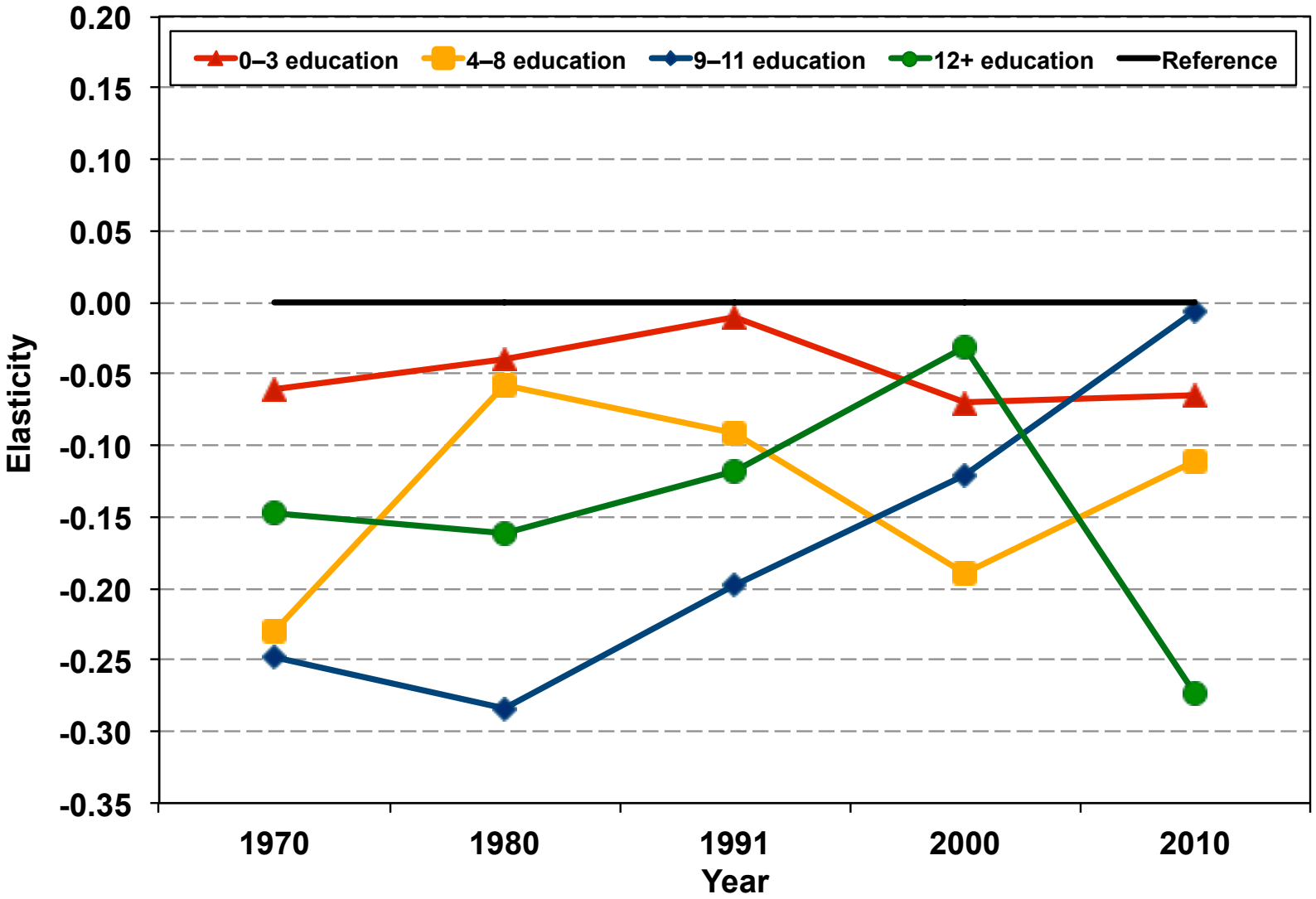
Effects of age-education indicators (G_{11}–G_{44}) Composition model, Mexico, 2010



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

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

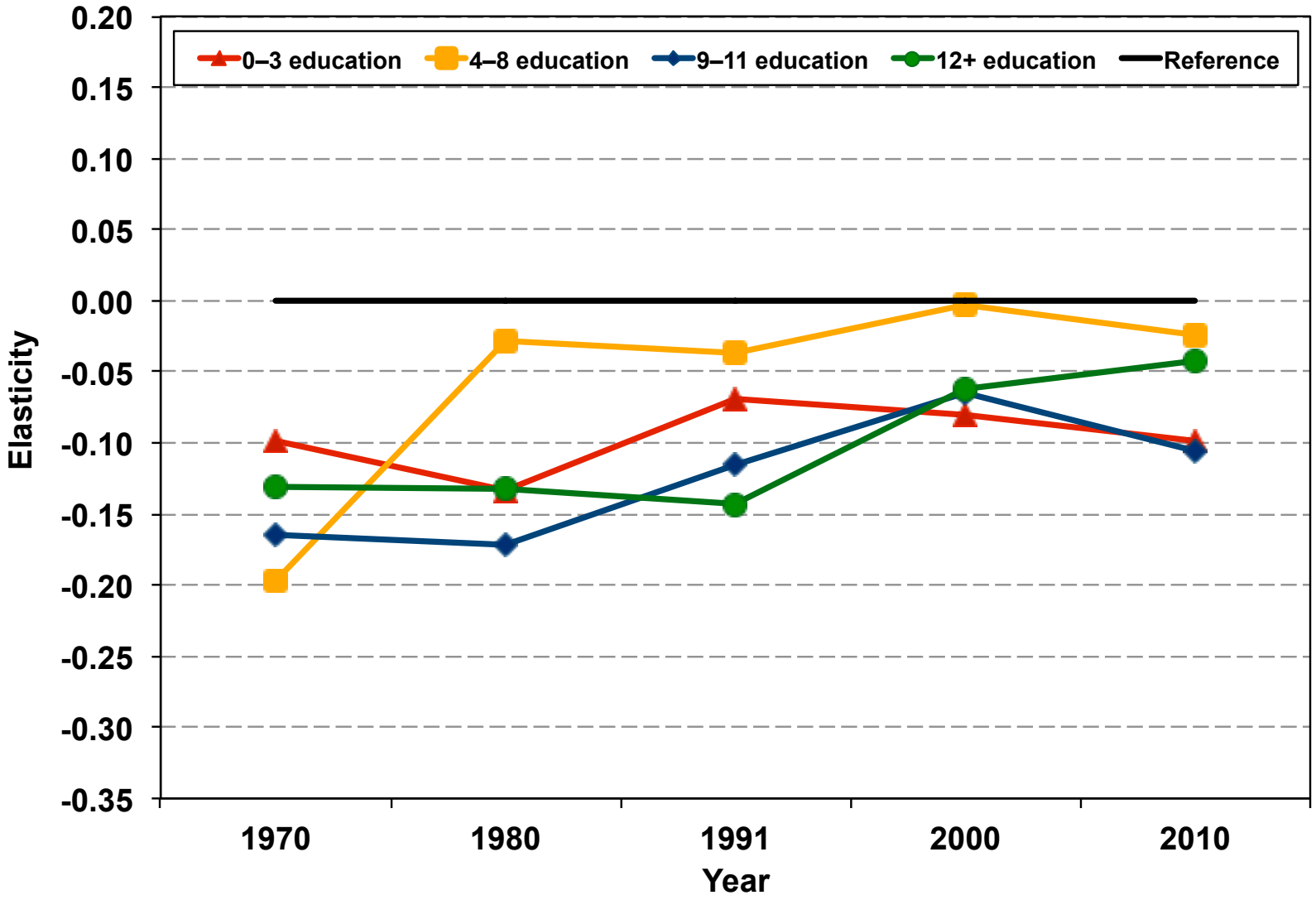
15–24 years



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

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

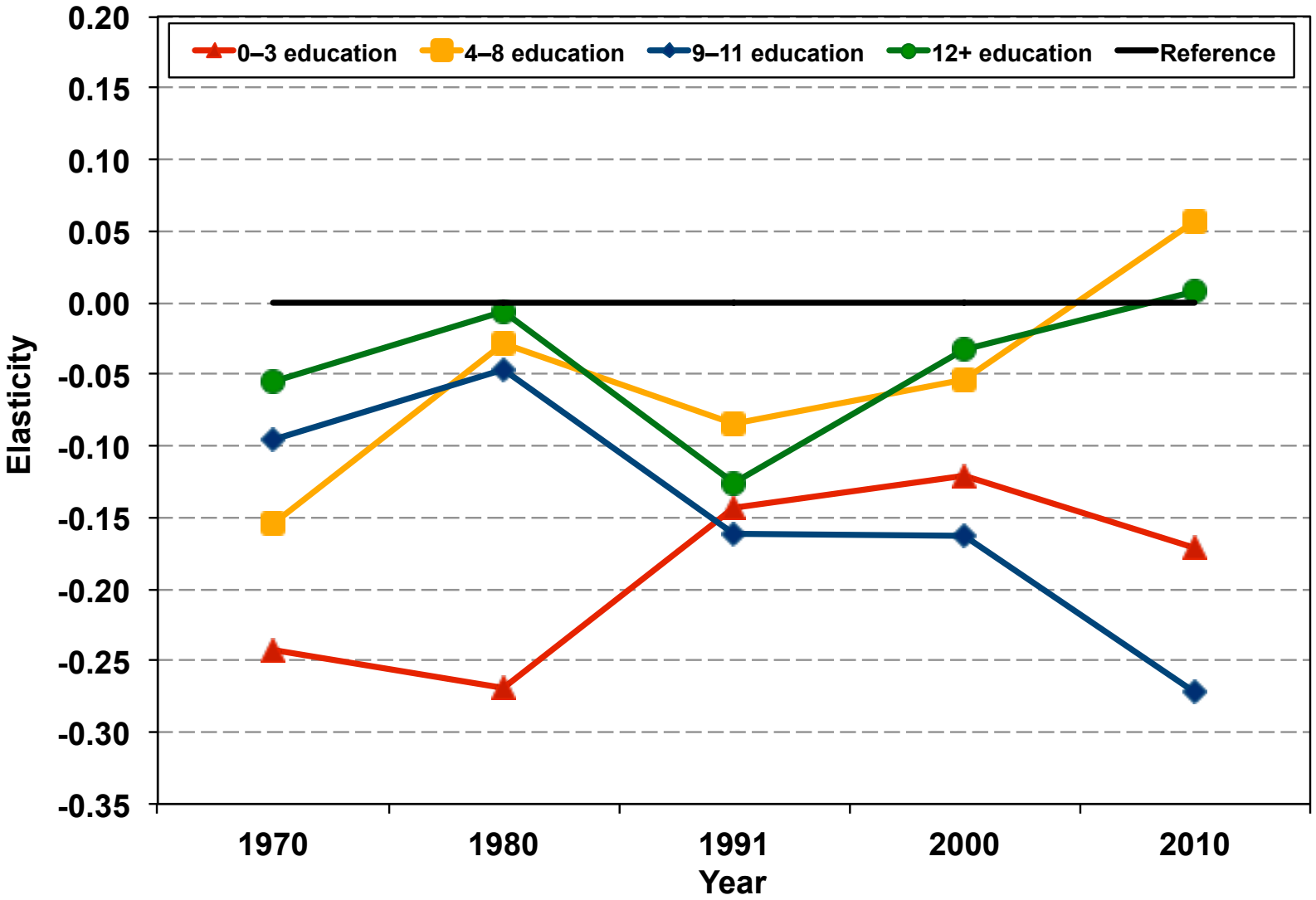
25–34 years



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

Effects of group proportions (P_{31}–P_{34}) on earnings, Brazil, 1970–2010

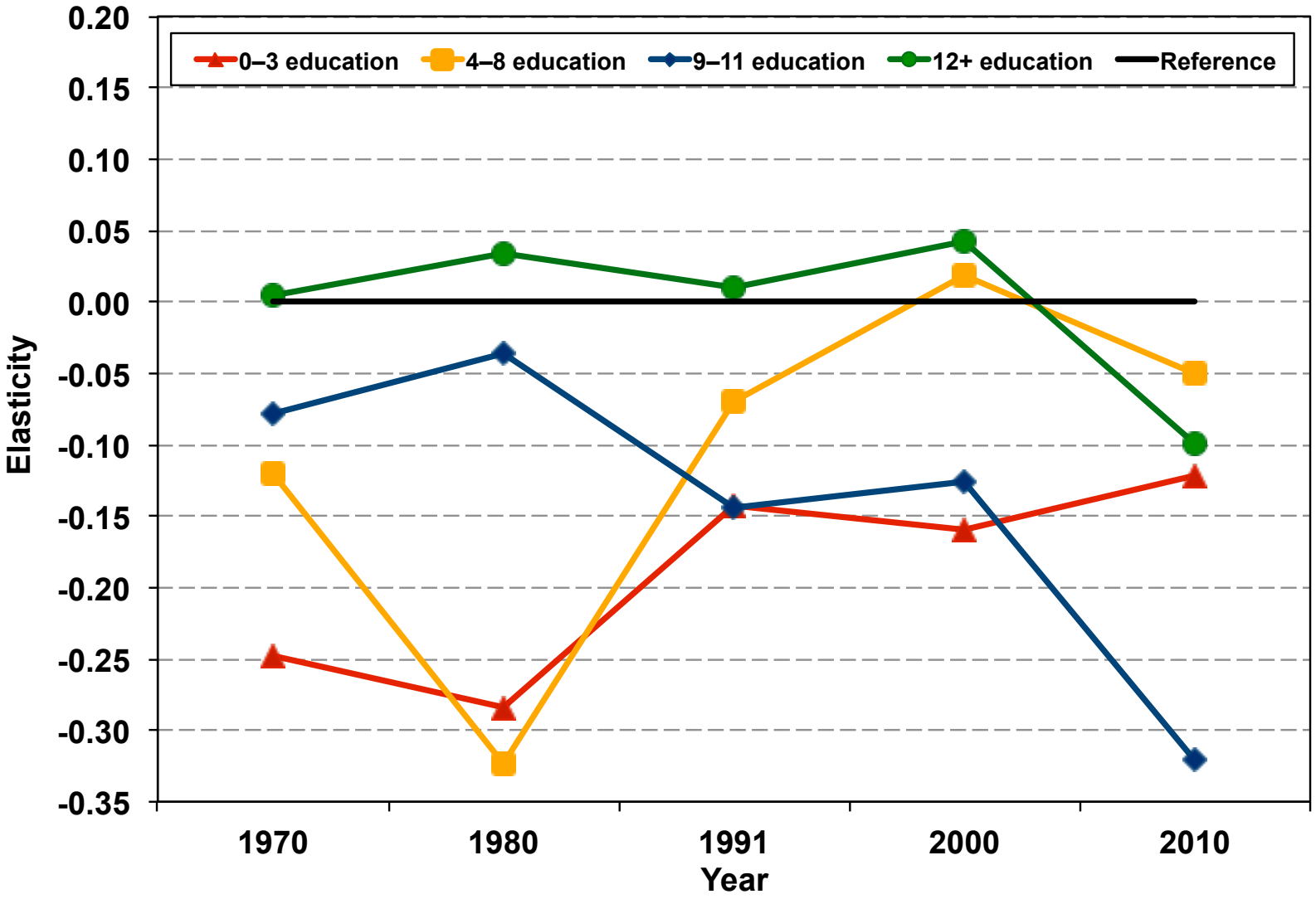
35–49 years



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

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

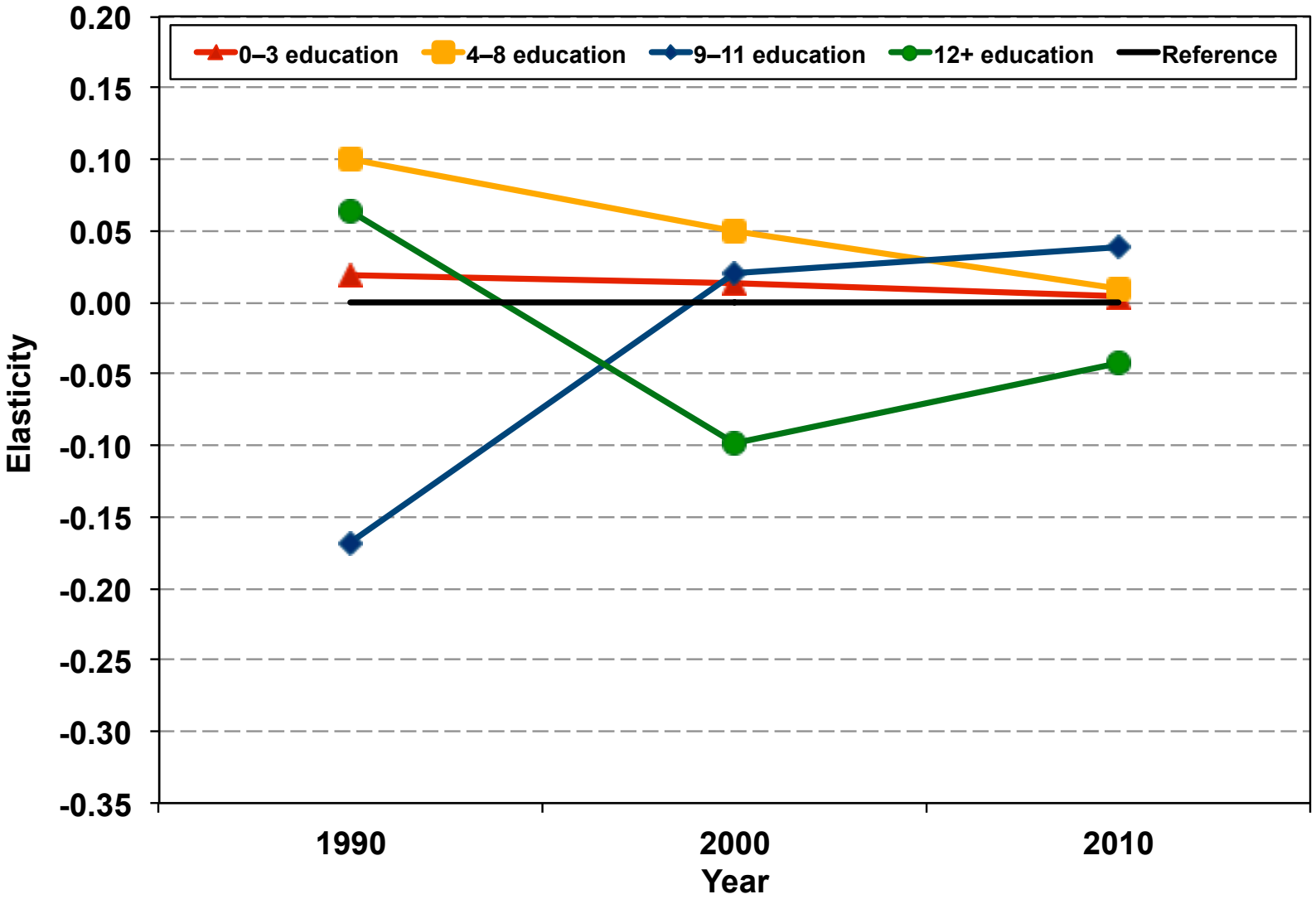
50–64 years



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

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

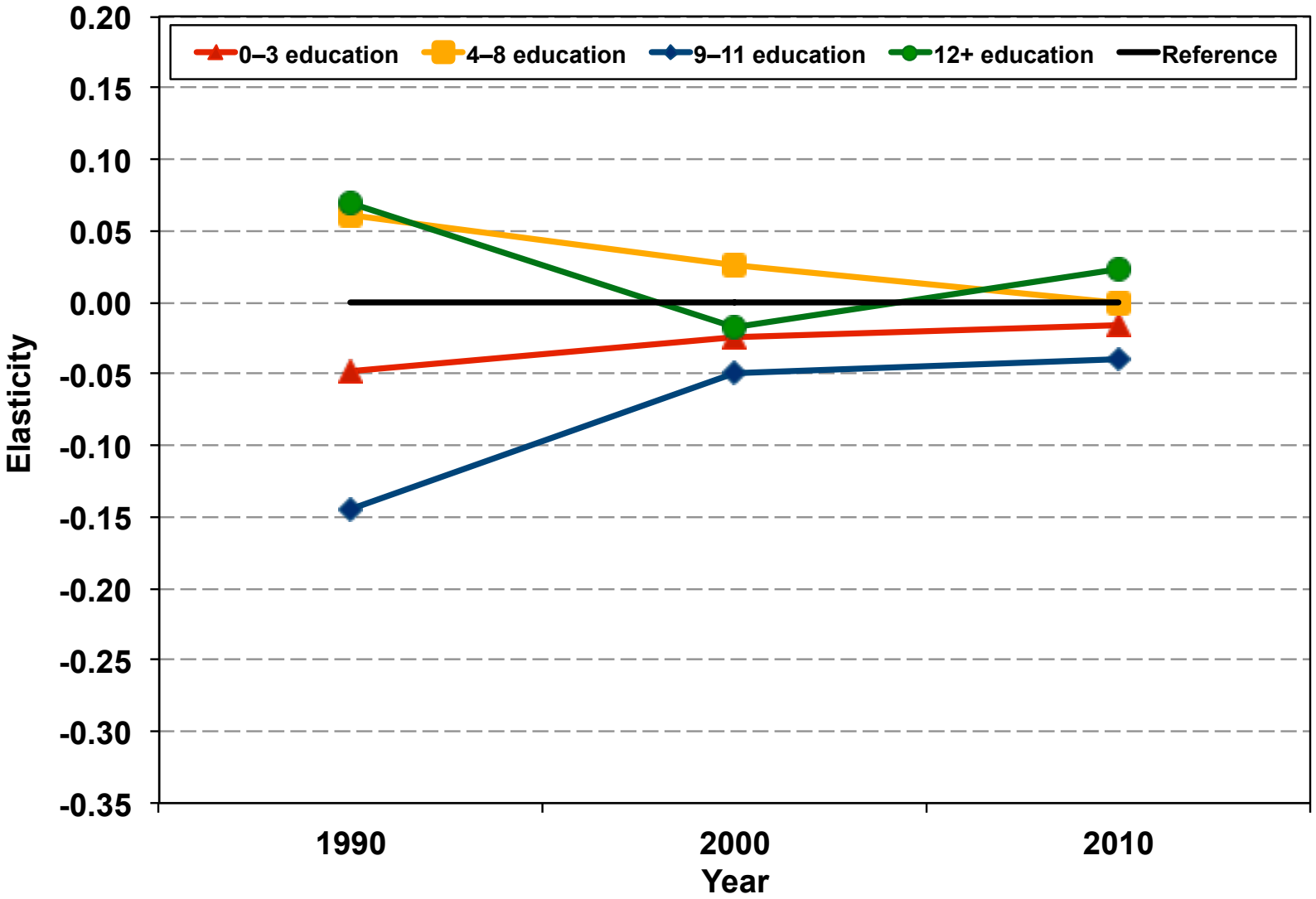
15–24 years



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

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

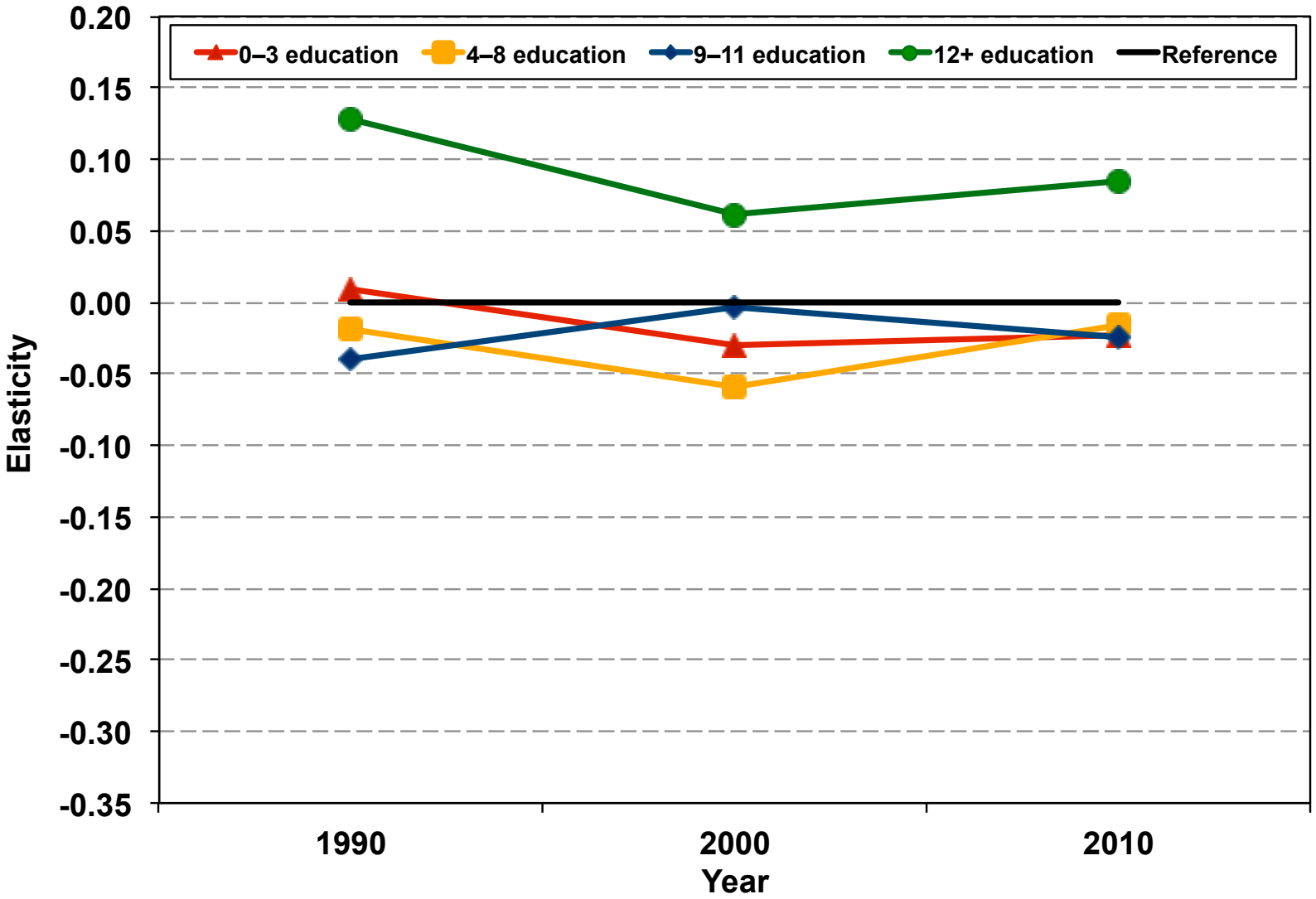
25–34 years



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

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

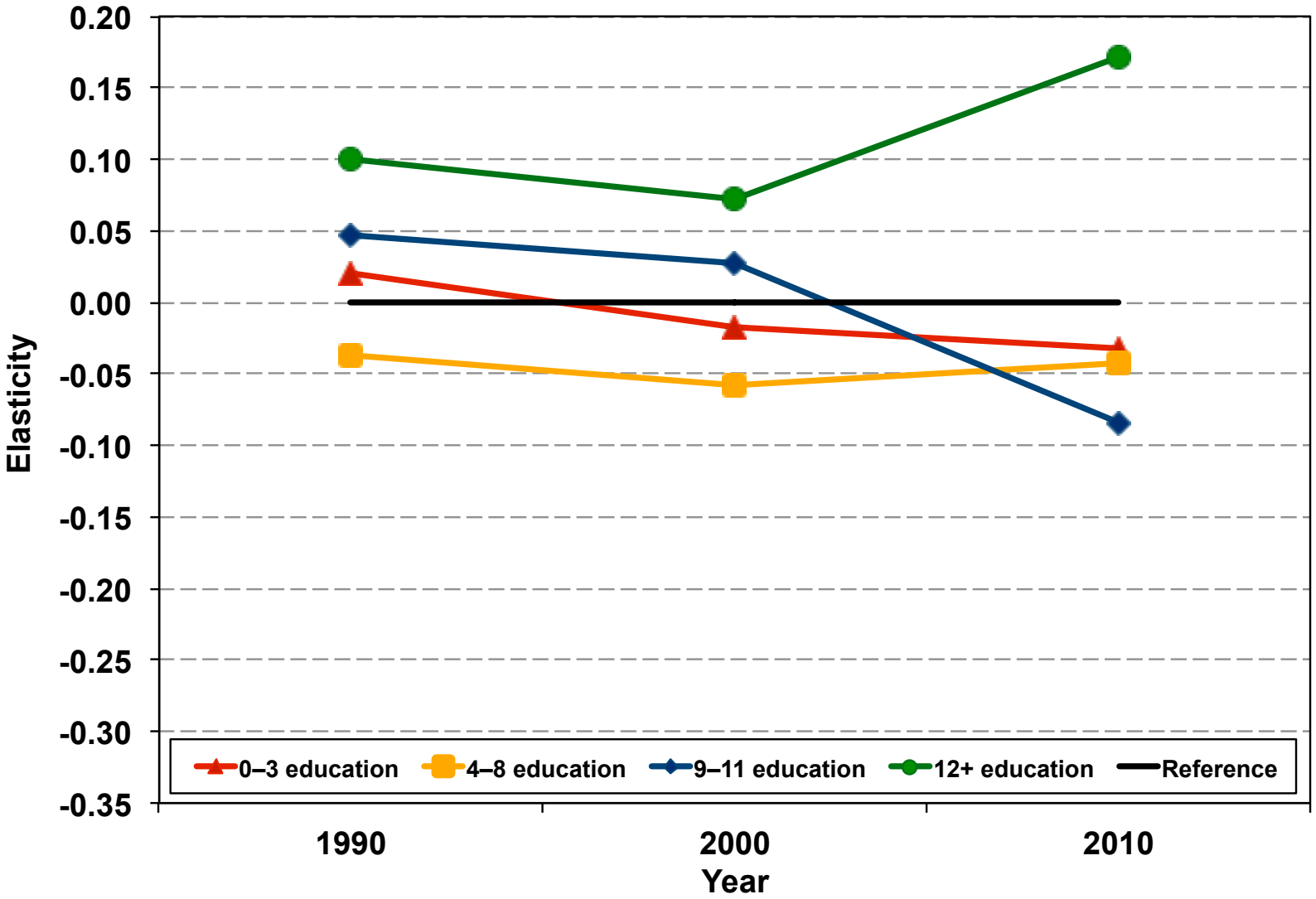
35–49 years



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

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

50–64 years



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

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:**

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

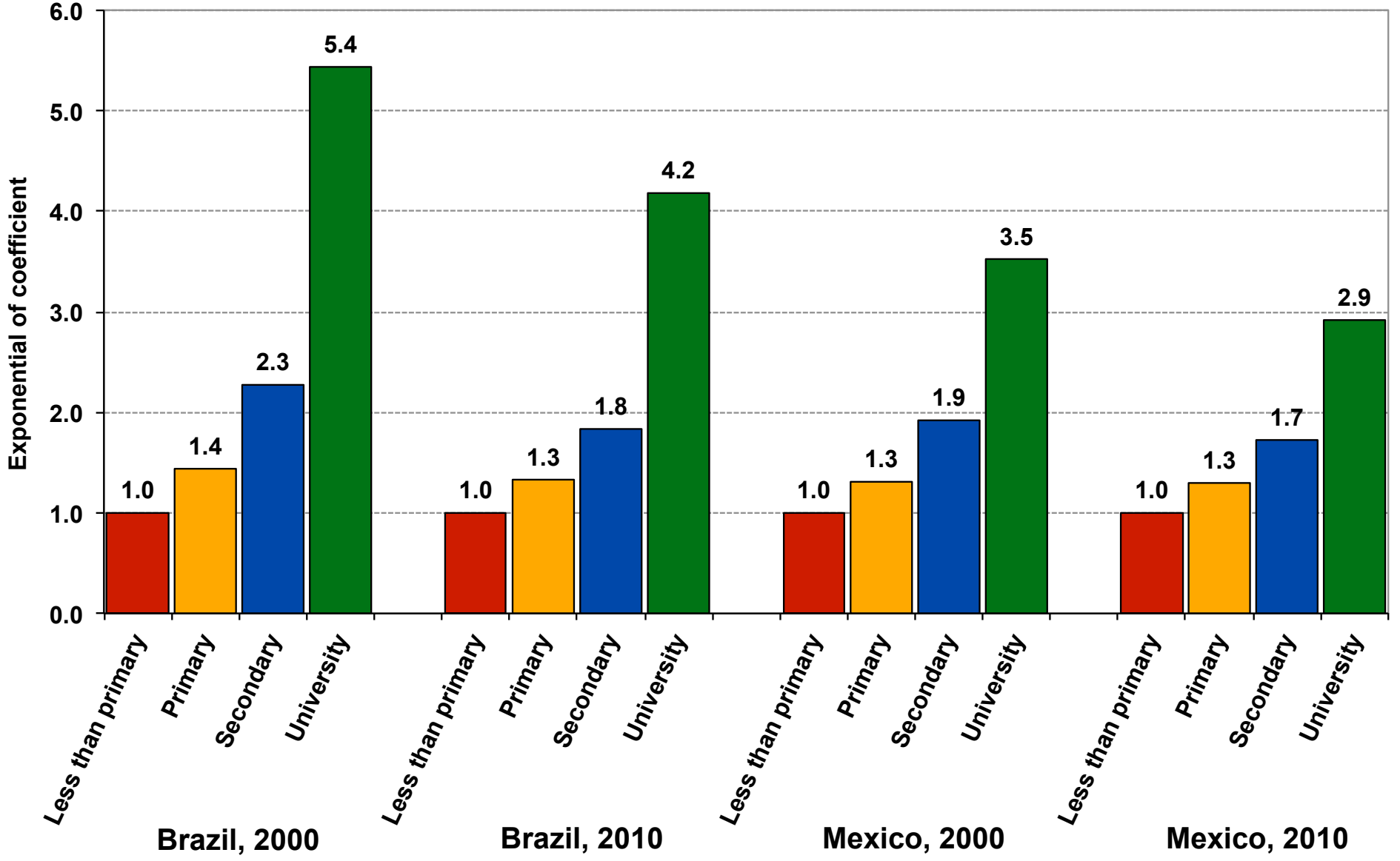
  - $P_{(t)}$: proportion of workers with high educational level (undergraduates) in time *t* for each investigated area.
  - $L_{1(t-n)}$: enrollment rate in high school in the previous census.
  - $L_{2(t-n)}$: young-age-dependency ratio in the previous census.
  - $L_{3(t-n)}$: local average earnings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

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

$$log(Y) = \beta_0 + \beta_n X_n + e$$

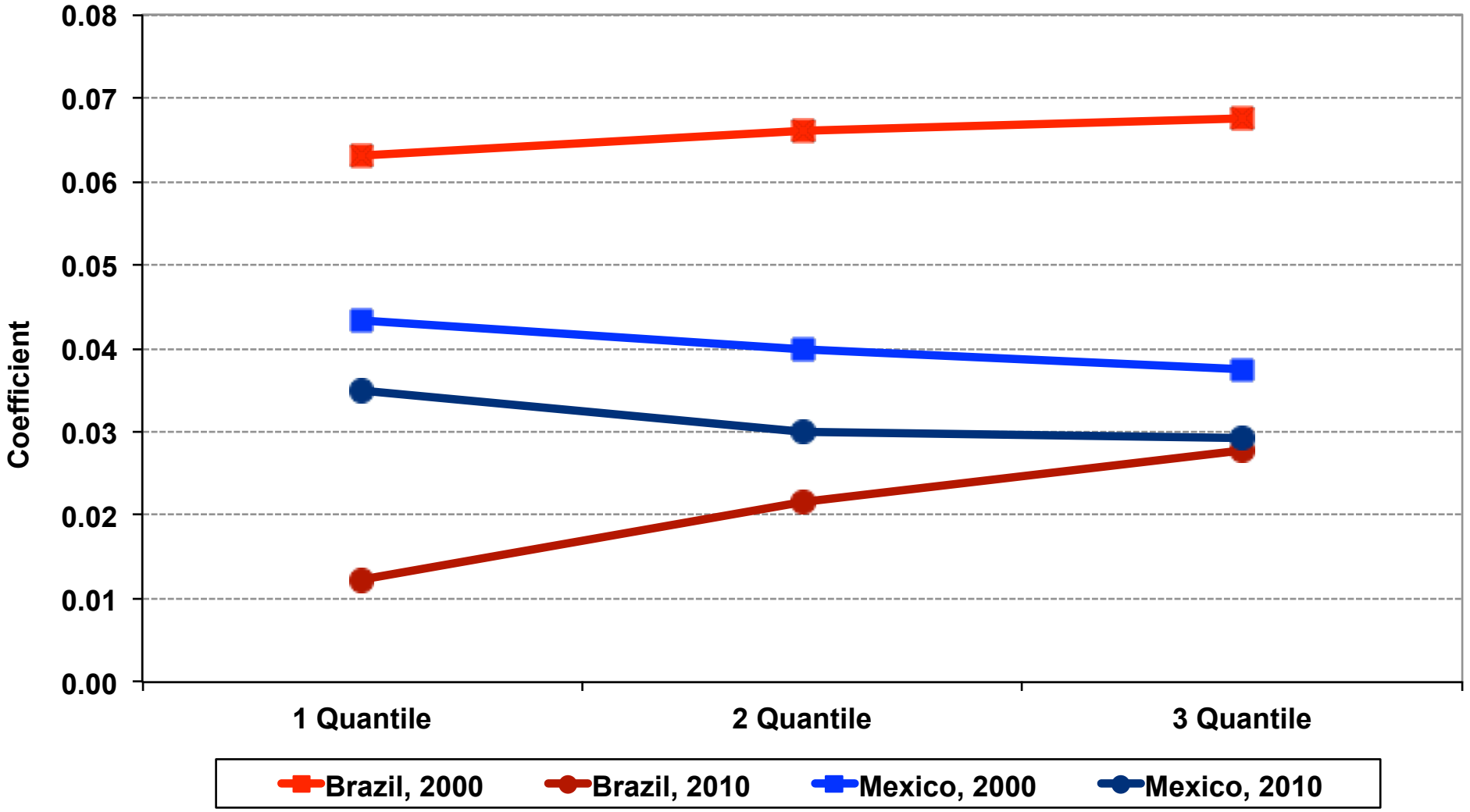
  - $log(Y)$: logarithm of individual earnings.
  - X_n: years of schooling; proportion of undergraduates; age; migrant; urbanization rate; unemployment rate; region.

Private returns to education, 2000 and 2010



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.