Demographic change and economic development at the local level in Brazil

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Outline

– Research question and background.

– Data and methods.

– Results.

– Robustness checks.

– Final considerations and future projects.

Research question

— **Main question:** What are the effects of changing age and educational compositions on male earnings in Brazil?

— 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:

    — Competition in the labor market.

   — Negative impacts on earnings of competing workers.

Main contribution

— **Study accounts for variations in age-education structure, combined with regional differences, to predict male earnings.**

— Brazil serves as a valuable case study and the models can be applied to other developing countries.

— The country has been experiencing:

  — Fertility decline.

  — An aging population.

  — Educational improvement.

  — Geographical variation.

Total Fertility Rate, 1970–2010

Source: Brazilian Census Bureau (IBGE, 2012).

Age composition, males, 1970–2010

Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.
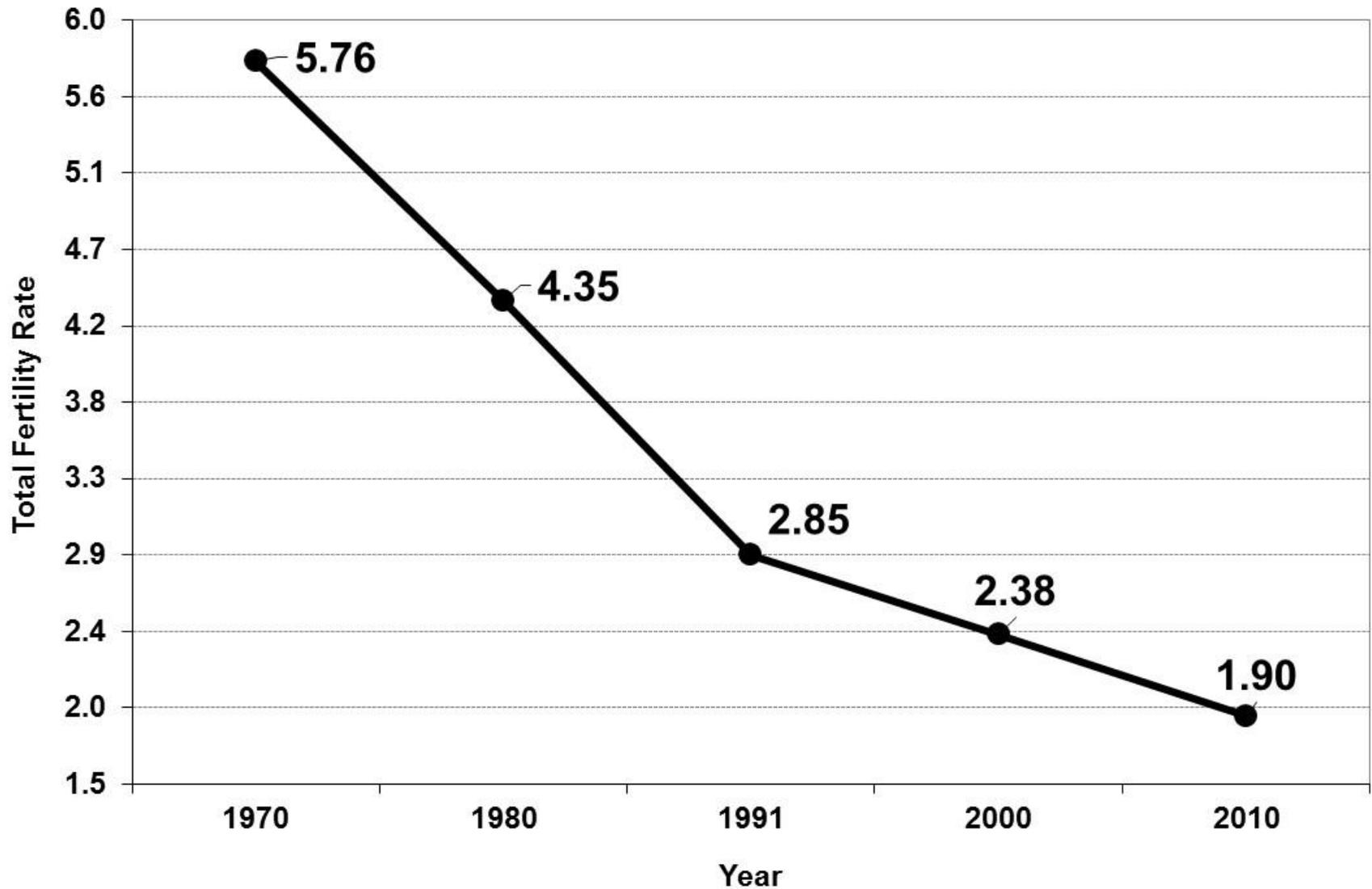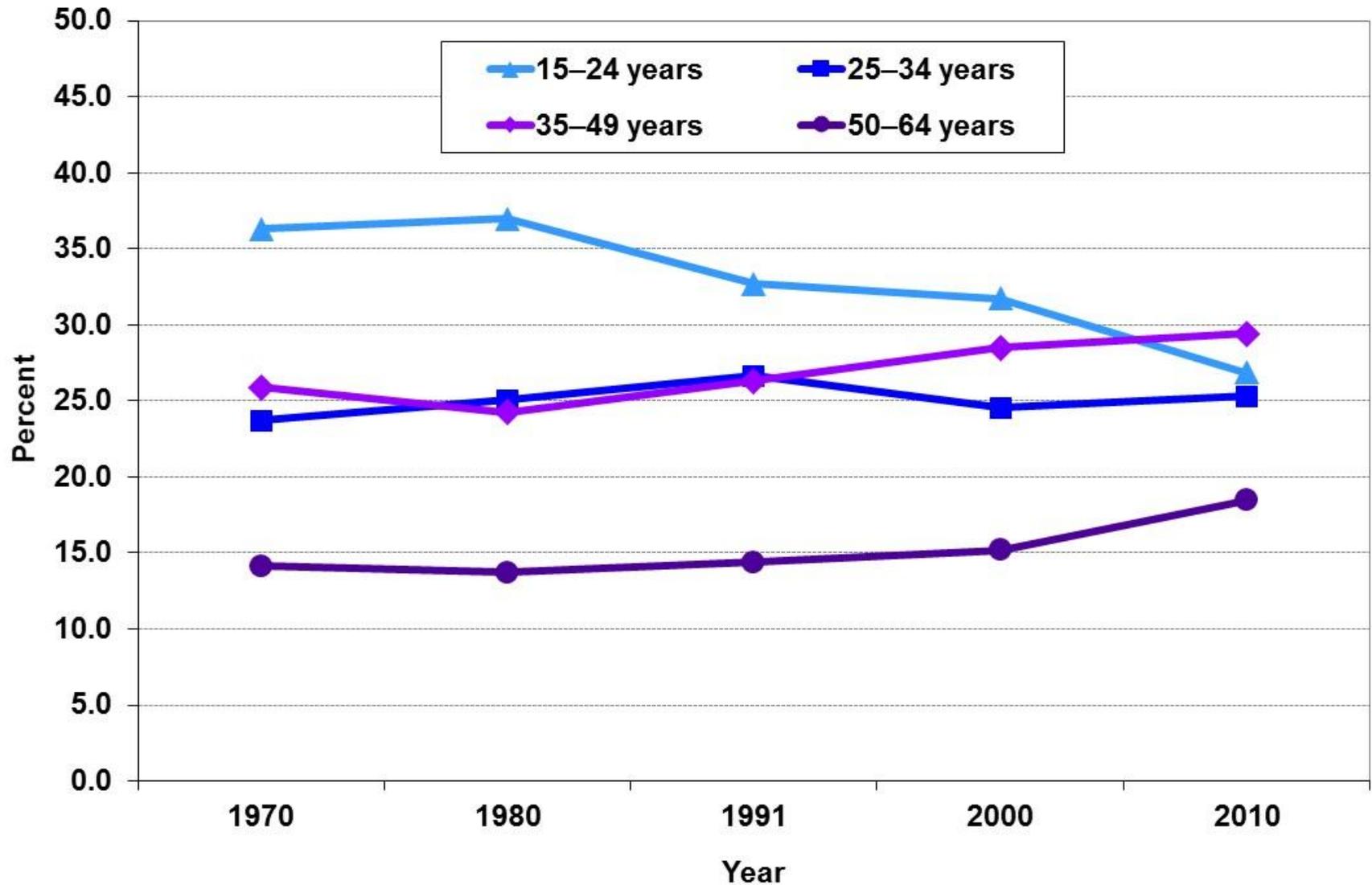
Educational composition, males, 1970–2010
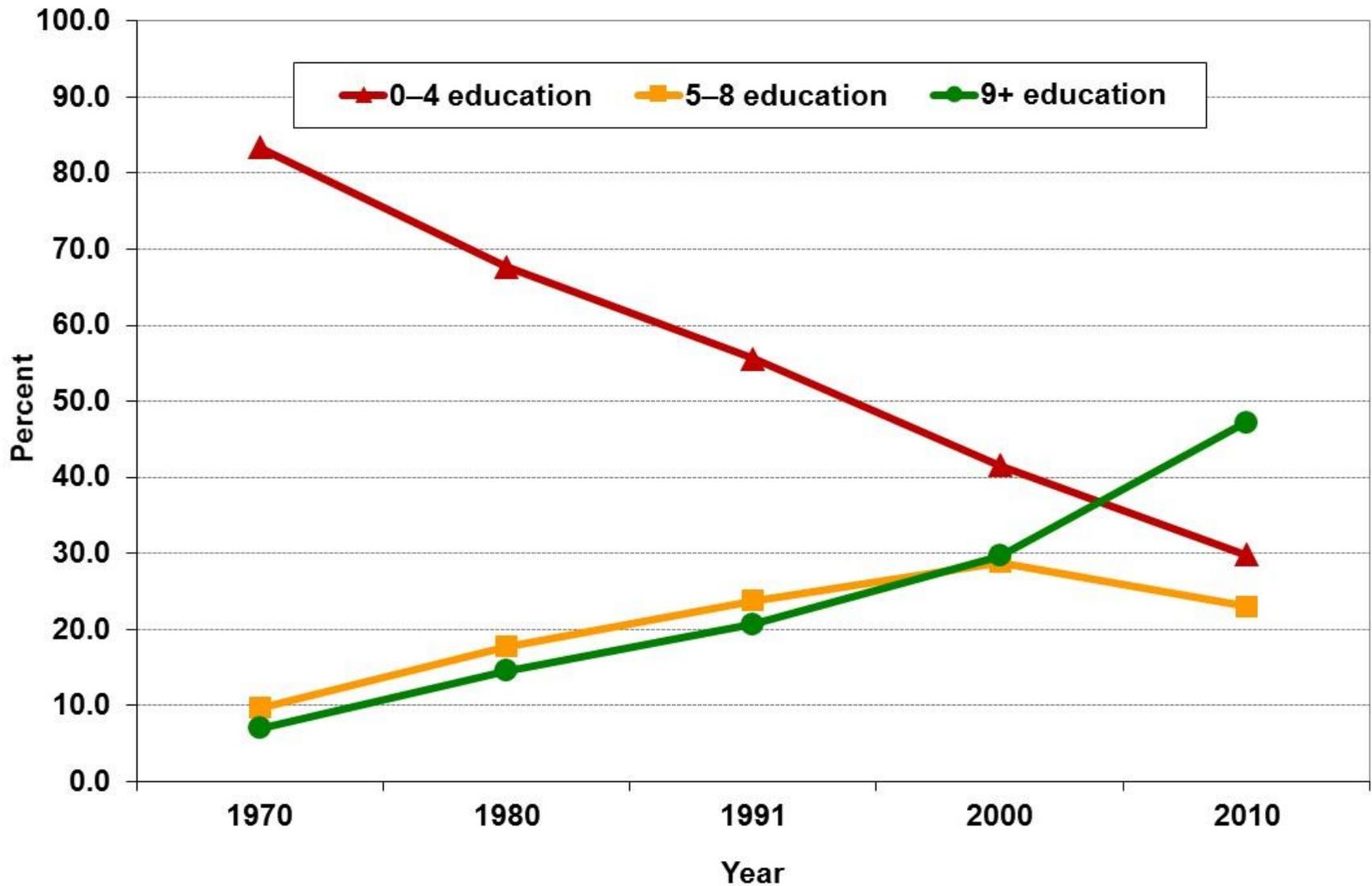
Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

Regional variation

- This study takes into account **geographical differences**.

- The greater heterogeneity within **developing countries** facilitates the identification of effects on earnings.

- In Brazil, **fertility** decline has varied in timing and pace across states and municipalities (Potter et al., 2002; Potter et al. 2010).

- **Educational attainment** increased, but with a great deal of regional disparity (Riani, 2005; Rios-Neto and Guimarães, 2010).

Five regions & 502 micro-regions

North

Northeast

Central-West

Southeast

Regions
Micro-regions

South

N
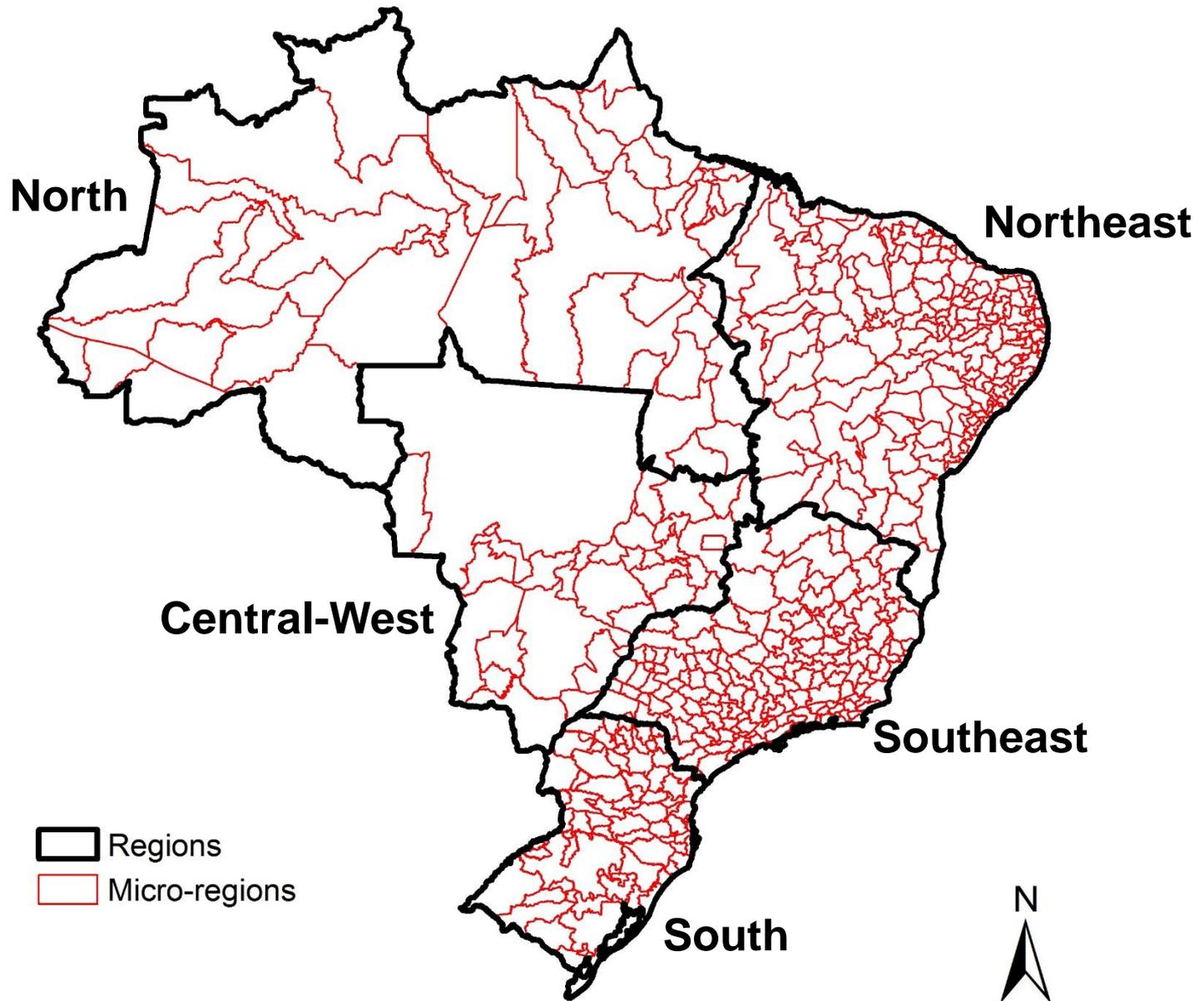
Previous studies

- **Baby boom:** large cohorts entered the U.S. labor market with better education, decreasing relative earnings.

  (Berger, 1985; Bloom and Freeman, 1986; Bloom, Freeman, and Korenman, 1987; Easterlin, 1978; Freeman, 1979; Sapozknikov and Triest, 2007; Welch, 1979)

- Changes in cohort size 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)

- We know less about how changes in age-education structures affect earnings in **developing countries**.

Micro-data

— **Brazilian Censuses**: 1970, 1980, 1991, and 2000.

— **Age** in years is categorized into four groups:

- Youth population (15–24).

- Young adults (25–34).

- Adults (35–49).

- Mature adults (50–64).

— **Education**: three groups indicating years of schooling:

- No further than the first phase of elementary school (0–4).

- Second phase of elementary school (5–8).

- At least some secondary school (9+).

— **Earnings** from main occupation: converted to Jan. 2002.

Aggregate-level data

— **Database** is aggregated by micro-regions, census years, and age-education groups (24,096 observations):

  — 502 micro-regions * 4 years * 12 age-education groups.

— Cells with less than 25 people receiving income were excluded:

  — 19,727 observations remained.

— **Only male population.**

Data setup

Micro-region	Census year	Log of mean real earnings $\log(Y_{git})$	Age-education group G11–G43	Distr. of male pop. P11–P43	P11	P12	P13	...	P43	Num. of obs.
110006	1970	5.82	15–24 years & 0–4 educ.	0.291	0.291	0	0	...	0	1616
110006	1970	6.21	15–24 years & 5–8 educ.	0.041	0	0.041	0	...	0	207
110006	1970	6.75	15–24 years & 9+ educ.	0.008	0	0	0.008	...	0	39
...	...	...	...	...	...	...	...	...	...	...
110006	1970	7.73	50–64 years & 9+ educ.	0.003	0	0	0	...	0.003	21
...	...	...	...	...	...	...	...	...	...	...

Main 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		
12 age-education indicators * time	$(G_{11}-G_{43}) * \theta_t$	$(G_{11}-G_{43}) * \theta_t$
Distribution of male population into 12 age-education groups * time		$(P_{11}-P_{43}) * \theta_t$
2008 area-time fixed effects	α_{it}	α_{it}

Assumptions

1. Relative sizes of age-education groups in a micro-region are assumed as exogenous to the **scale of production**:

– However, more skilled workers are likely to be located in areas with better job opportunities.

– **Any differences in labor demand across micro-regions and years are controlled by the area-time fixed effects.**

2. **Educational attainment** is assumed as exogenous:

– However, young people may seek higher levels of schooling, as returns to education increase.

– **If these workers were in the labor market, the impacts of composition on earnings would be even stronger.**

Brazilian male working-age population

— Main results: published in *Demographic Research* (2013).

— Description of **15–64 year-old males:**

  — Age-education composition, 1970–2000.

  — Proportion with 9+ years of schooling by micro-region, 1970–2000.

  — Mean real monthly earnings in main occupation, 2000.

Age-education composition, 1970–2000
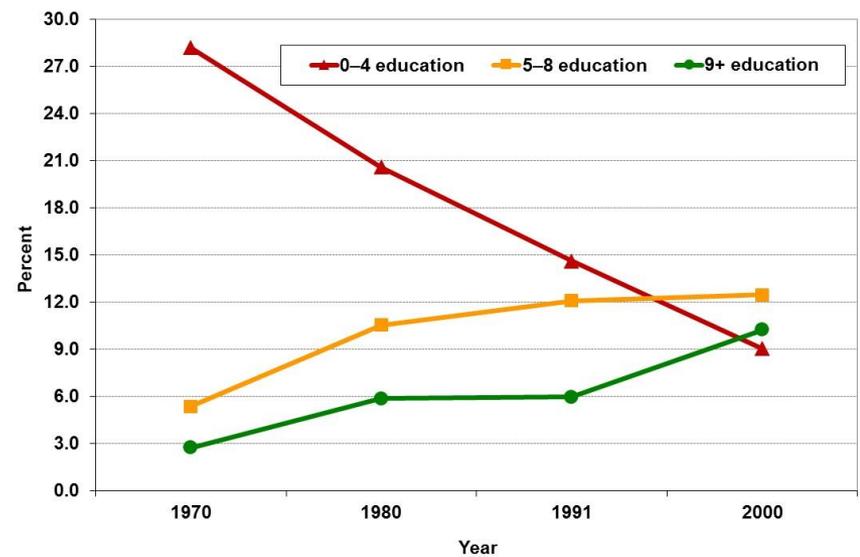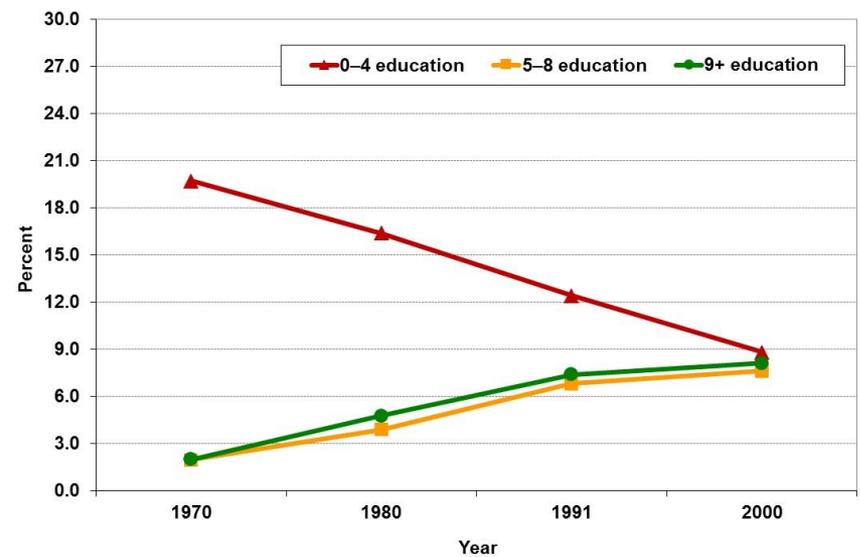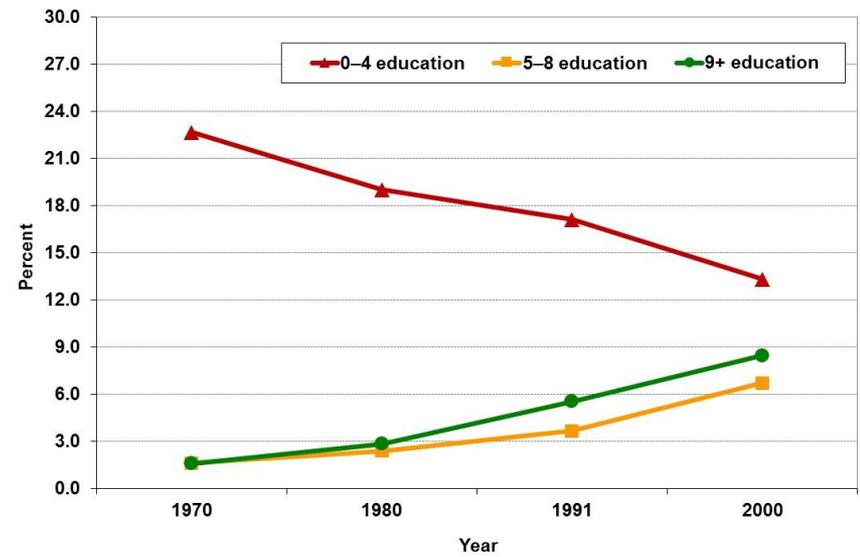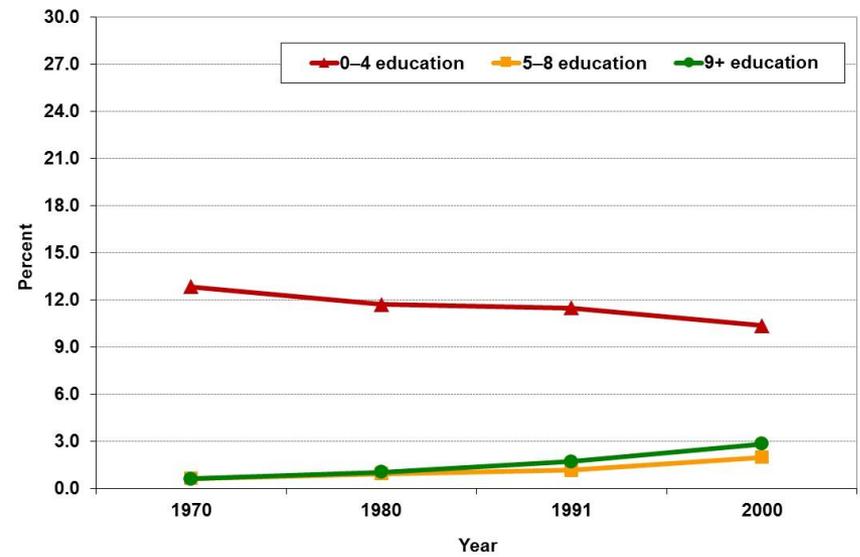
Source: 1970, 1980, 1991, and 2000 Brazilian Demographic Censuses.

# Proportion with 9+ years of schooling, 1970
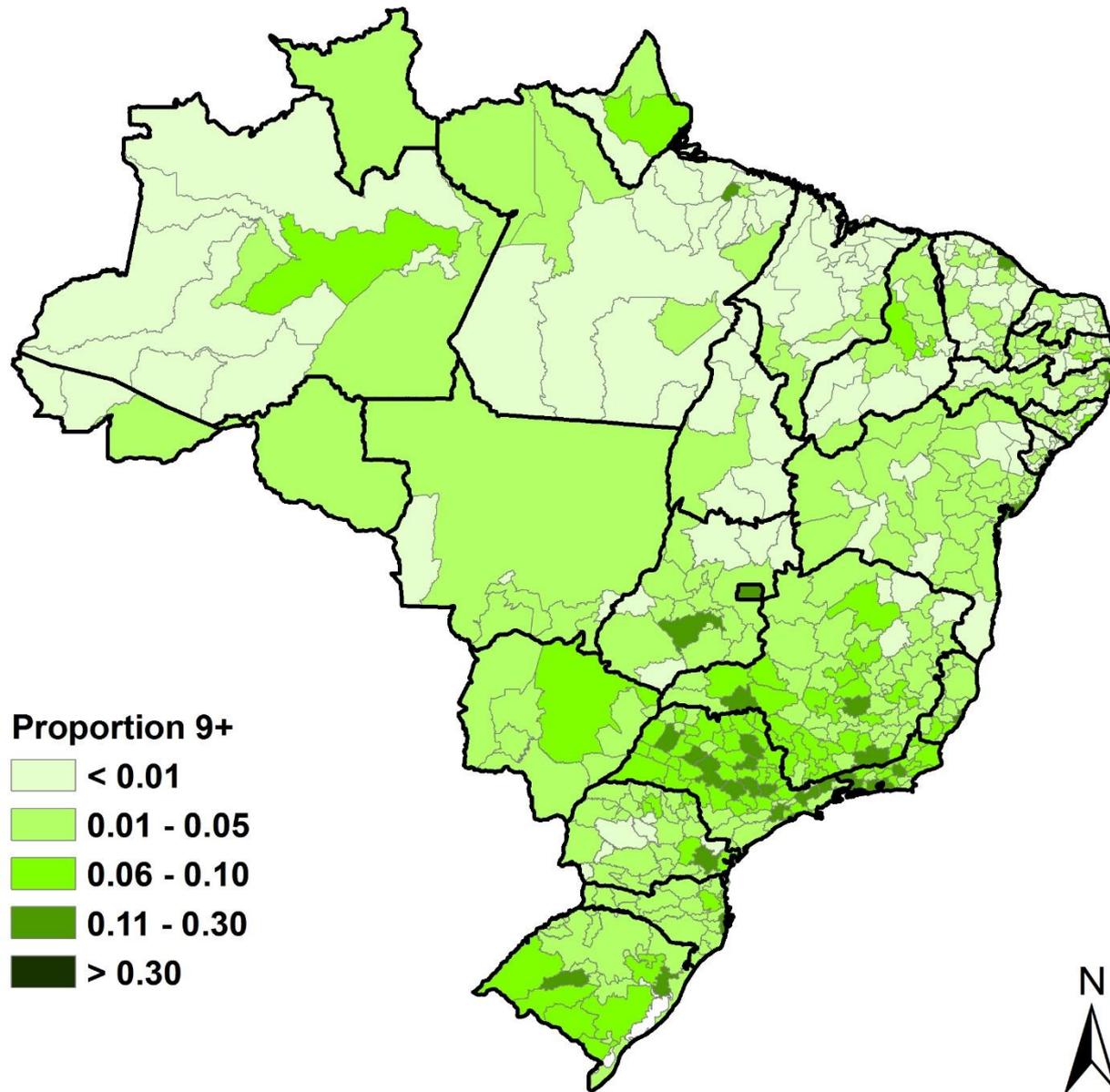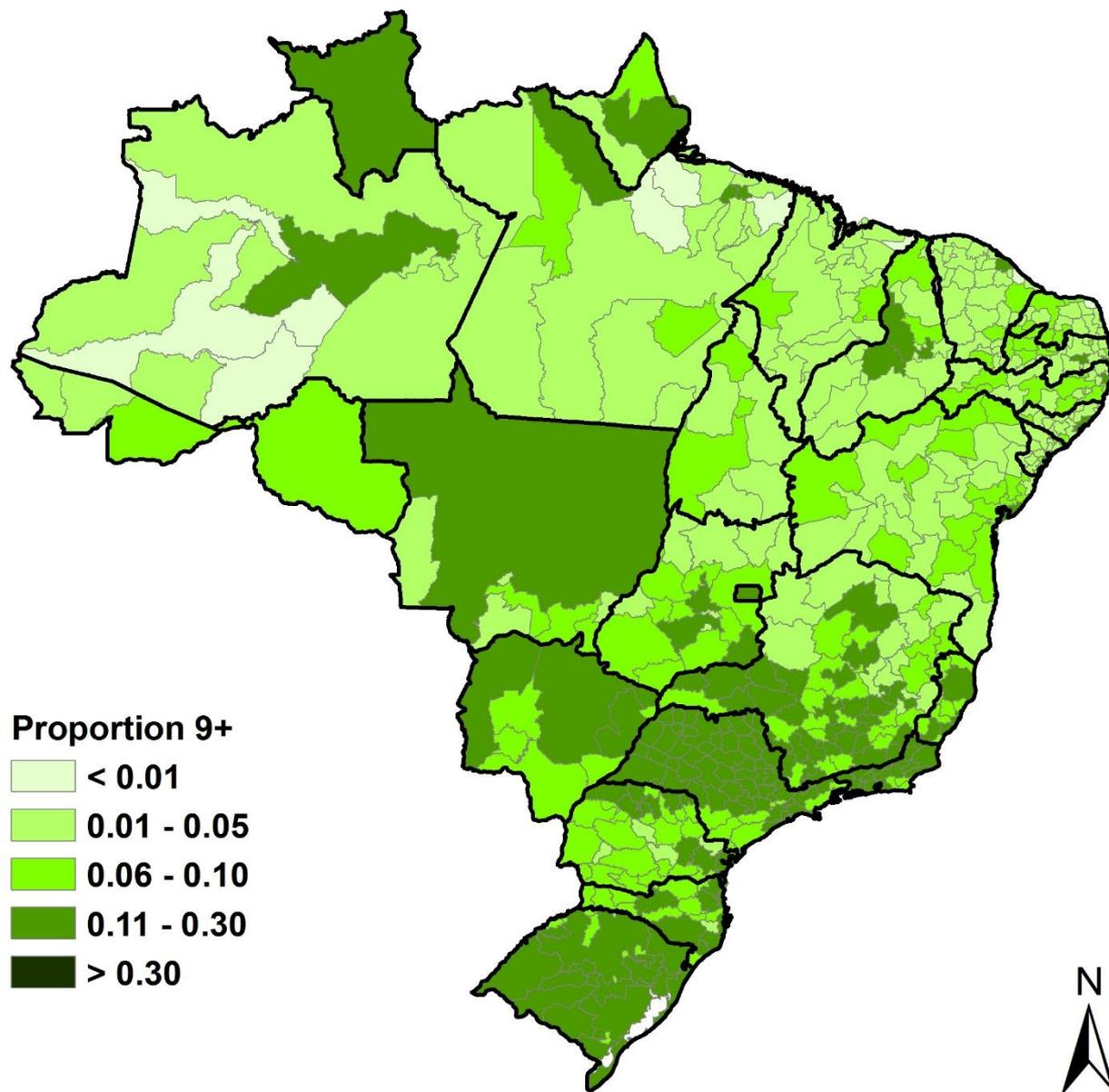
Proportion 9+

- < 0.01
- 0.01 - 0.05
- 0.06 - 0.10
- 0.11 - 0.30
- > 0.30

N

Source: 1970 Brazilian Demographic Census.

Proportion with 9+ years of schooling, 1980

Source: 1980 Brazilian Demographic Census.

Proportion with 9+ years of schooling, 1991

Proportion 9+

- □ < 0.01
- □ 0.01 - 0.05
- □ 0.06 - 0.10
- □ 0.11 - 0.30
- ■ > 0.30

Source: 1991 Brazilian Demographic Census.

Proportion with 9+ years of schooling, 2000

Proportion 9+

- < 0.01
- 0.01 - 0.05
- 0.06 - 0.10
- 0.11 - 0.30
- > 0.30

Source: 2000 Brazilian Demographic Census.

Mean real monthly earnings in main occupation, 2000

Source: 2000 Brazilian Demographic Census.
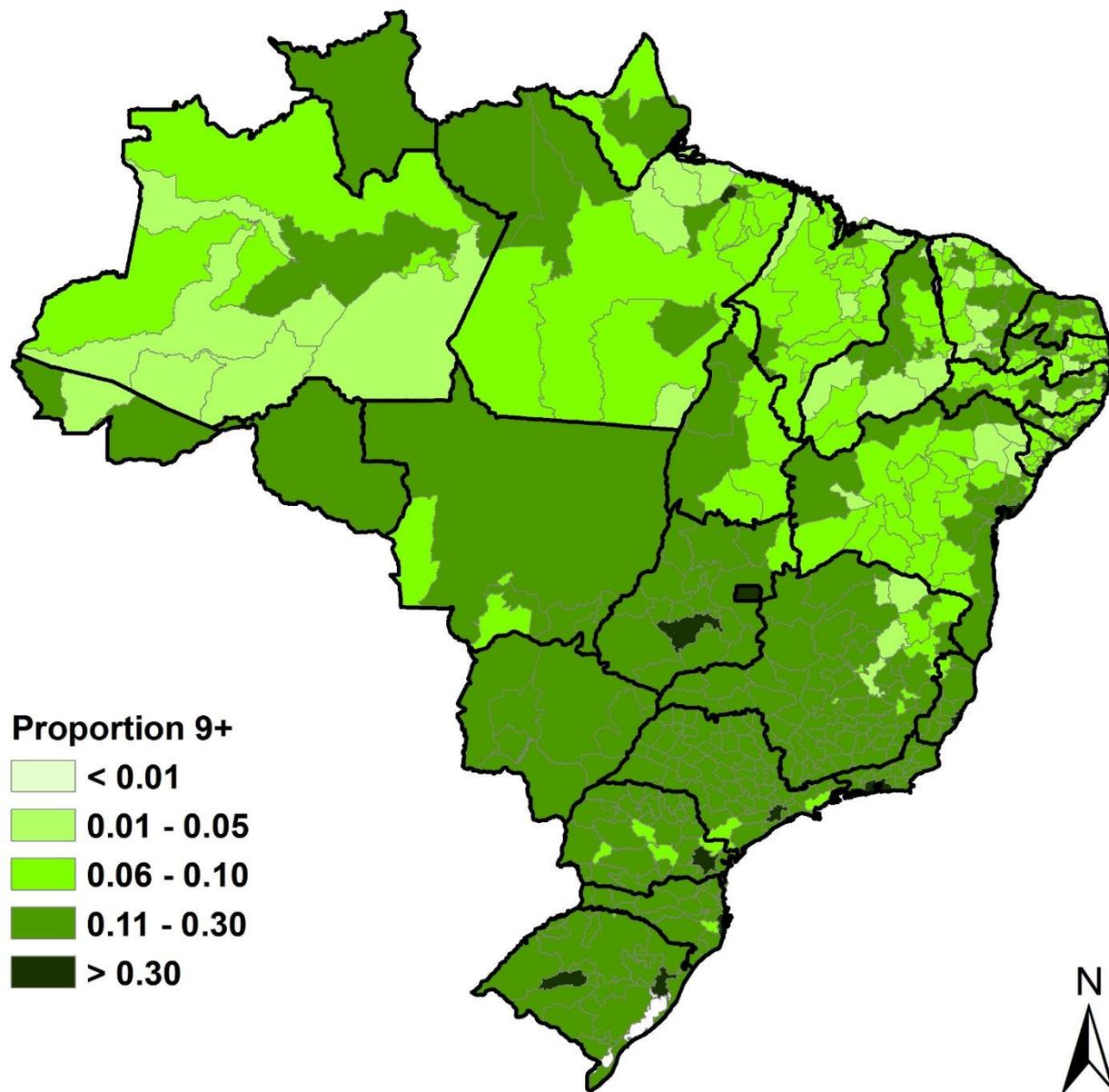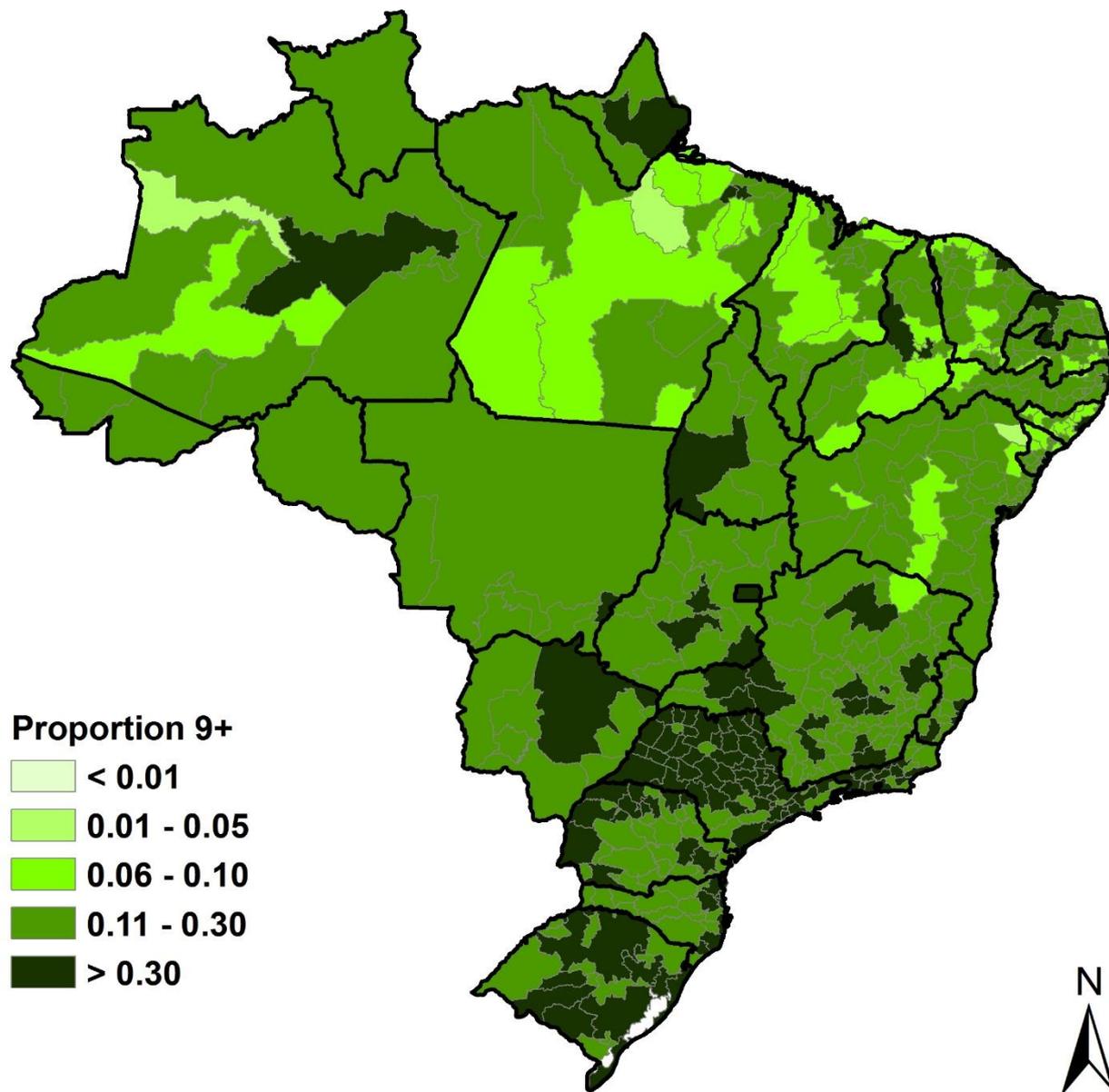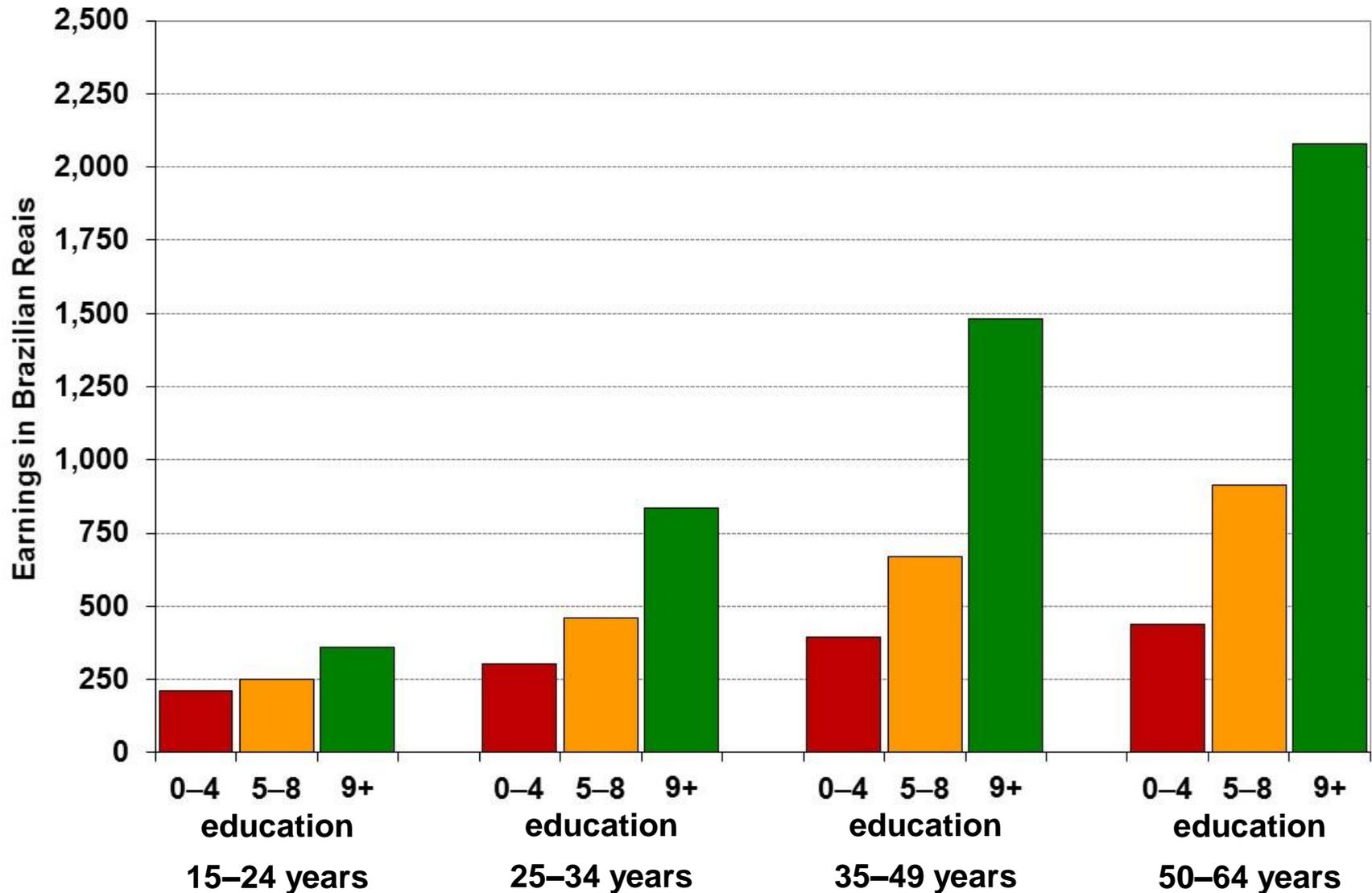
Estimating the impacts of relative group size on male earnings

– **Baseline model:**

  – Effects of age-education indicators (G_{11}–G_{43}), 2000.

– **Composition model:**

  – Effects of age-education indicators (G_{11}–G_{43}), 2000.

  – Effects of age-education-group proportions (P_{11}–P_{43}), 1970 and 2000.

Effects of age-education indicators (G_{11}–G_{43})[24] on earnings from baseline model, 2000

Source: 1970, 1980, 1991, and 2000 Brazilian Demographic Censuses.
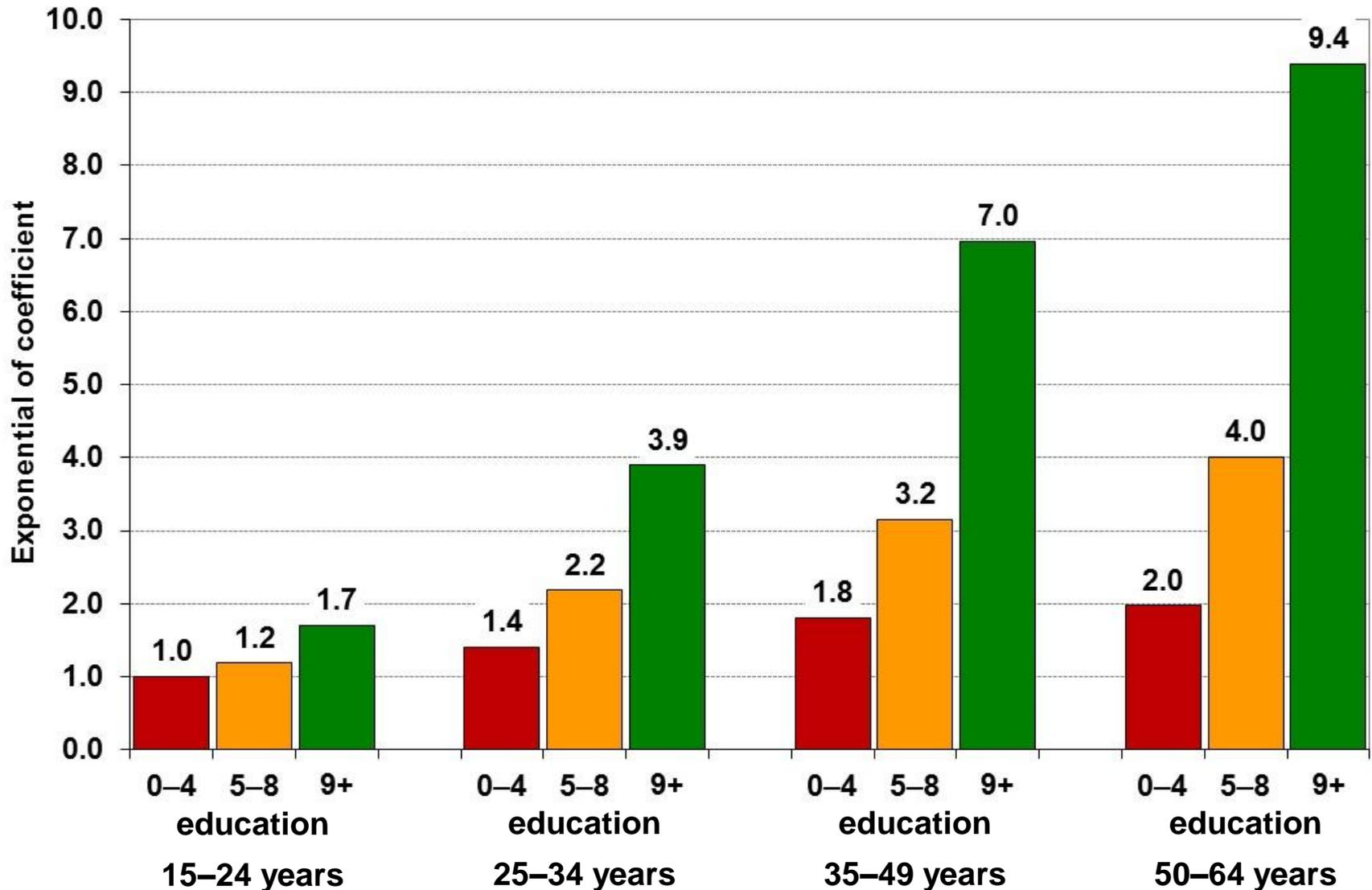
Effects of age-education indicators (G_{11}–G_{43}) on earnings from composition model, 2000

Source: 1970, 1980, 1991, and 2000 Brazilian Demographic Censuses.
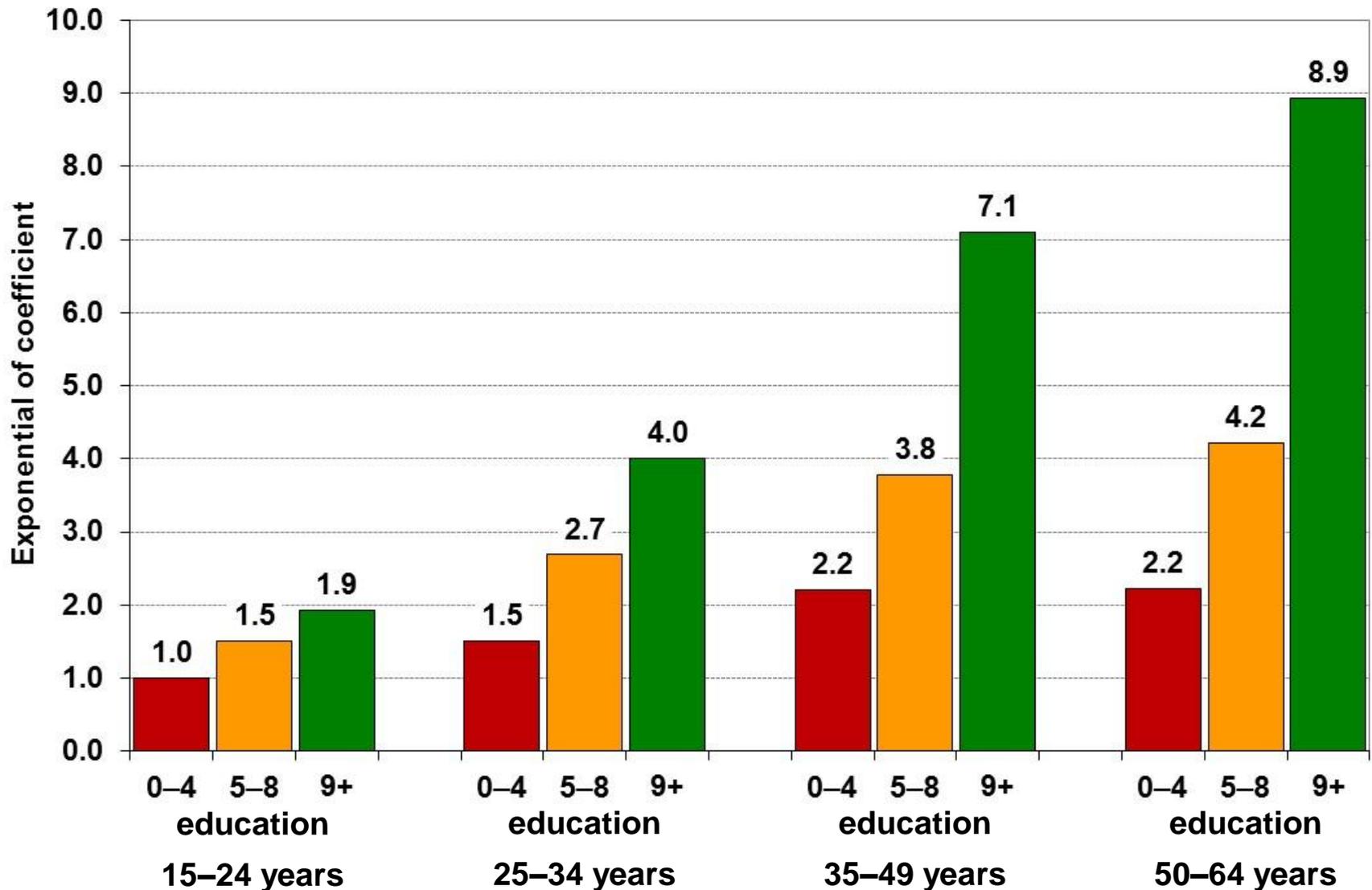
Effects of group proportions in 502 micro-regions (P_{11}–P_{23}) on earnings, 1970 and 2000

15–24 years

### 0–4 education
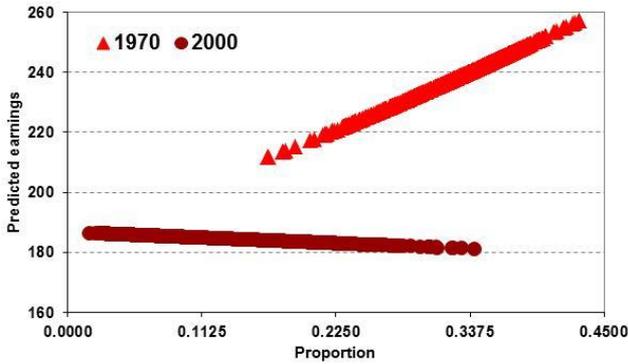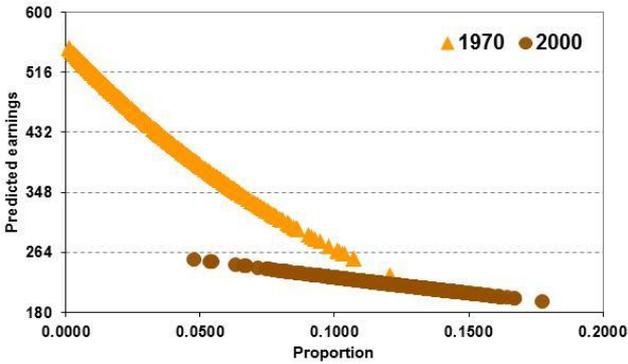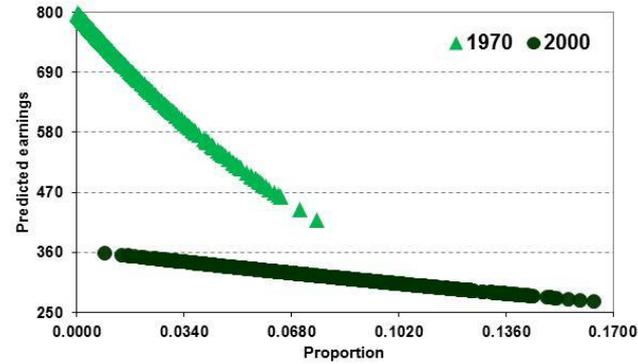
5–8 education

9+ education

25–34 years

0–4 education

5–8 education

9+ education

Source: 1970, 1980, 1991, and 2000 Brazilian Demographic Censuses.
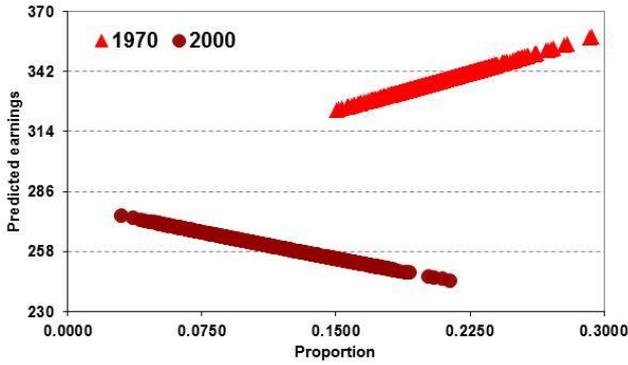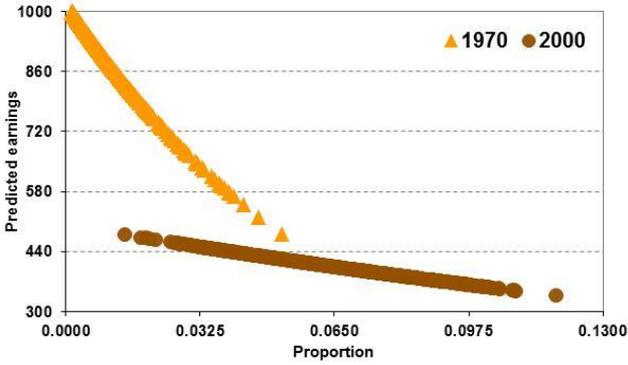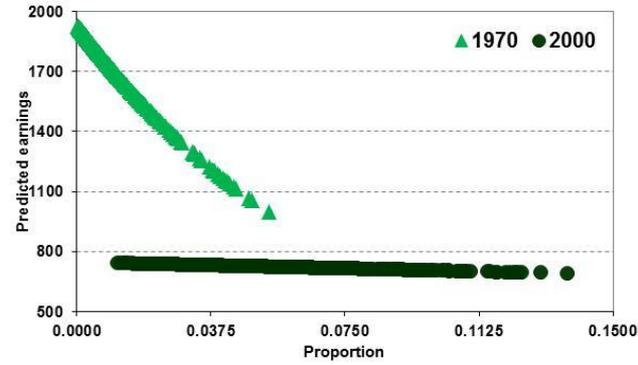
Effects of group proportions in 502 micro-regions (P_{31}–P_{43}) on earnings, 1970 and 2000

35–49 years
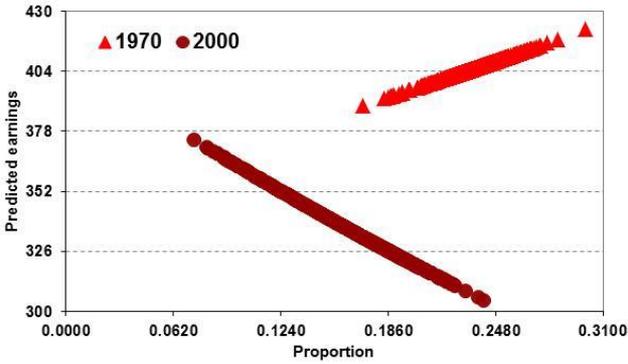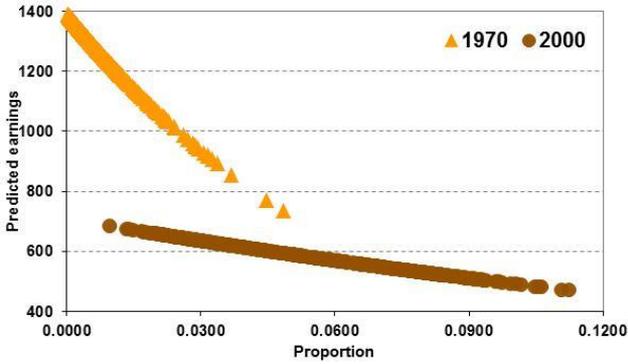
0–4 education · 5–8 education · 9+ education

50–64 years

0–4 education · 5–8 education · 9+ education

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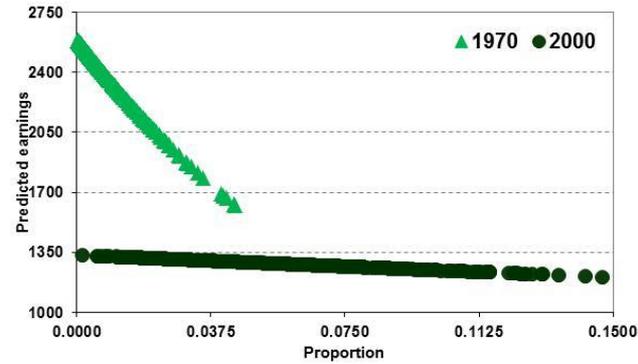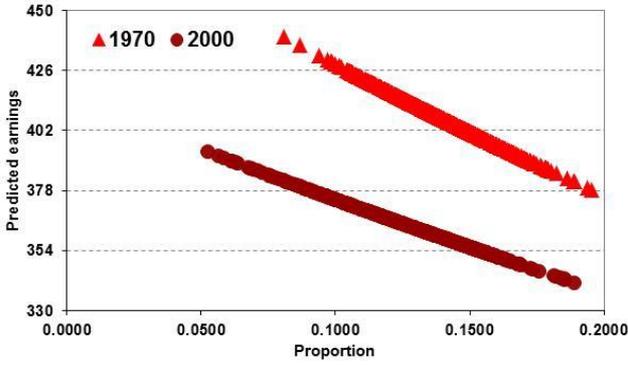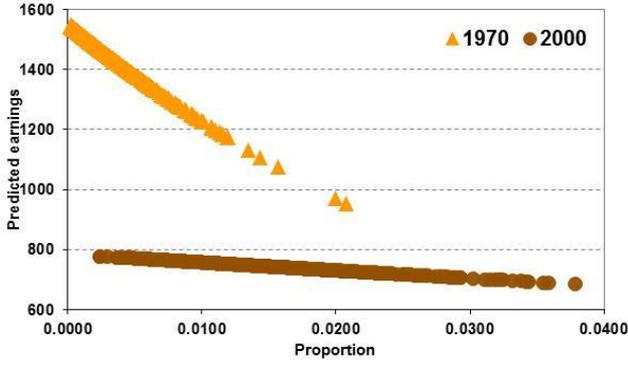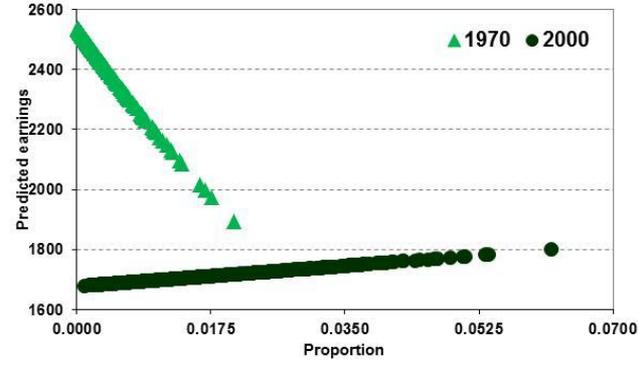
Robustness checks

– Extra models included as independent variables:

  – Cross effects.

  – Population size of micro-regions.

  – Female workers:

    – Accepted for publication in **Poverty & Public Policy**.

– **Original impacts** of distribution of males into age-education groups (P_{11}–P_{43}) remained negative and significant.

Inter-micro-regional migration

— Analysis at the **local level** (502 areas): need to consider the impact of internal migration.

— Migration generates **spatial-economic equilibrium**.

— **Without migration:**

  — Sending areas would have even lower earnings.

  — Receiving areas would have even higher earnings.

— **Hypothesis:** negative impacts of proportions on earnings would be more negative when controlling for migration.

— Submitted for publication in *Space Populations Societies*.

Reverse causality

Migration ⟵⟶ **Earnings**

– In-migration increases competition and affects earnings.

– Availability of jobs and income levels influence migration.

– An exogenous measure of migration was estimated.

– Data on municipality of residence five years before the census (1991 and 2000) was used:

– Instead of municipality of previous residence (1980 and 1991).

Methodological steps for migration

1. Estimate exogenous **level of migration** with gravity models between micro-regions.

2. Compute **age-specific in-migration rates** (*ASIMR*) between the five regions.

3. Model *ASIMR* to obtain smooth curves representing **patterns of migration**.

4. **Integrate** level and pattern of migration, as in an exercise of standardization.

5. Calculate a measure of **exogenous force of migration** for each micro-region, year, and age-education group.

1. Estimating level of migration

— **Gravity models** take into account distances among areas as an instrumental variable for predicting migration.

— **Poisson regression** for each year and education group:

$$M_{ij} = exp(b_0 + b_1 log\ P_i + b_2 log\ P_j + b_3 log\ d_{ij}) + \varepsilon_{ij}$$

  – M_{ij}: migrants at the end of the period with **20–24 years** of age between micro-regions of origin and destination: n=251,502 (502*501).

  – P_i: population at the beginning of the period with 15–19 years of age for micro-regions of origin.

  – P_j: population at the end of the period with 20–24 years of age for micro-regions of destination.

 – d_{ij}: distance between micro-regions.

2. Estimating age pattern of migration

– The estimation of migration patterns for all combinations of micro-regions and years would generate low rates.

– Then, migration patterns were estimated among the five **regions** in each year (1991 and 2000): 5*5*2=50.

– **Age-specific in-migration rates ($ASIMR_{x,ij}$)** consider populations (K) in regions of origin (i) and destination (j):

$$ASIMR_{x,ij} = \frac{\sum K_{x,ij}}{t * \sum \frac{(K_{x,j.} + K_{x,jj}) + (K_{x,j})}{2}}$$

3. Modeling age pattern of migration

— A mathematical equation was used to smooth the rates:
(Raymer and Rogers, 2007; Rogers and Castro, 1981; Rogers and Jordan, 2004)
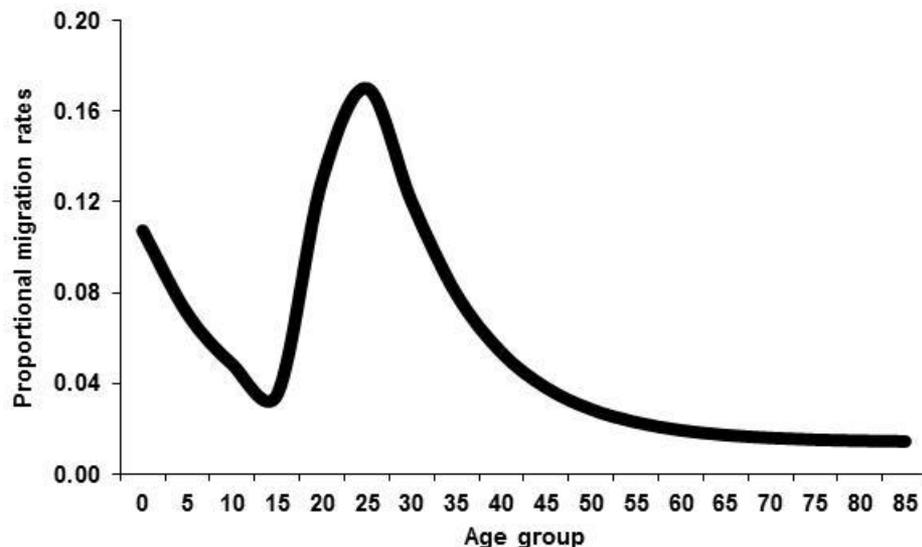
— Negative exponential curve in the first age groups.

— Parabola in labor ages.

— Constant term in post-labor ages.

— Rates were modeled for men between 15–64 years of age.

# Observed and estimated proportional *ASIMR*, Northeast to Southeast, 1991 and 2000

Source: 1991 and 2000 Brazilian Demographic Censuses.
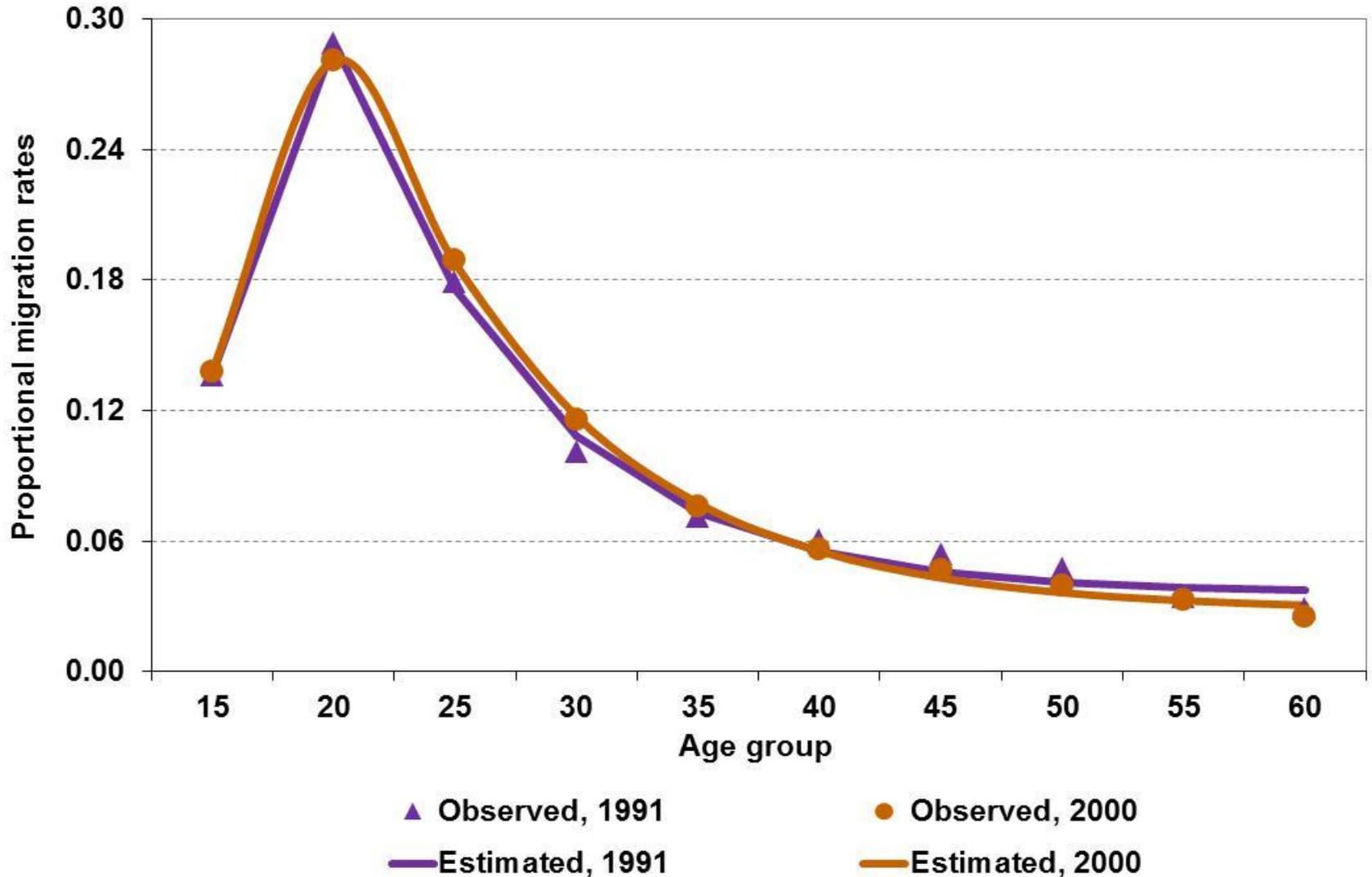
Observed and estimated proportional *ASIMR*, Southeast to Northeast, 1991 and 2000

Source: 1991 and 2000 Brazilian Demographic Censuses.
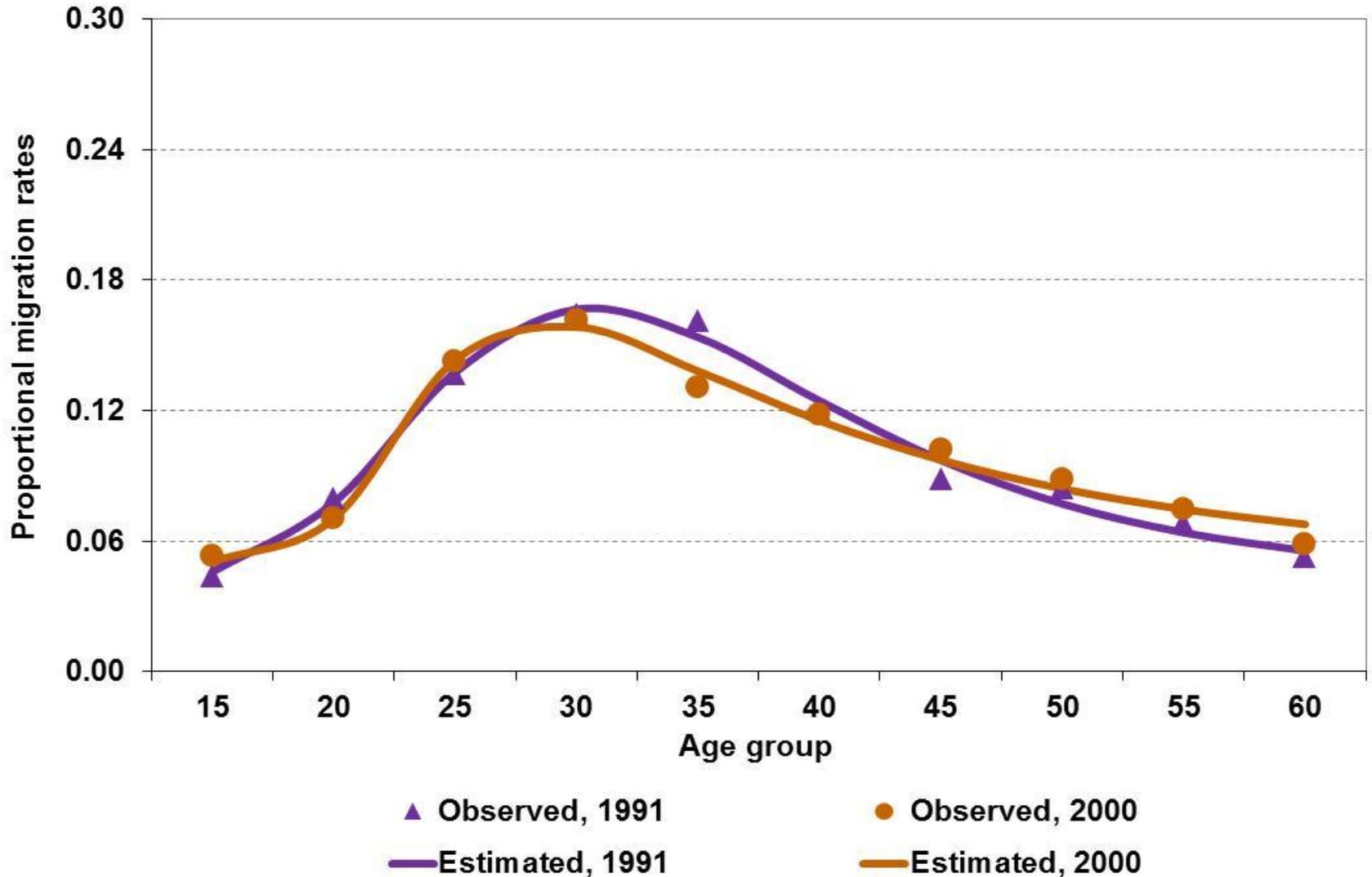
4. Integrating level and pattern of migration

- **Micro-region levels:** applied to **regional patterns**.

- **Assumption:** micro-regional flows have the same patterns as the regional flows.

- **Ratio** of migration level to migration pattern was calculated (20–24 years of age) for flows between micro-regions by year and education group.

- Rates of other age groups from migration pattern were multiplied by this ratio.
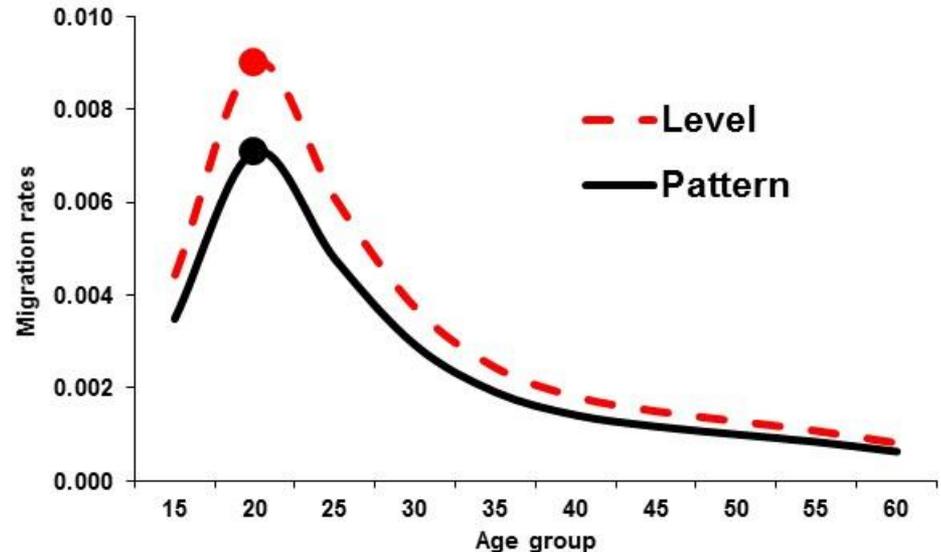
5. Exogenous force of migration

— An exogenous **force of migration** was estimated for each micro-region, year, and age-education group.

— The exogenous measure of migration was included in the models as independent variables.

— In general, the coefficients of group proportions (P_{11}–P_{43}) became more negative than the previous estimates.

Estimated elasticities of proportions in age-education groups (P_{11}–P_{43}), 1991
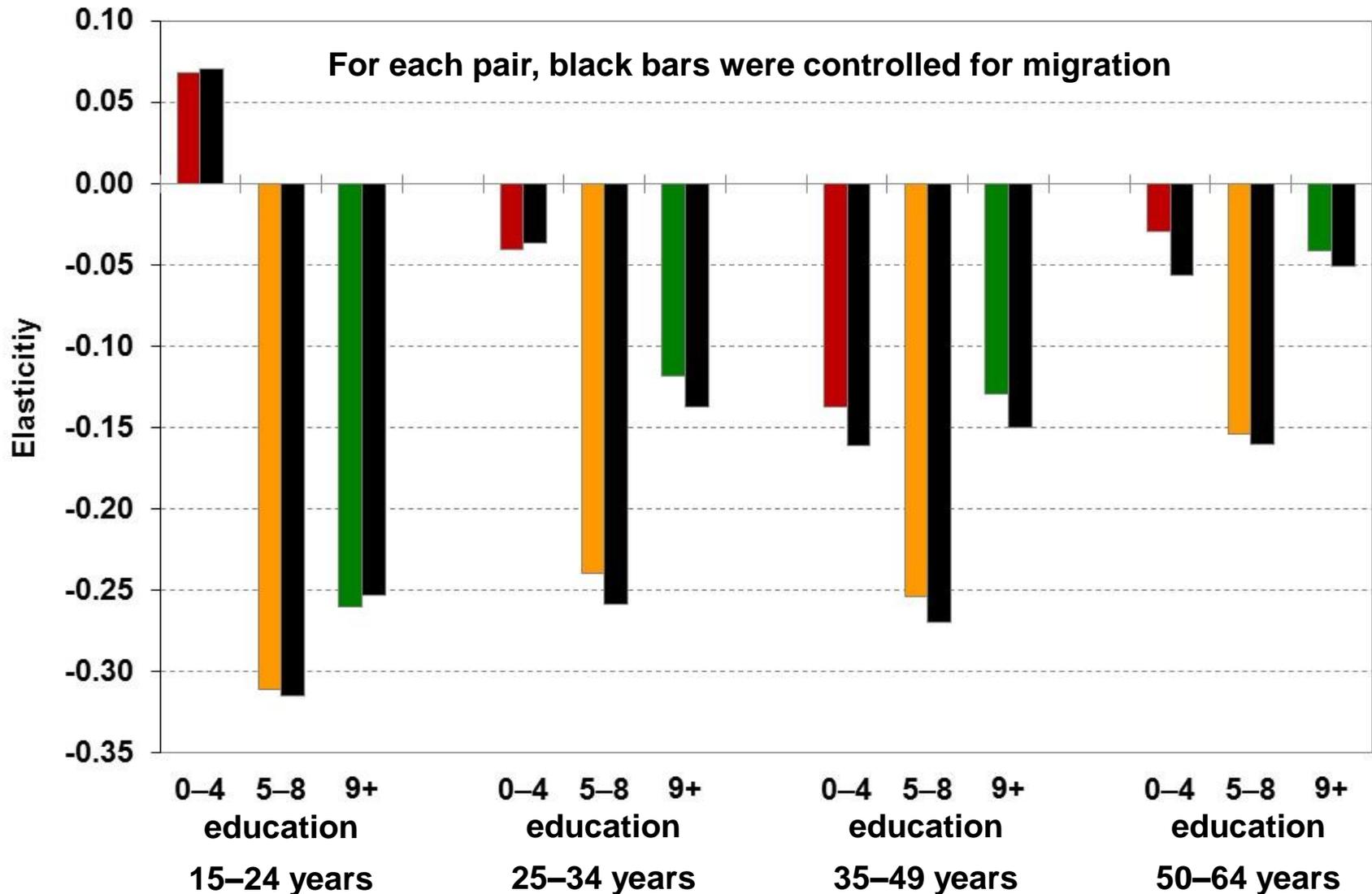
Source: 1991 and 2000 Brazilian Demographic Censuses.

Estimated elasticities of proportions in age-education groups (P_{11}–P_{43}), 2000

Source: 1991 and 2000 Brazilian Demographic Censuses.
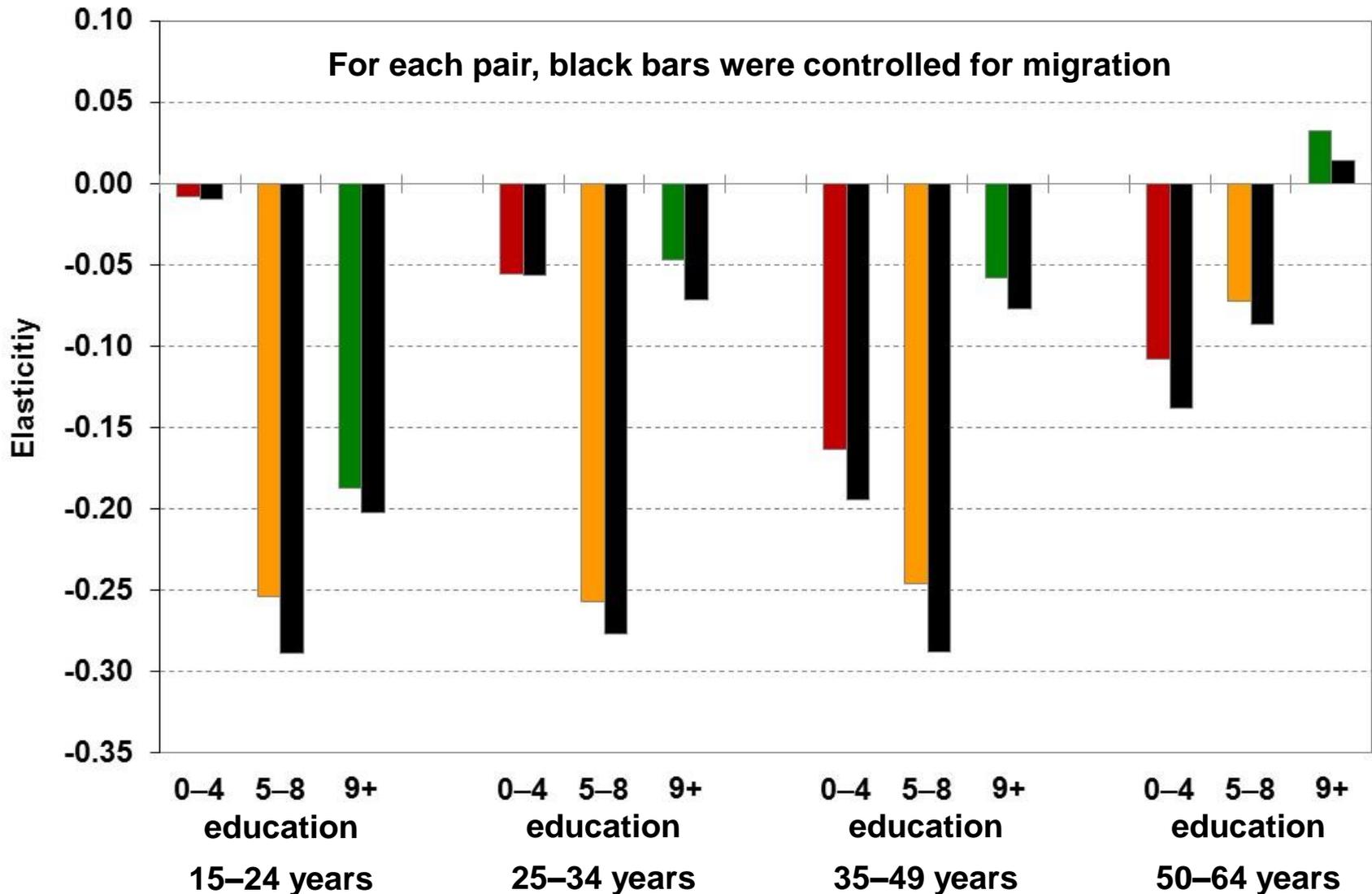
Final considerations

– **Cohort size matters:** negative effects on earnings are greater for workers under age 50.

– **Education matters:** greatest impact on middle group (5–8).

– **Low-educated men:** these groups are decreasing over time, but their earnings are not increasing.

– **Time:** effects are becoming less negative over the years.

– **Control for migration:** influence of cohort size is stronger.

– **In line with theory:** larger cohort-education size generally depresses earnings.

– **Compositional approach:** can be applied to future studies that address economic development.

Implications

– Compositional changes reduced **economic inequality:**

  – More better-educated men reduced income differentials in relation to lower-educated men.

  – The presence of fewer younger men prevented greater negative impacts on the earnings of this group.

– Impacts of **employed females** decreased gender gap.

– **Public policies:**

  – Improve educational attainment in areas that still have large proportions of people with lower levels of schooling.

  – Stimulate further increases in female employment.

Research papers

— Published:

    — ***Demographic Research*** (2013)

      Main models

    — ***Population Research & Policy Review*** (2012)

      Decomposition of effects

    — ***Bulletin of Latin American Research*** (2012)

      Projection exercise

— Accepted:

    — ***Poverty & Public Policy*** (2013)

      Models with women

— Submitted:

    — ***Space Populations Societies***

      Models with migration

    — ***Social Forces***

      Effects of race and increasing proportion of Protestants

Future projects

‒ **2010 Brazilian Census:** make data compatible with the 502 micro-regions.

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

‒ **Women in both sides of equation:** use instrumental variables to predict distribution of female workers.

‒ **Multinomial models:** estimate impacts of composition on:

   ‒ Having a formal job.

   ‒ Having an informal job.

   ‒ Being self-employed.