Influences of transition in age-education structure and internal migration on the labor market in Brazil

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Demographic transition and economic development

- Part of a larger project to look at the relationship between changes in the age distribution and economic development at the local level in both **Brazil and Mexico** (PI: Professor Joseph Potter, UT).
- Motivated by results for **Asia** and their relevance to Latin America (Bloom, Canning, Williamson, Mason and others).
- Awareness that the heterogeneity that prevails in Brazil and Mexico could work to our advantage.
- Figuring out how to take advantage of this heterogeneity led us to look at studies that had been done on another major demographic shock... the **“baby boom” in the US**.

“Baby Boom” and US Labor Market

- Large literature on age-education shifts in the US (Freeman 1979; Welch 1979; Berger 1985; Triest, Sapozhnikov e Sass 2006).
- Exceptionally large cohorts born during the **“baby boom”** entered the American labor market in the 1970s with higher levels of education.
- Studies suggest that **large cohorts** depressed earnings.
- Negative effects increase with **education**.
- “Baby boomers” will still affect income structure after their **retirement**.

The case of Brazil

- Might such compositional changes have influenced earnings in a large Latin American country such as **Brazil**?
- As in other developing countries, **age-education transitions** in Brazil provide a lot of variation in demographic structure:
  - **Fertility** decline varied in timing and speed across states and municipalities.
  - **Educational enrollment** increased substantially from very low levels, but with much regional variation.
- Our idea was to use this **regional variation** to analyze who gains and loses from these compositional shifts, with a cross-section time series approach.

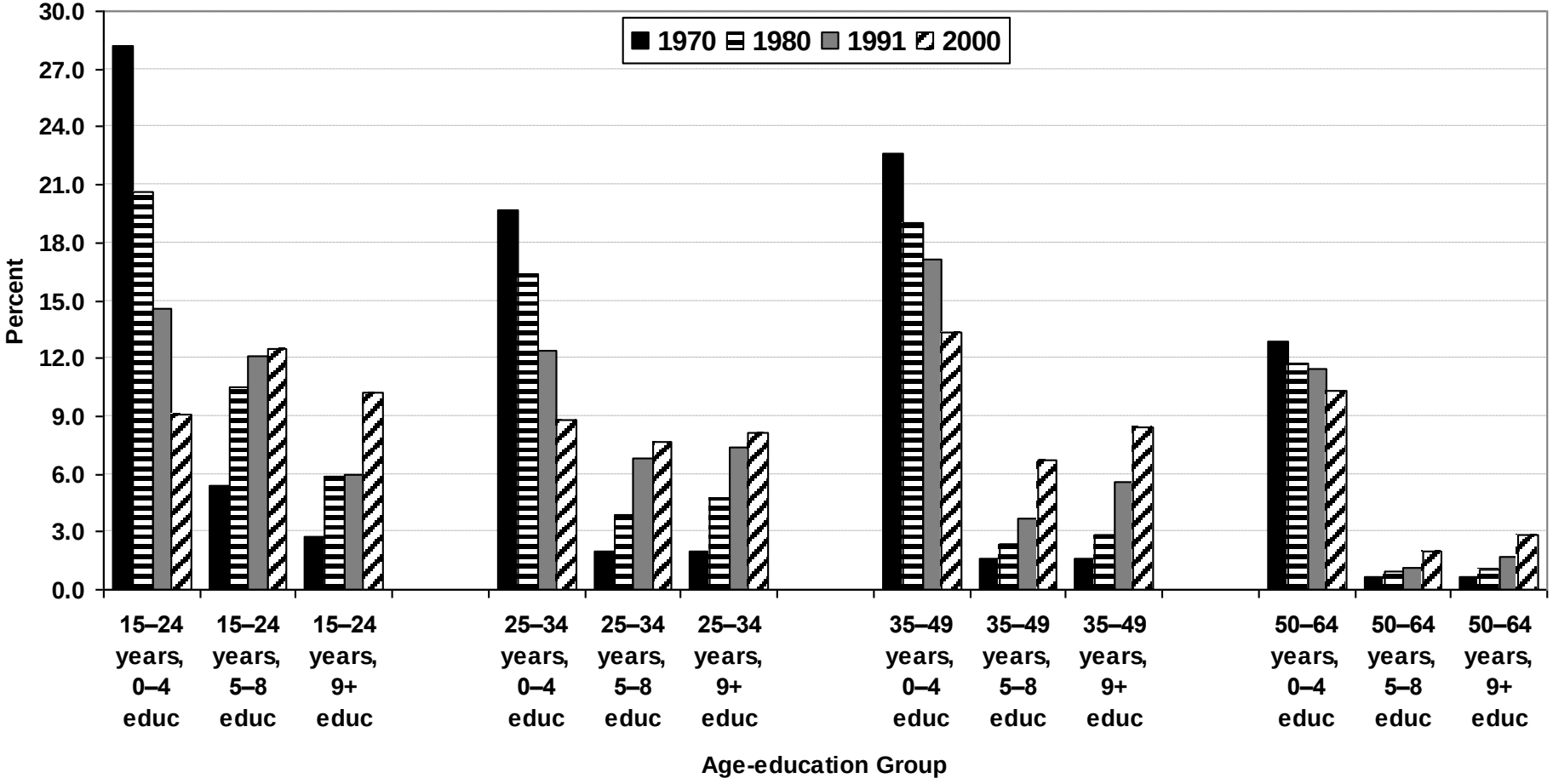
Data

- Microdata from the 1970-2000 **Brazilian Censuses**.
- Census long forms are available for 25% (1970 and 1980) and 10% or 20% (1991 and 2000) of households.
- Long forms contain information on age, sex, education, income, occupation, and migration.
- We aggregate municipalities to the **micro-region level**, yielding 502 comparable areas across the four censuses.

Categories

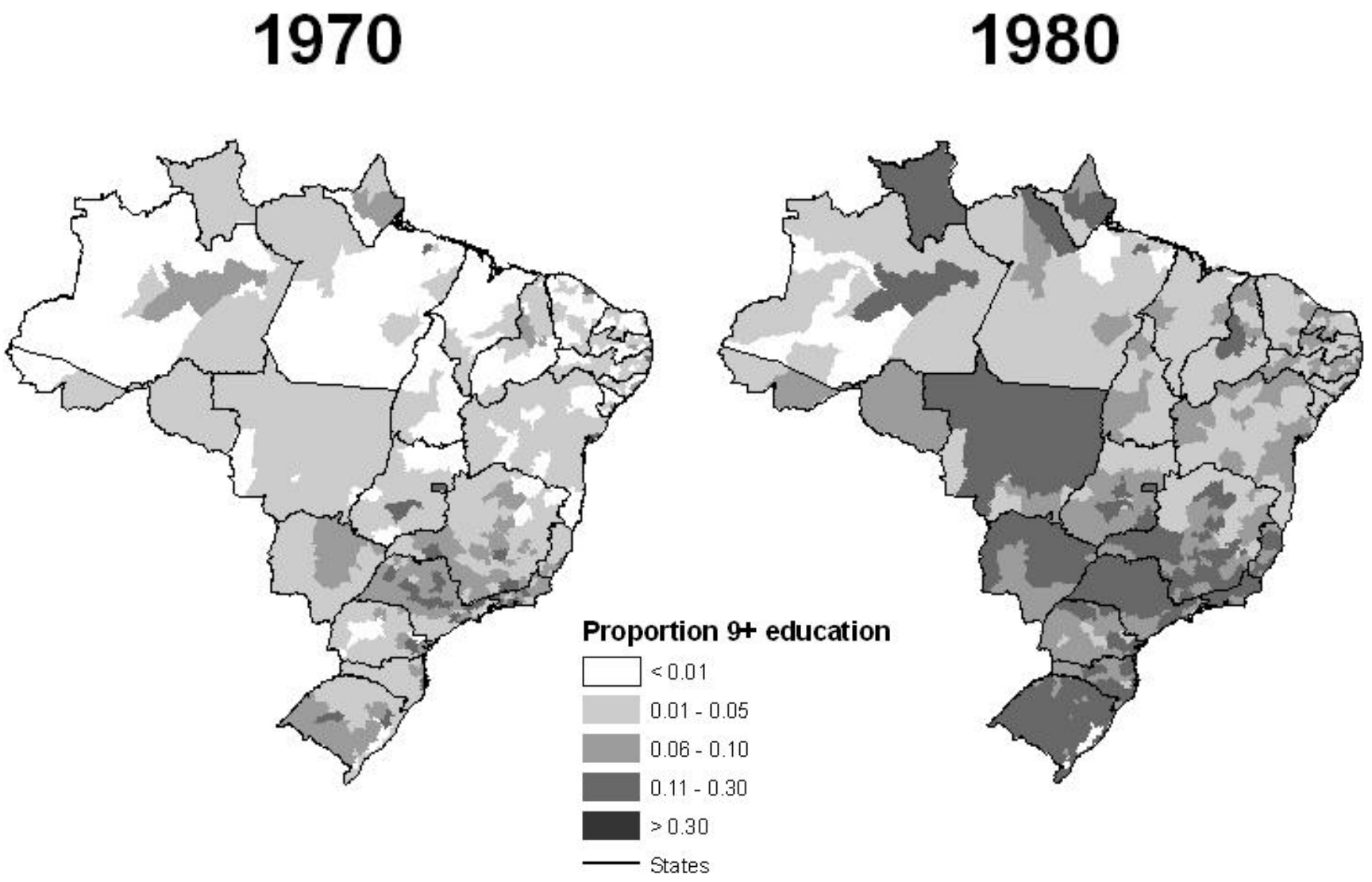
- **Time** (census years): 1970, 1980, 1991, and 2000.
- **Age** is categorized in four groups:
  - Youth population (15-24).
  - Young adults (25-34).
  - Adults (35-49).
  - Mature adults (50-64).
- **Educational attainment** was classified in three groups according to years of schooling completed:
  - 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** in main occupation: converted to January 2002.

Male population (15–64) by year and age-education group, 1970–2000 (%)



Source: 1970–2000 Brazilian Censuses.

Male population (15–64) with 9+ years of schooling by micro-region and year



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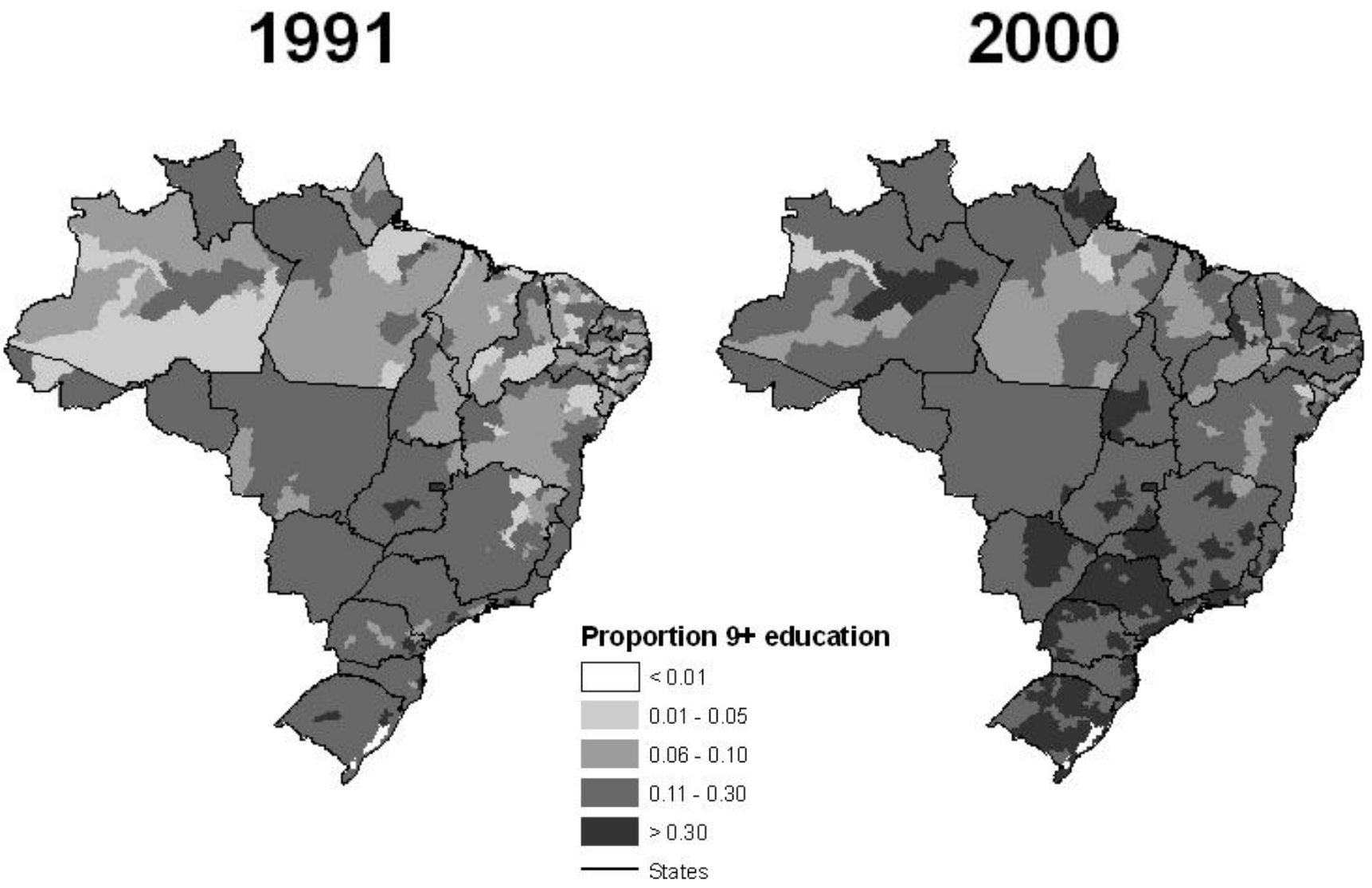
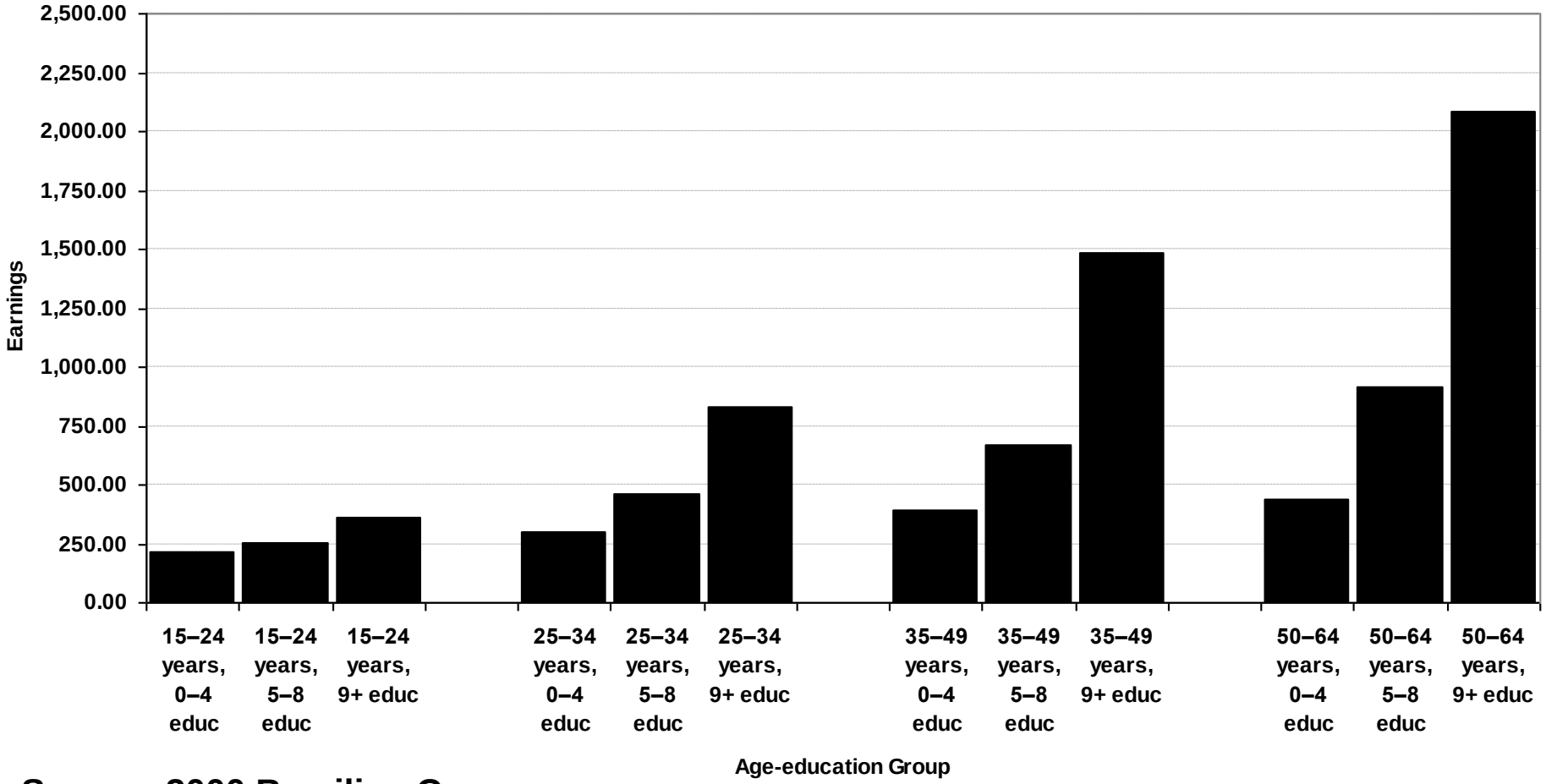


Mean real monthly earnings in main occupation of male population (15–64) by age-education group, 2000



Source: 2000 Brazilian Census.

Obs.: Nominal income was converted to base 1 in January 2002, taking into account changes in currency and inflation.

Estimation of models

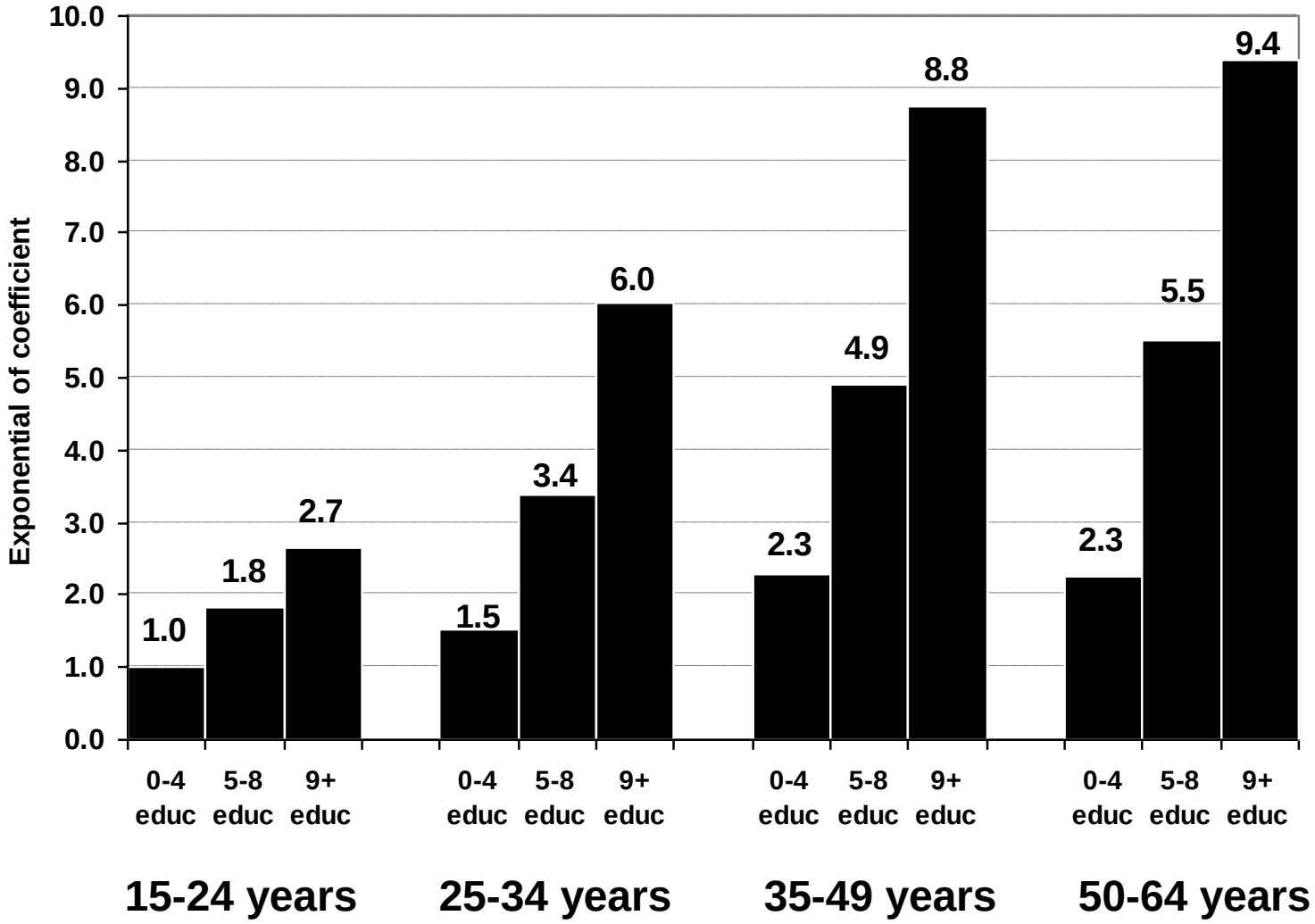
- **Fixed-effects models** allow the estimation of coefficients that reflect relationships within 502 micro-regions between 12 age-education groups over time on labor outcomes.
- Regressions only include **males**.
- Areas with less than 25 people receiving income were not included in the regression.
- **Dependent variable:** the logarithm of the mean real income in main occupation in a group.
- **Independent variables:** age-education indicators (*G*) and distribution of male population in 12 age-education groups (*X*) interacted with time (θ); and area-time fixed effects (α):

$$log(Y_{git}) = \beta_0 + (\beta_1 G_{12} + \ldots + \beta_{11} G_{43})*\theta_t + (\gamma_1 X_{11} + \ldots + \gamma_{12} X_{43})*\theta_t + \alpha_{it} + \varepsilon_{git}$$

Data setup

Micro-region	Age-education group	Census year	Prop. of people	X11	X12	X13	...	X43	Log of real mean income	Num. of obs.
110006	15-24 years & 0-4 educ.	1970	0.291	0.291	0	0	...	0	5.82	1616
110006	15-24 years & 5-8 educ.	1970	0.041	0	0.041	0	...	0	6.21	207
110006	15-24 years & 9+ educ.	1970	0.008	0	0	0.008	...	0	6.75	39
...	...	...	...	...	...	...	...	...	...	...
110006	50-64 years & 9+ educ.	1970	0.003	0	0	0	...	0.003	7.73	21
...	...	...	...	...	...	...	...	...	...	...

Effects of age-education indicators (G_{11}-G_{43}) on earnings, 1970–2000

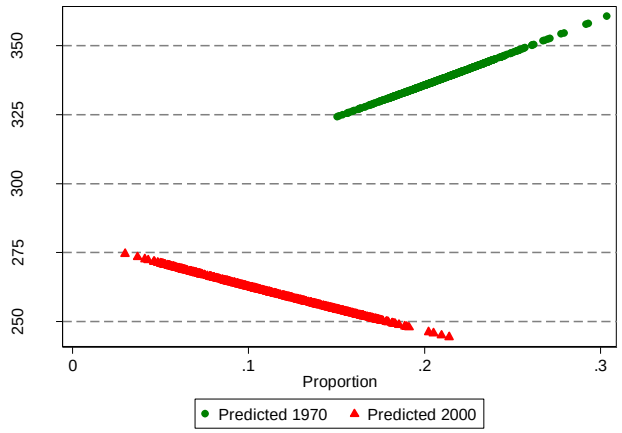


Source: 1970–2000 Brazilian Censuses.

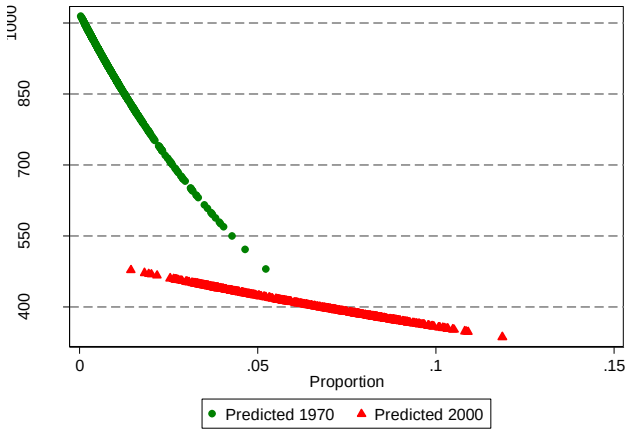
Effects of male proportions in 502 micro-regions (X_{11}-X_{43}) on earnings, 1970 and 2000

25–34 years

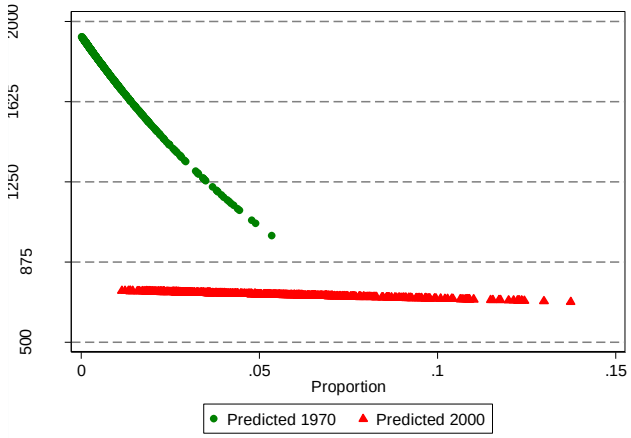
0–4 education



5–8 education

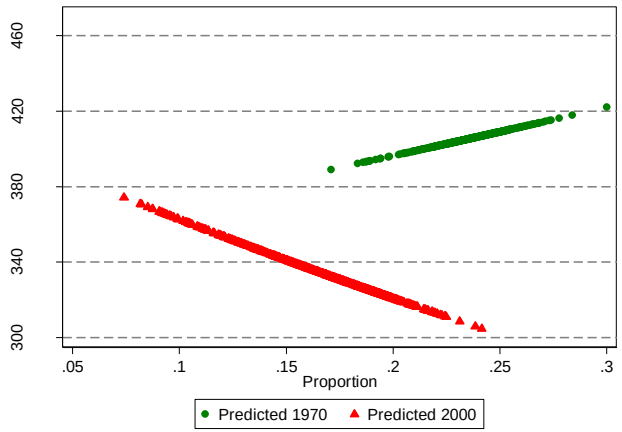


9+ education

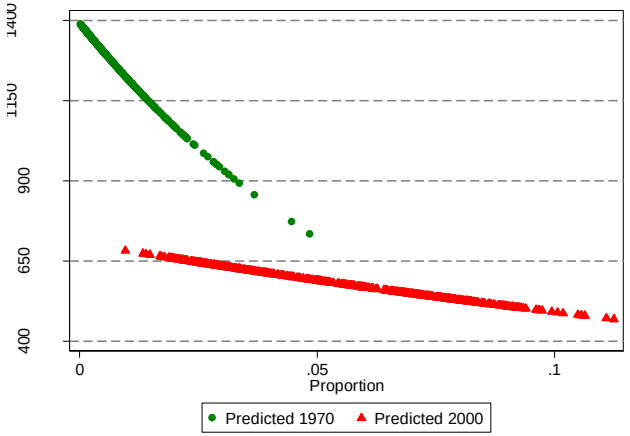


35–49 years

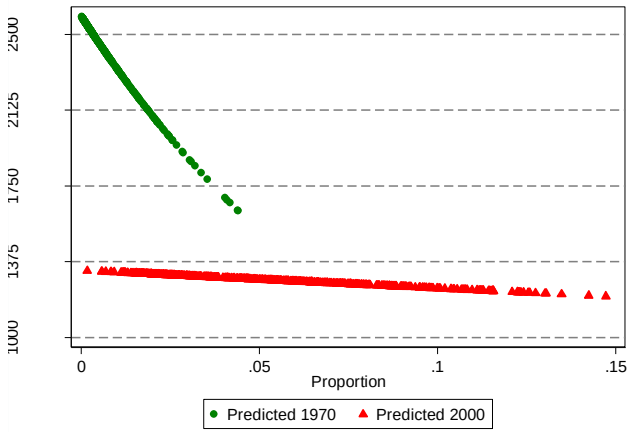
0–4 education



5–8 education



9+ education



New considerations

- Objective is to develop methodological procedures to include information of **internal migration** in the previous models.

- **If there was no migration flows**, the sending areas (which already have lower relative earnings) would have even lower earnings, and the receiving areas (which already have higher relative earnings) would experience raises on earnings.

- By not controlling for migration in the models, results are **underestimating the negative effect** of group size (cohorts) on earnings.

- The **hypothesis** is that, by controlling for migration flows, the negative impacts of age-education-group proportions will be even more negative than previous estimates.

Methodological procedures

- Migration flows cannot just be introduced as independent (exogenous) variables in the models.
- Since internal population flows in Brazil are influenced by availability of jobs and levels of income in sending and receiving areas, **migration is an endogenous variable**.
- As a strategy to correct for endogeneity problems, a methodology was developed by congregating the estimation of **migration level** (Stillwell 2005) and the modeling of **migration schedules** (Rogers and Castro 1981).
- These procedures were developed in collaboration with Professor Eduardo Rios-Neto (CEDEPLAR/UFMG).

Estimation of migration level

- **Gravity models** take into account distances among areas, and are used to control for migration flows (Stillwell 2005).
- **Poisson regression** uses migrants between region *i* and region *j* (M_{ij}); pop. at the beginning of the period (P_i); pop. at the end of the period (P_j); and distance among regions (d_{ij}):

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

- Since flows between areas (502*501=251,502) have low number of migrants, it was selected the **20-24 age group** to estimate the level of migration.
- A model was estimated for each year (1991 and 2000) and education group, using information on municipality of residence five years before the census.
- **Result:** populations at the beginning and end of the period have positive effects; and distance has a negative impact.

Estimation of migration schedule

- In order to estimate migration schedules, it is necessary to estimate **migration rates by age groups**.
- The estimation of migration rates for combinations of micro-regions and year would generate low results.
- The solution is to estimate rates for the flows among the major-regions (North, Northeast, Southeast, South and Central-West) in each year (1991 and 2000): 5*5*2=50.
- Information on **municipality of residence five years before the census** was used.
- **Age-specific immigration rates (*$ASIR_{x,ij}$*)** by age group were estimated, considering populations (*K*) in regions of origin (*i*) and destination (*j*):

$$ASIR_{x,ij} = \sum(K_{x,ij}) / t^{*}\sum\{[(K_{x,j.} + K_{x,jj}) + (K_{x,j})]/2\}$$

Modeling migration schedules

- After the estimation of immigration rates by age group, the mathematical models proposed by Rogers and Castro (1981) were implemented to these rates.

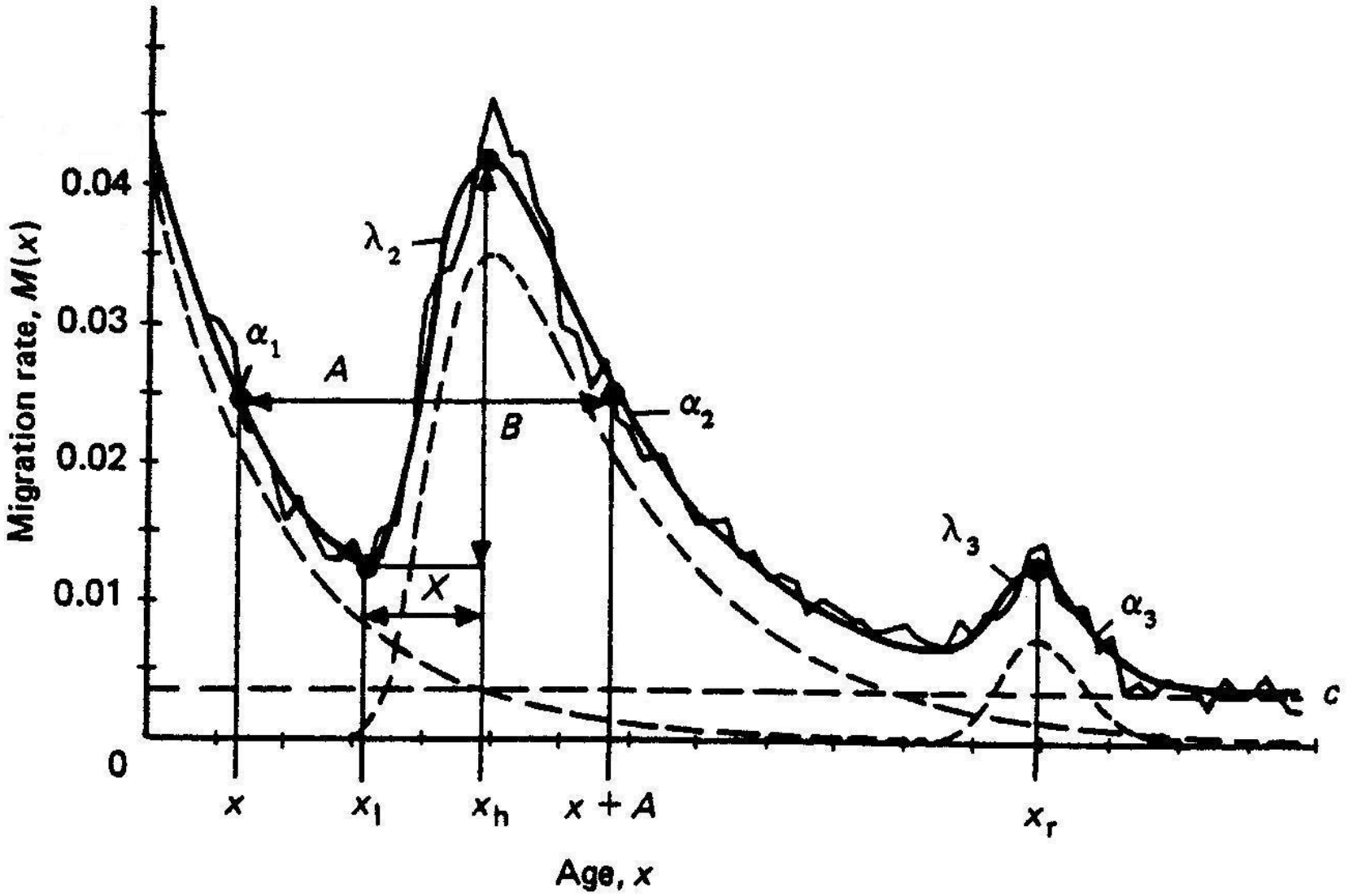
- Rogers and Jordan (2004) indicate that migration flows are usually modeled with the following equation:

$$S(x) = a_1 * exp(-\alpha_1 x) + a_2 * exp\{-\alpha_2(x-\mu_2) - exp[-\lambda_2(x-\mu_2)]\} + c$$

- This equation has a negative exponential curve in the first age groups, followed by a parabola on labor ages, and a constant term on post-labor ages.

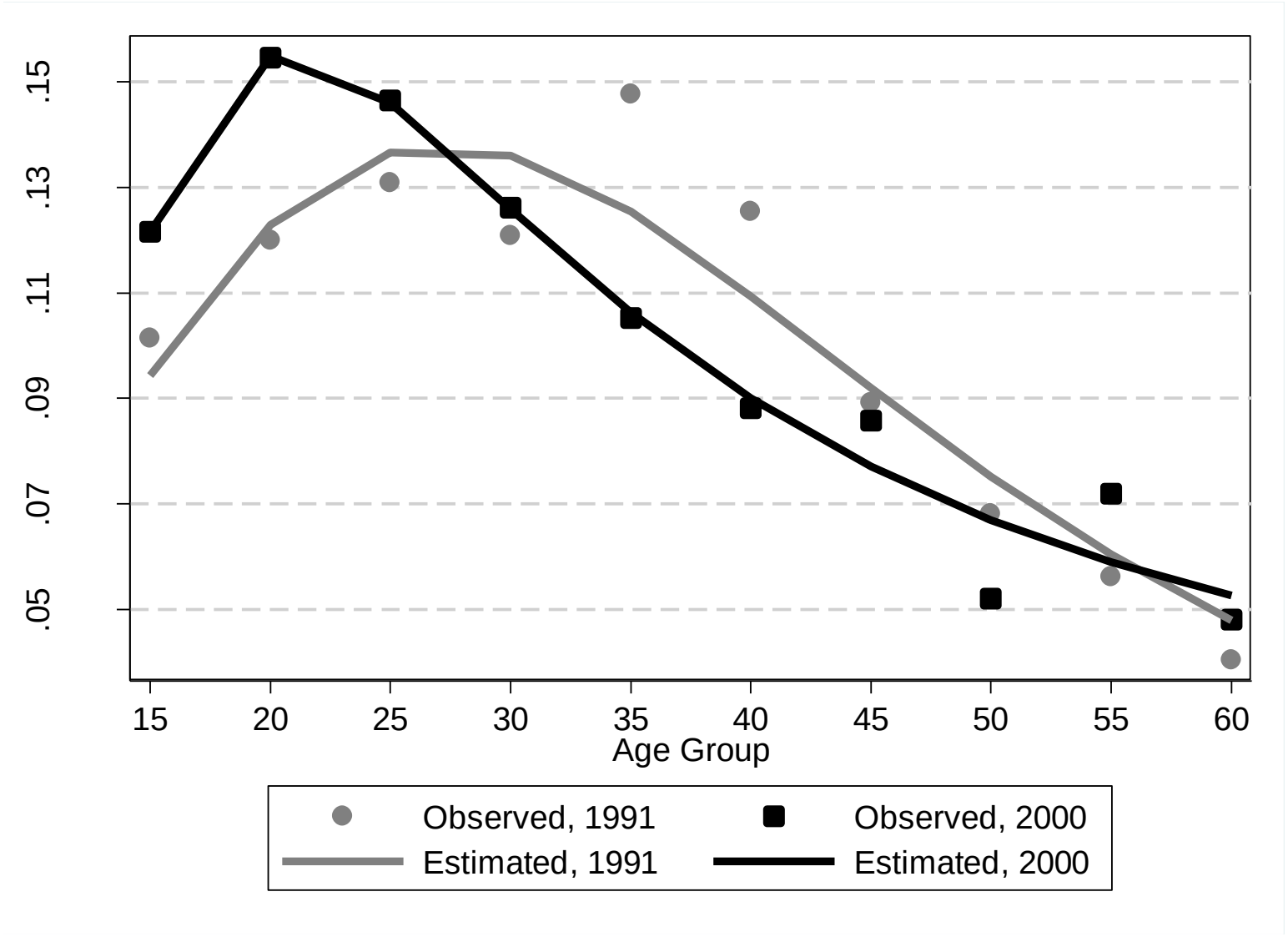
- For this exercise, rates were modeled only for those between 15 and 64 years of age.

The model migration schedule



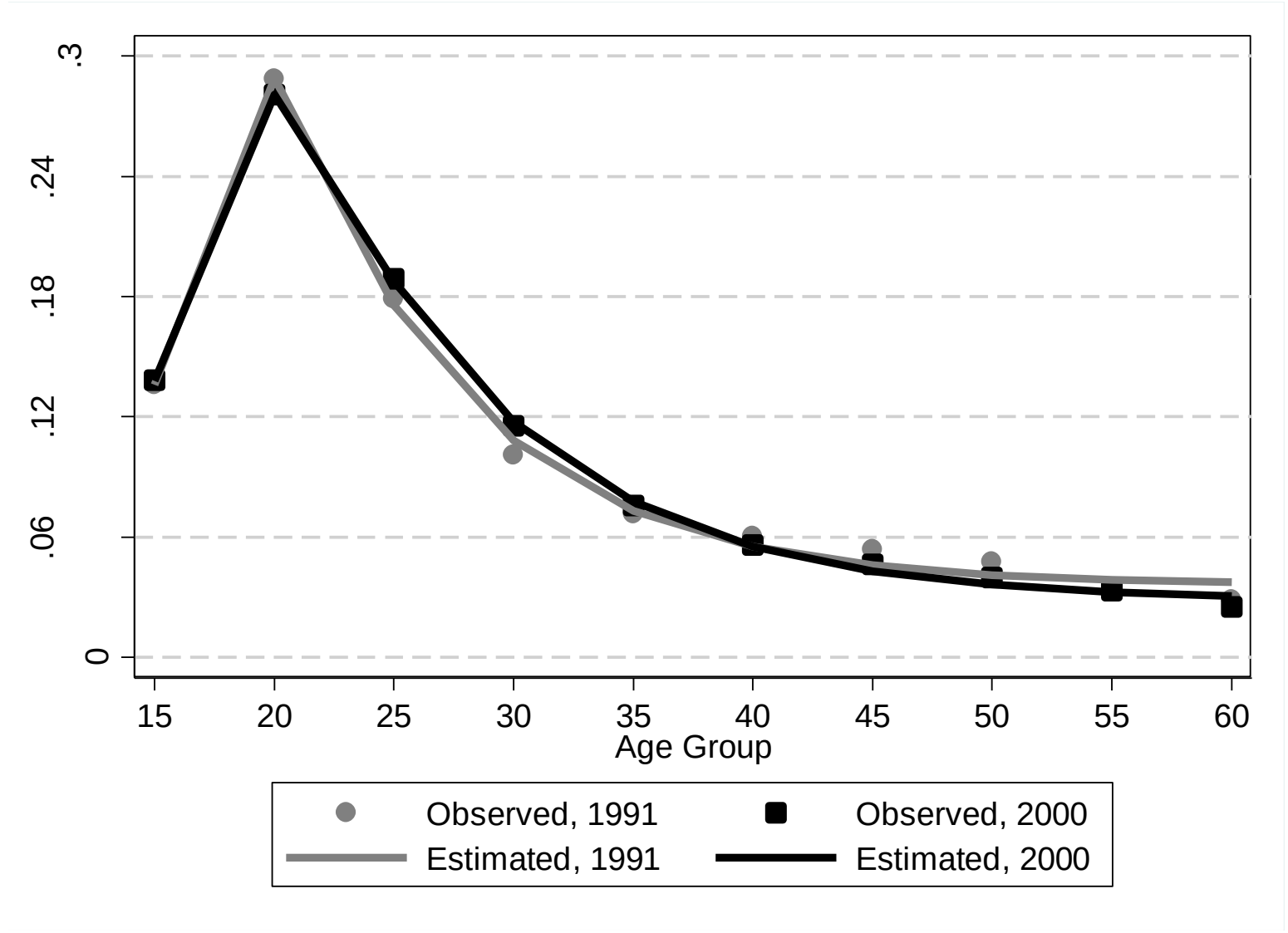
Source: Rogers and Castro (1981, p.6).

Observed and estimated proportional ASIR, North to Southeast, 1991 and 2000



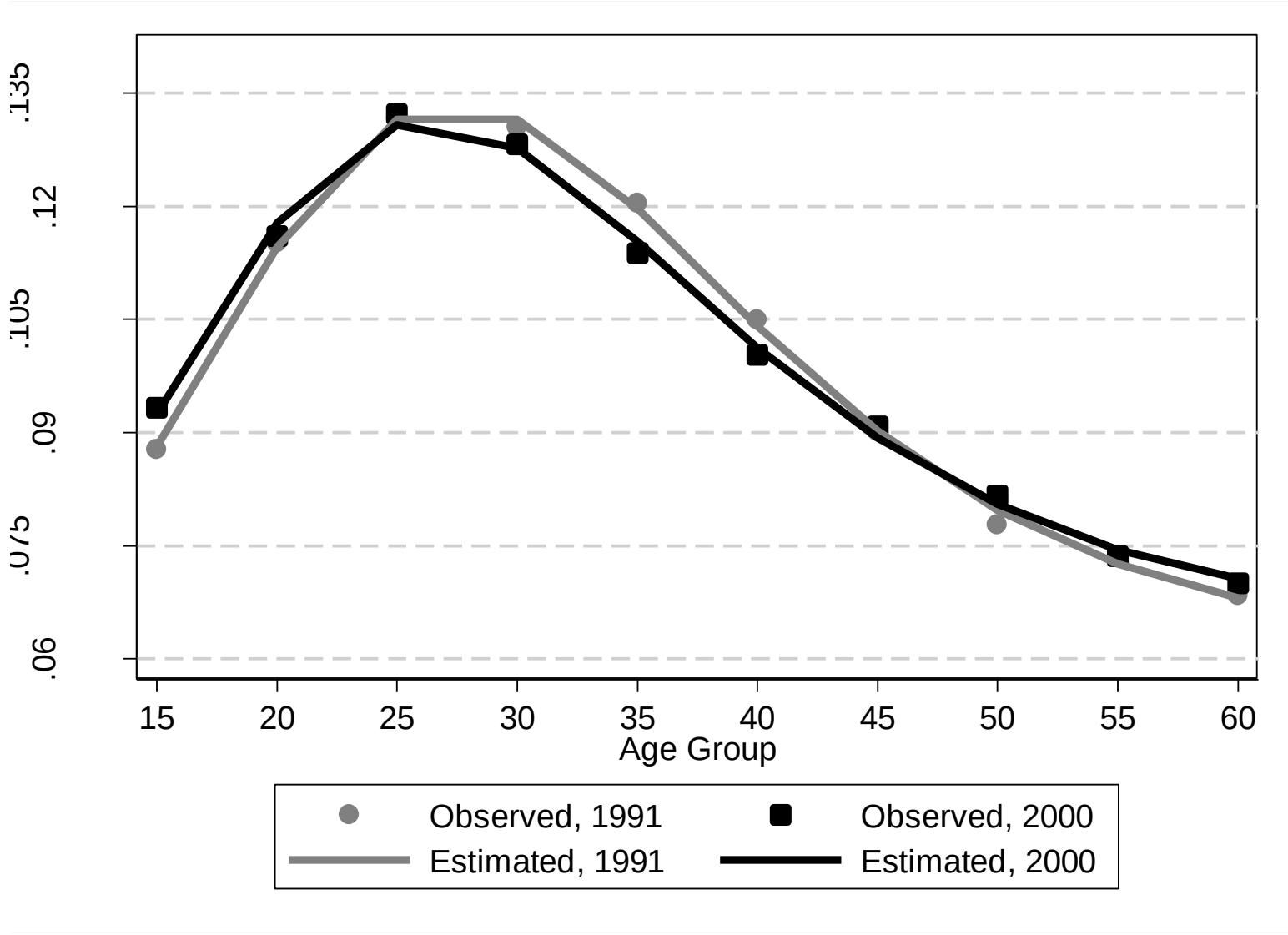
Source: 1991 and 2000 Brazilian Censuses.

Observed and estimated proportional ASIR, Northeast to Southeast, 1991 and 2000



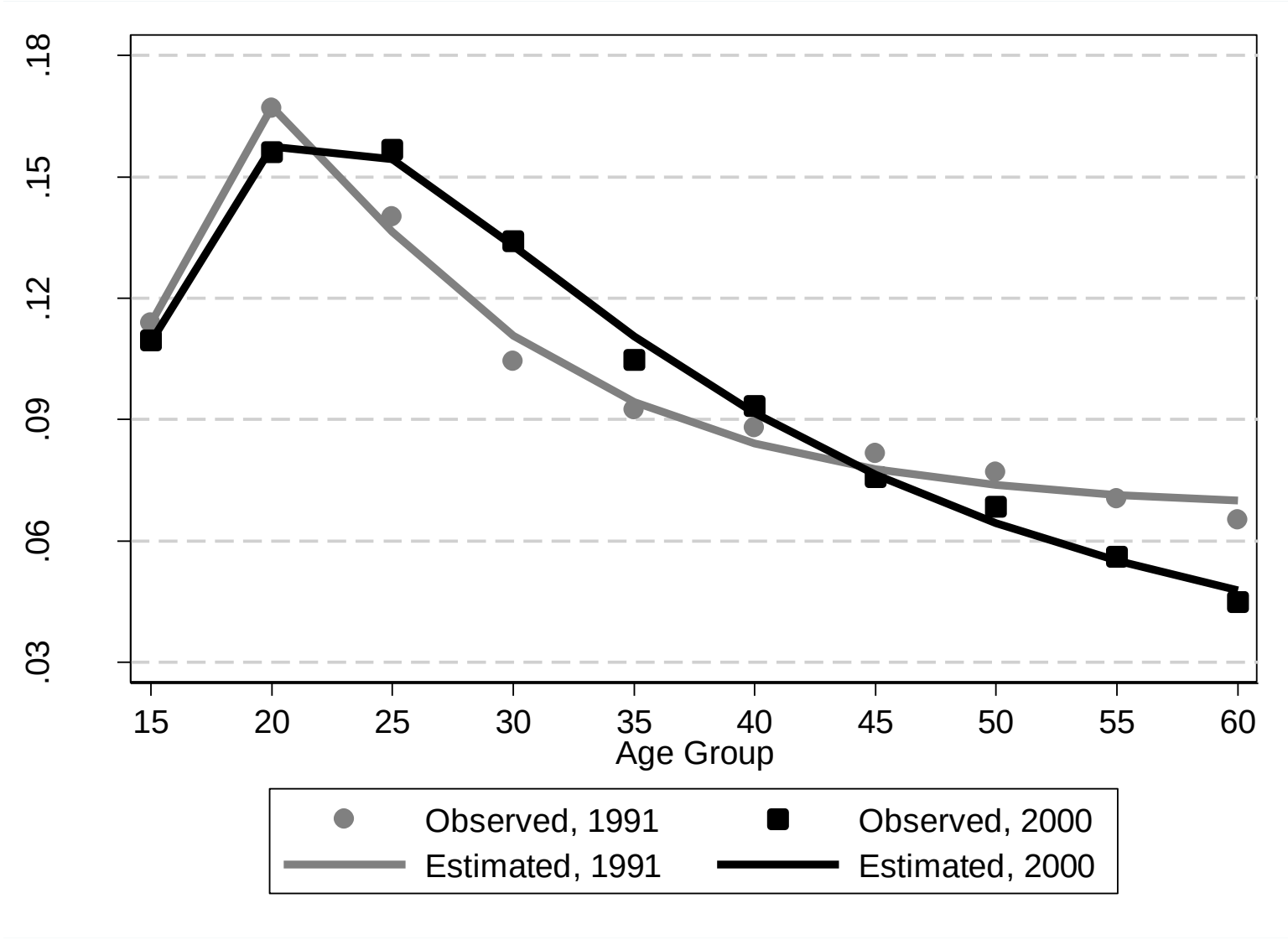
Source: 1991 and 2000 Brazilian Censuses.

Observed and estimated proportional ASIR, Southeast to Southeast, 1991 and 2000



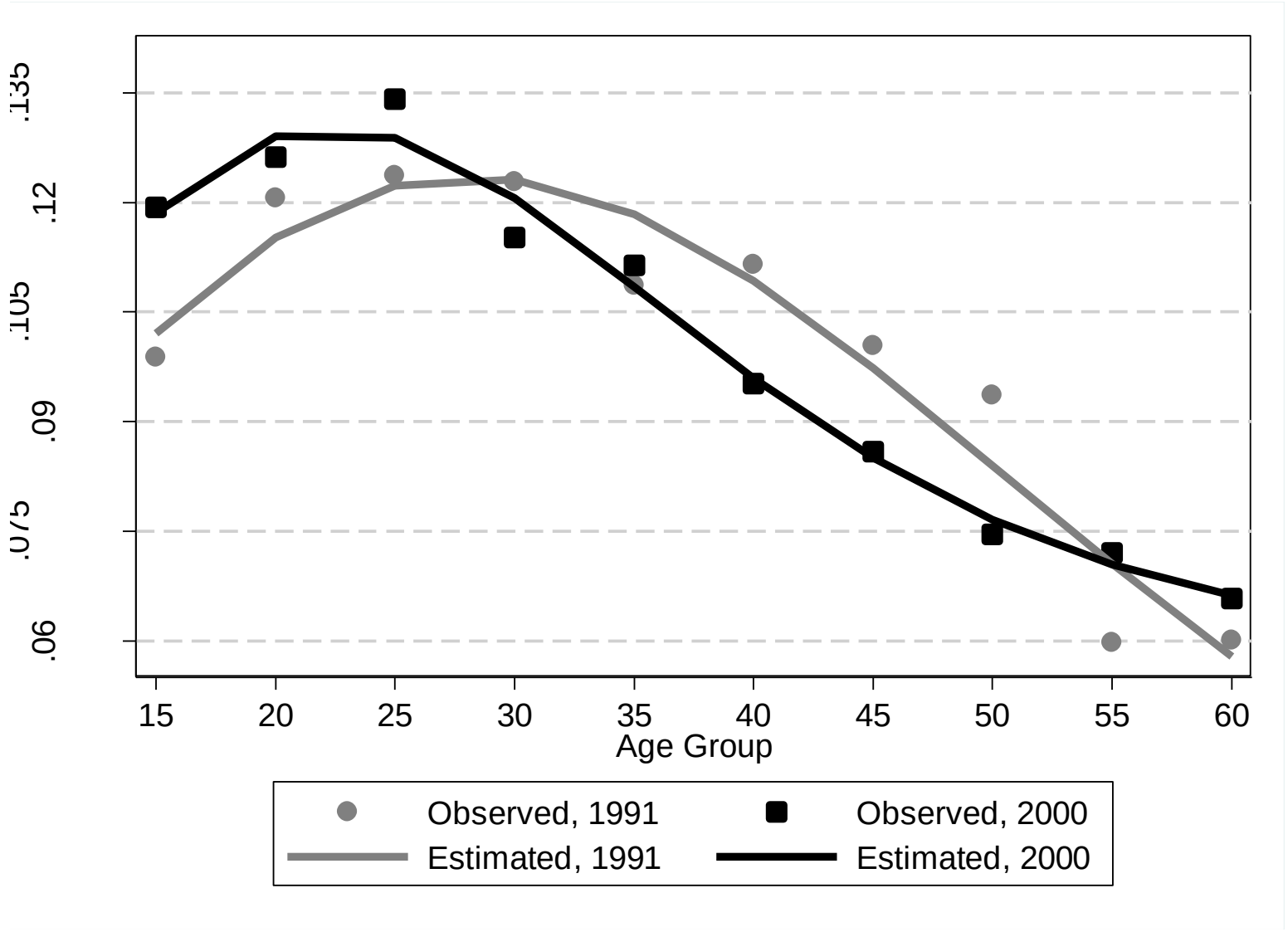
Source: 1991 and 2000 Brazilian Censuses.

Observed and estimated proportional ASIR, South to Southeast, 1991 and 2000



Source: 1991 and 2000 Brazilian Censuses.

Observed and estimated proportional ASIR, Central-West to Southeast, 1991 and 2000



Source: 1991 and 2000 Brazilian Censuses.

Integrating level and schedule of migration

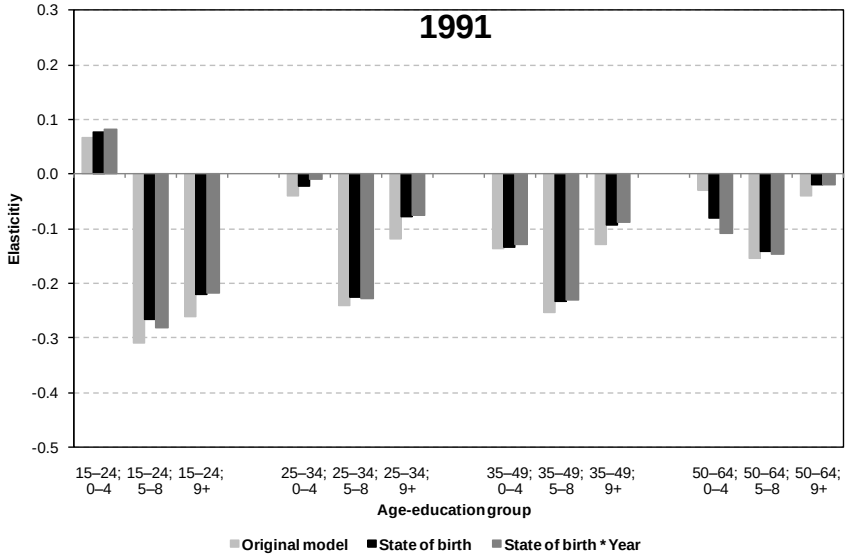
- The **level of migration** for men aged 20-24 years between the 502 micro-regions by education group (0-4, 5-8, and 9+) and year (1991 and 2000) was estimated.
- The **pattern of migration** was estimated with the modeling of age-specific immigration rates ($ASIR_{x,ij}$) for each population flow among the five major-regions by year.
- Then, the **ratio** between the level of migration and the *ASIR* for the 20-24 age group was calculated.
- The ratio was then multiplied by each $ASIR_{x,ij}$ of the other age groups, considering the education group, area and year.
- Finally, a measure of **force of migration** was estimated for each micro-region, age-education group and year.

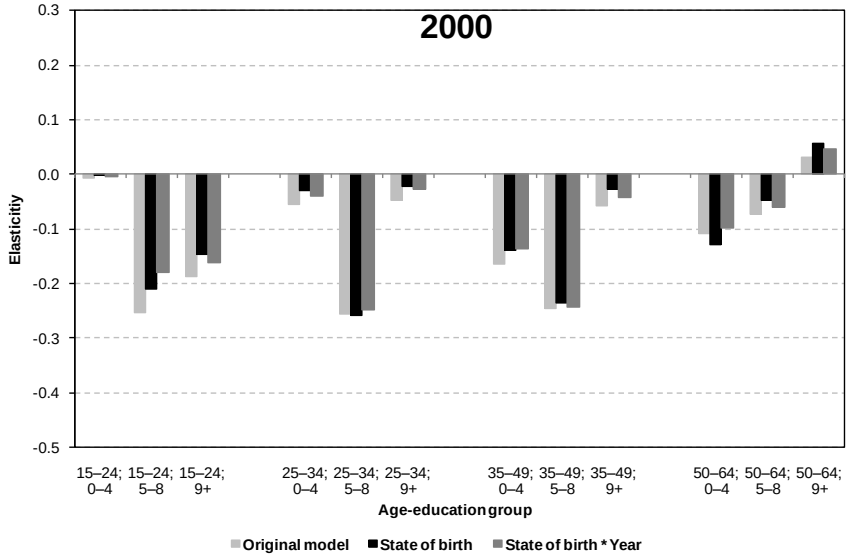
New regression models

- **Original model** (1970-2000 & 1991-2000): age-education*year; proportion by age-education*year.
- **Migration model 1** (1970-2000 & 1991-2000): original model; state of birth; state of birth*year.
- **Migration model 2** (1970-2000 & 1991-2000): original model; time of residence; time of residence*year.
- **Migration model 3** (1991-2000): original model; residence five years before the census; residence five years before the census*year.
- **Migration model 4** (1991-2000): original model; adjusted migration; adjusted migration*year.
- The elasticities for the 1991-2000 models...

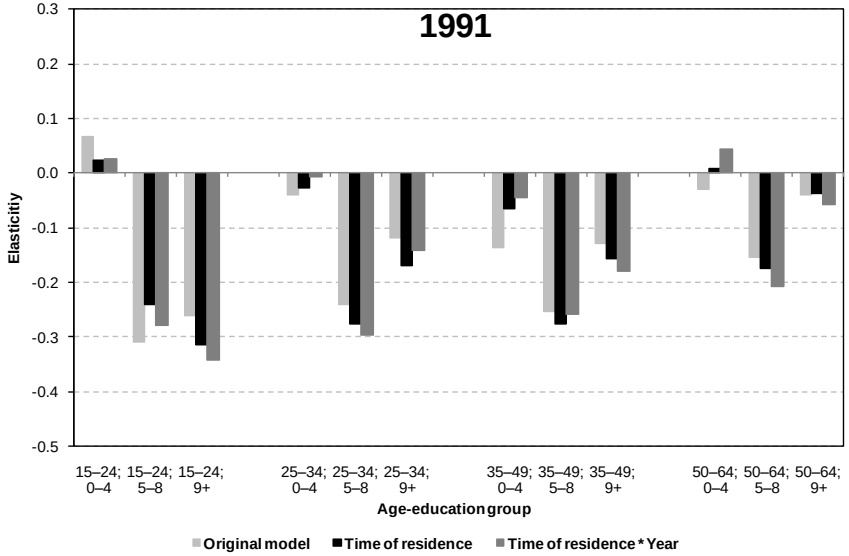
Estimated elasticities of proportions in age-education groups, 1991 and 2000

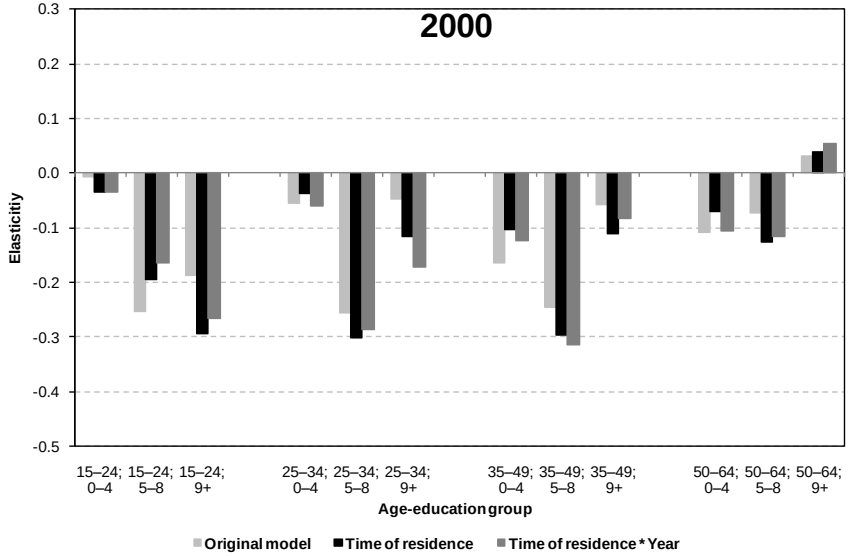
STATE OF BIRTH





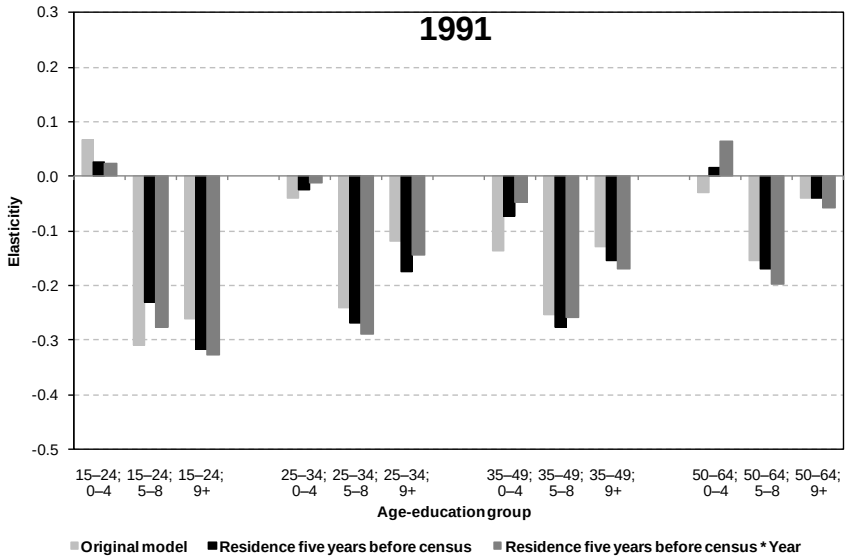
TIME OF RESIDENCE (LESS THAN 5 YEARS IN THE MUNICIPALITY)

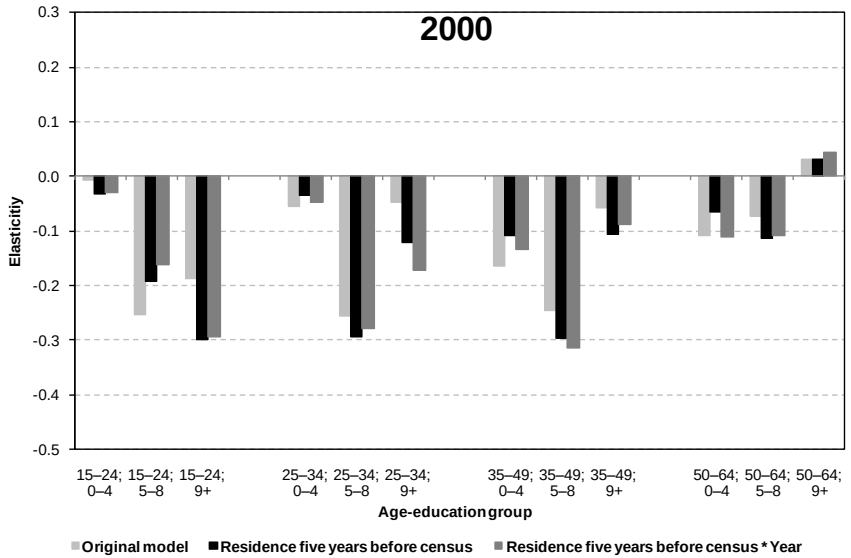




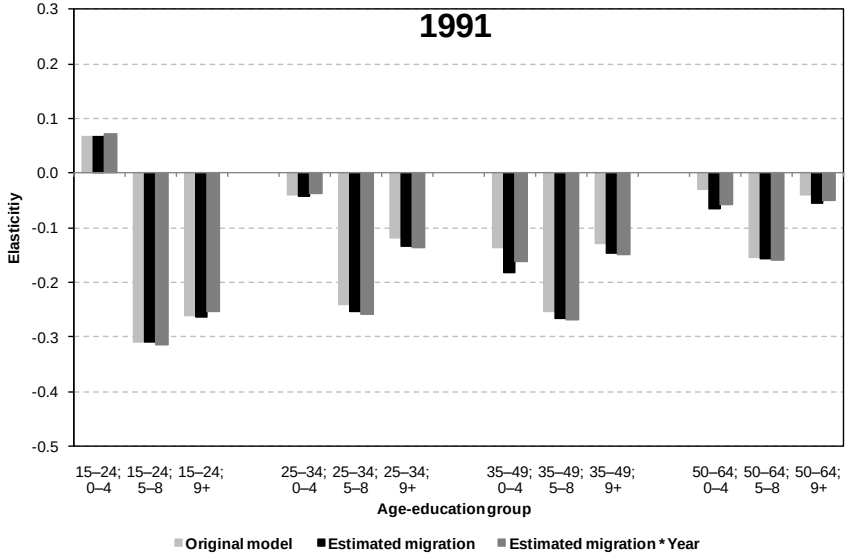
Estimated elasticities of proportions in age-education groups, 1991 and 2000

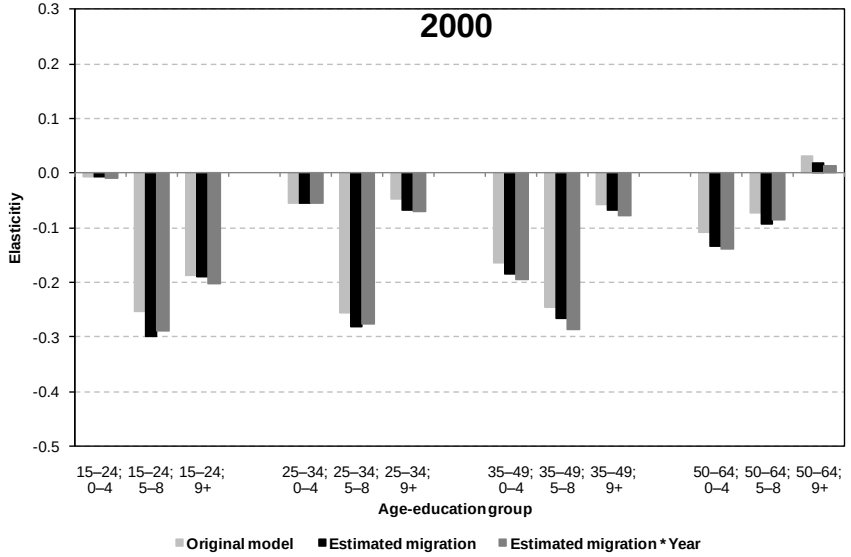
RESIDENCE FIVE YEARS BEFORE THE CENSUS





ADJUSTED MIGRATION





Final considerations

- Findings follow the **initial hypothesis**, which addressed that, by controlling for migration flows, negative impacts of cohort size on earnings are even more negative than estimates that did not take into account population flows.

- The inclusion of internal migration has consistent results only with the **adjusted level and pattern** of flows.

- These strategies were designed in such a way that they can be used in **further studies**, when new date become available, as well as in the context of other countries with the availability of migration data.