# DEMOGRAPHIC CHANGE AND ECONOMIC DEVELOPMENT AT THE LOCAL LEVEL IN BRAZIL

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# Project

- **The main focus of the demographic dividend (DD) literature has been on the direct impact of the age structure on economic development as the dependency ratio decreases.**

- **However the composition of the Brazilian labor force, in terms of age and educational attainment, is also undergoing drastic shifts with great regional variation.**

- **The questions are whether these compositional shifts have had an effect beyond the formal labor force equations estimated by DD studies, and whether the approach of a formal theory of labor demand is worthwhile in this study.**

# 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.**

- **Municipalities are aggregated to the micro-region level, yielding 502 comparable areas across the four censuses.**

- **Age is categorized in four groups: 15–24, 25–34, 35–49, and 50–64.**

- **Educational attainment is classified in three groups according to years of schooling completed: 0–4, 5–8, 9+.**

# Proportion of Men with 25–34 Years of Age and 9+ Years of Schooling in 502 Brazilian Micro-regions, 1970–2000 Censuses
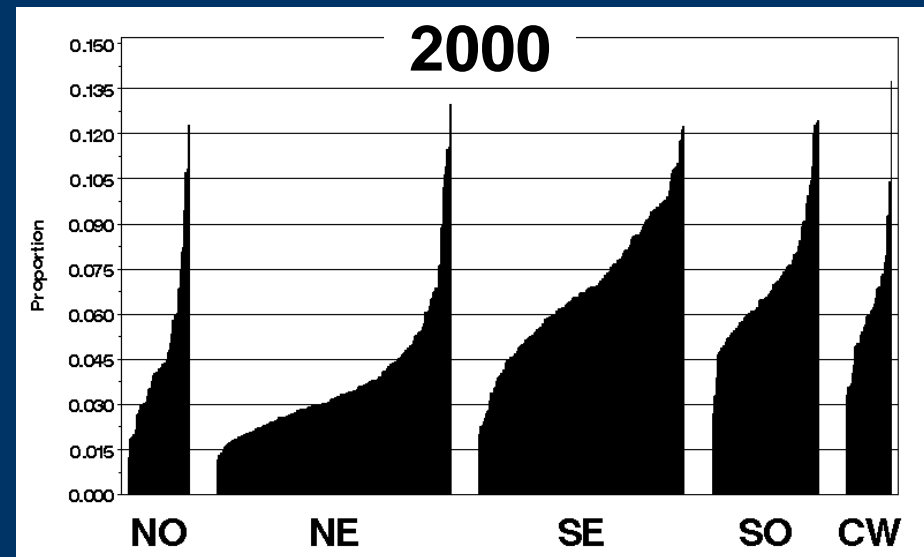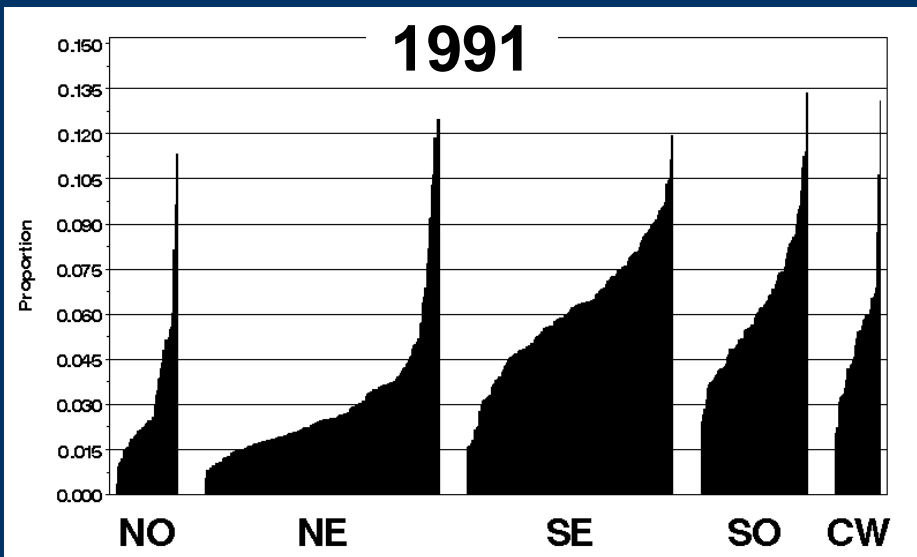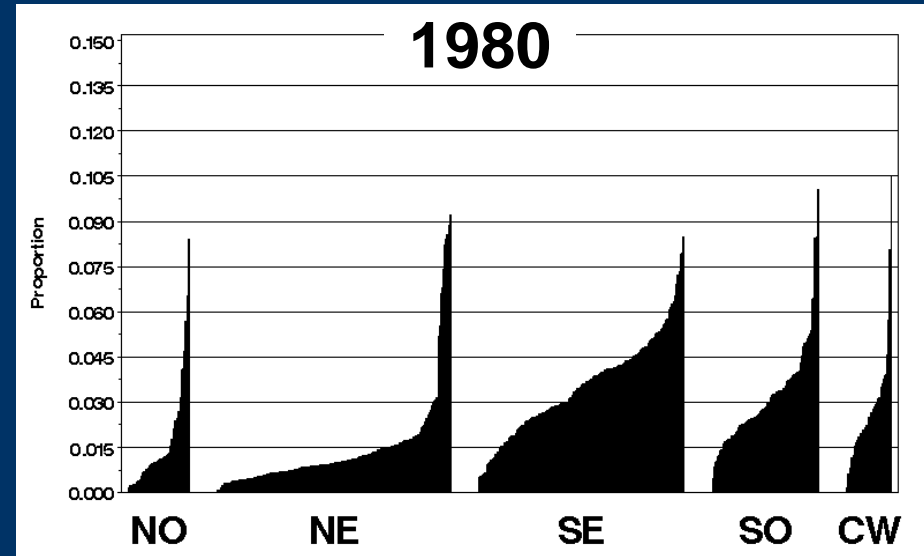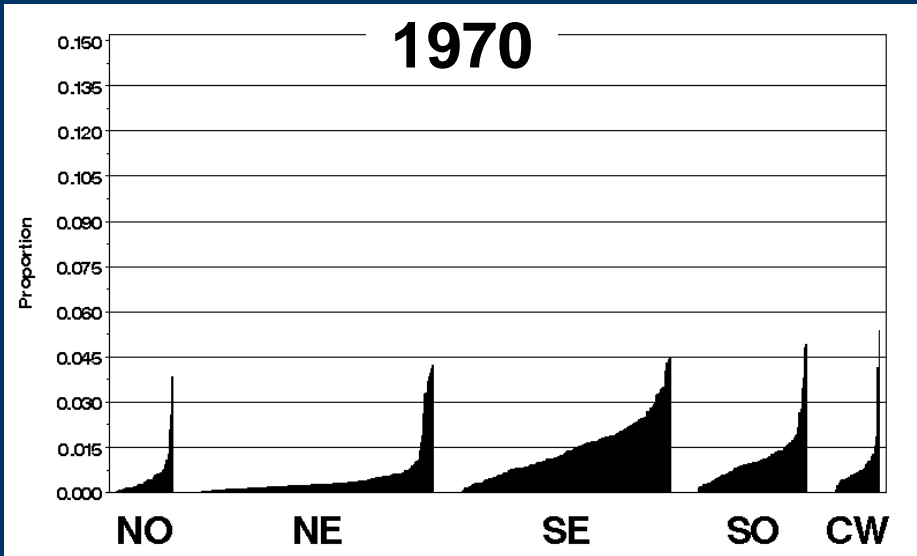
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# and 0–4 Years of Schooling in 502 Brazilian Micro-regions,
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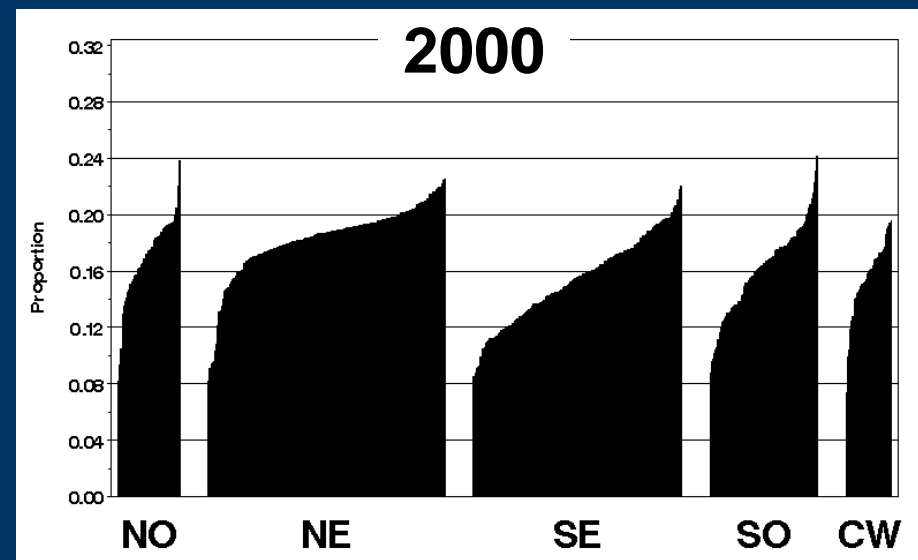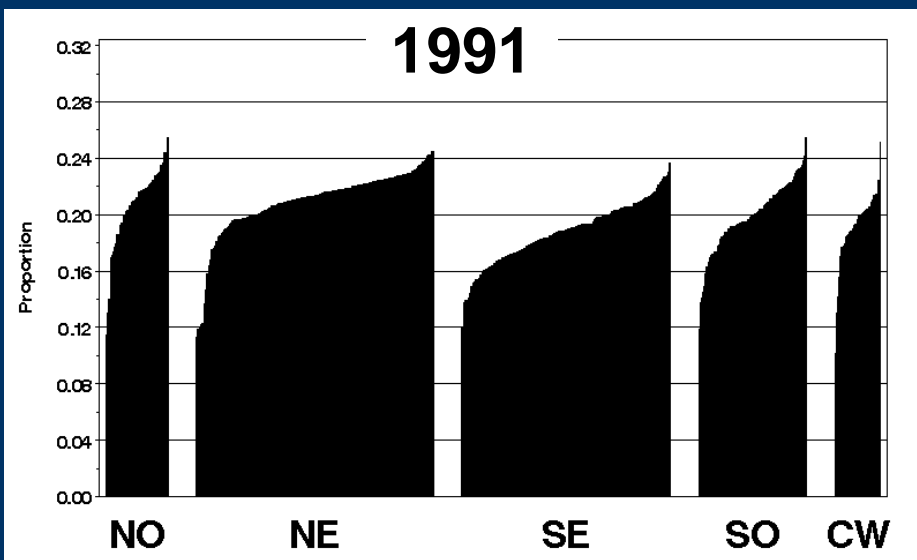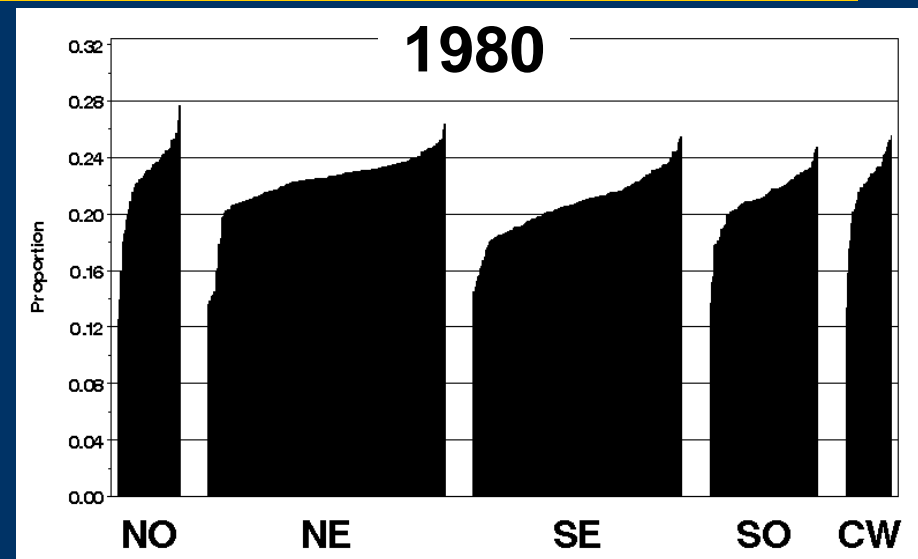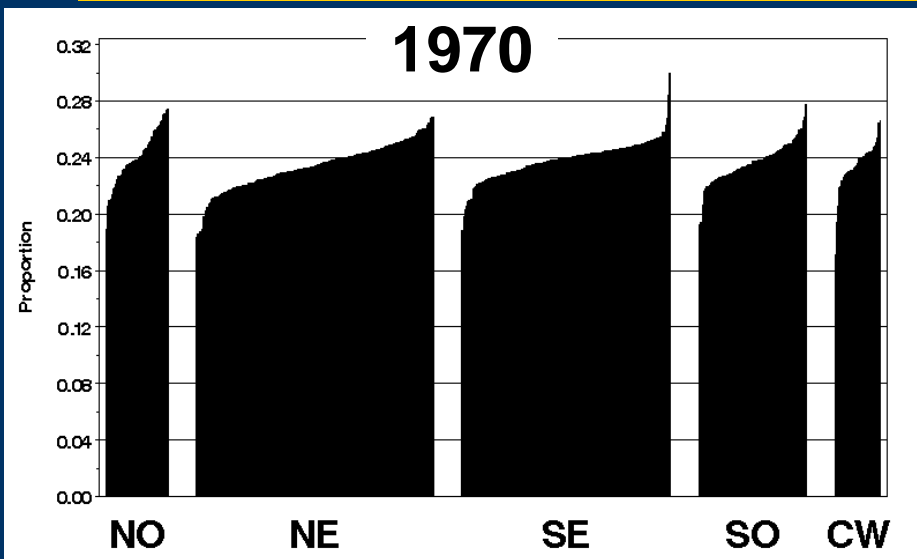
# Inverse Demand Function

- **Equations estimated in this study are inverse demand functions, which are derivable from the production function.**

- **The demand for a particular good depends on, among other things, the price at which a firm sells its products, constituting the ordinary demand function:**

$$q_i=q_i(p_1,...,p_n, Y).$$

- **Inverse demand functions can also be estimated, in which the price depends on the demand for a particular good:**

$$p_i=p_i(q_1,...,q_n, Y).$$

# Elasticities of Labor Demand & Factor Price

- **Wage elasticities of labor demand** allow for the estimation of effects of exogenous changes of wage rates on the amount of labor that employers demand to use.

  - The percentage change in price explains the percentage change in quantity demanded, i.e. factor prices are exogenous.

- **Quantity elasticities of factor price** indicate the impact of exogenous changes of the demand for labor on wage rates.

  - The percentage change of workers' labor demanded determines the percentage change in their wage rate, i.e. factor quantities are exogenous.

# Complementarity & Substitution

- *Partial elasticities of **labor demand** — inputs *i* and *j* are:*

  - ***p-complements*** if the conditional demand for one of them decreases when the cost of the other factor increases.

  - ***p-substitutes*** if the conditional demand for one of them increases when the cost of the other factor increases.

- *Partial elasticities of **factor price** — inputs *i* and *j* are:*

  - ***q-substitutes*** if the conditional wage for one of them decreases when the supply of the other factor increases.

  - ***q-complements*** if the conditional wage for one of them increases when the supply of the other factor increases.

# Effects of Education and Demographic Shocks on Elasticities

- **Unskilled workers** are easier to substitute for capital than skilled labor:

  - Own-price elasticities of labor demand are greater for unskilled than for skilled workers.

- **Skilled workers'** earnings are more affected by own-cohort size than unskilled workers:

  - Own-quantity elasticities of factor-price are greater for highly educated workers.

- Increases of female labor force participation, younger workers, and skilled workers in the labor force do not have large effects on the relative wages of other groups.

# Estimation of Models

- **Fixed-effects models** allow the estimation of coefficients that reflect relationships within micro-regions over time on labor outcomes.

- The **dependent variable** is the logarithm of the mean real income in a group.

- Areas with less than **25 people** receiving income were not included in the regression.

- Regressions only include **males**.

- **Marginal cost** is specified as constant, because there is no information on the scale of production in each area, i.e. there is the implicit assumption of separability of the examined inputs from capital.

# Equation 1: OWN-EFFECTS

- **EQUATION 1**: within each area (i), at each time (t), income is predicted by the proportion of people in each one of the age-education cells (c). Giving 12 regressions of the following form:

$$W_{itc} = \beta_0 + \beta_1 X_{itc} + \upsilon_i + \theta_t + \varepsilon_{itc} , \quad i = 1 \dots K; \ t = 1 \dots T$$

- **POOLED VERSION**:

  - Three indicators for census years.

  - Eleven indicators for age-education groups.

  - Twelve proportions of people in each one of the age-education groups.

# Predicted Earnings from Own-Effects Model by Proportion of People in 502 Brazilian Micro-regions, 1970–2000
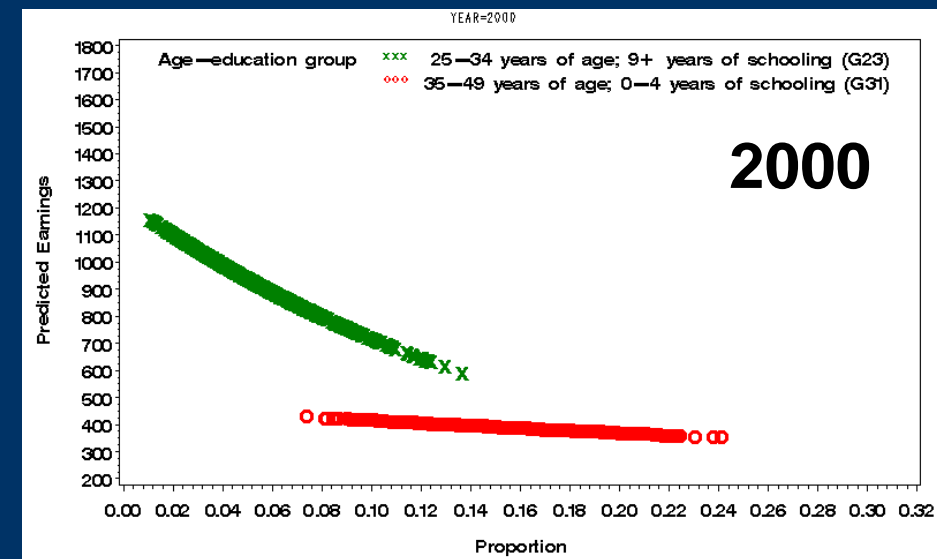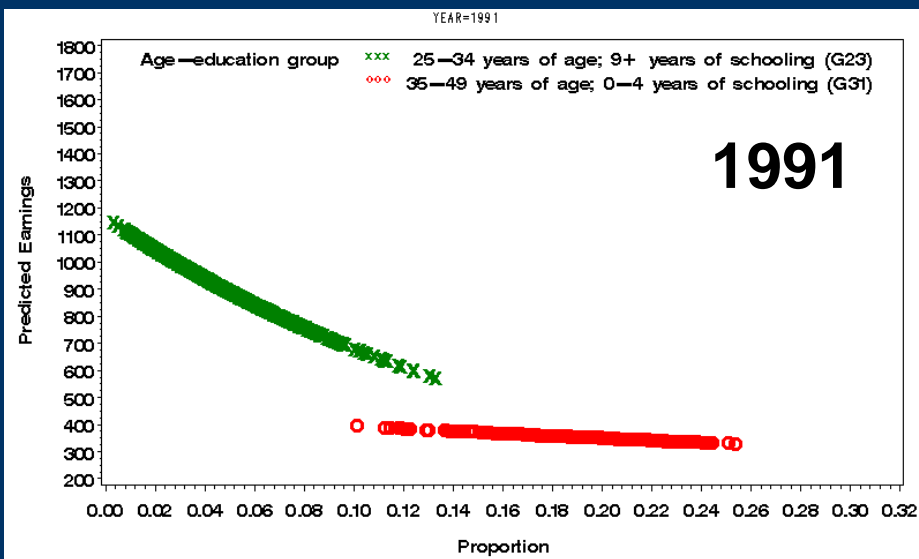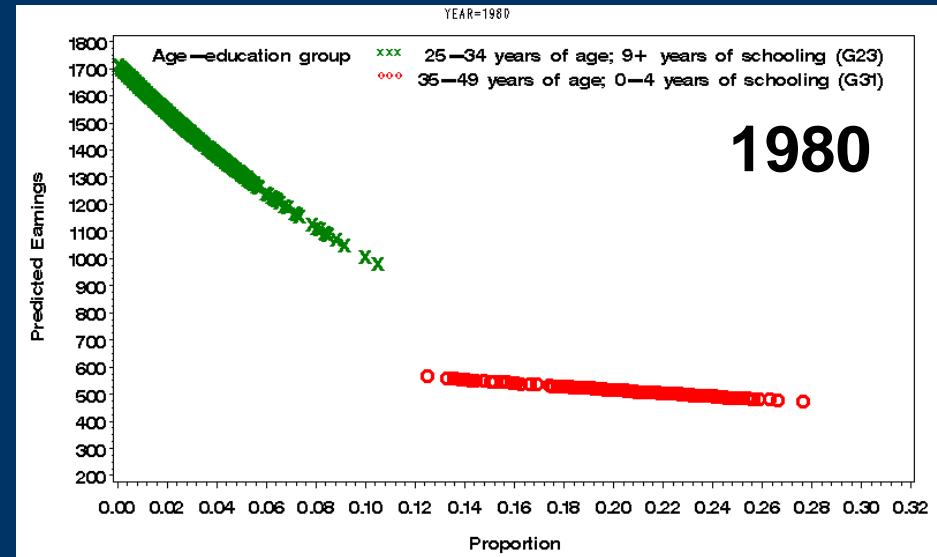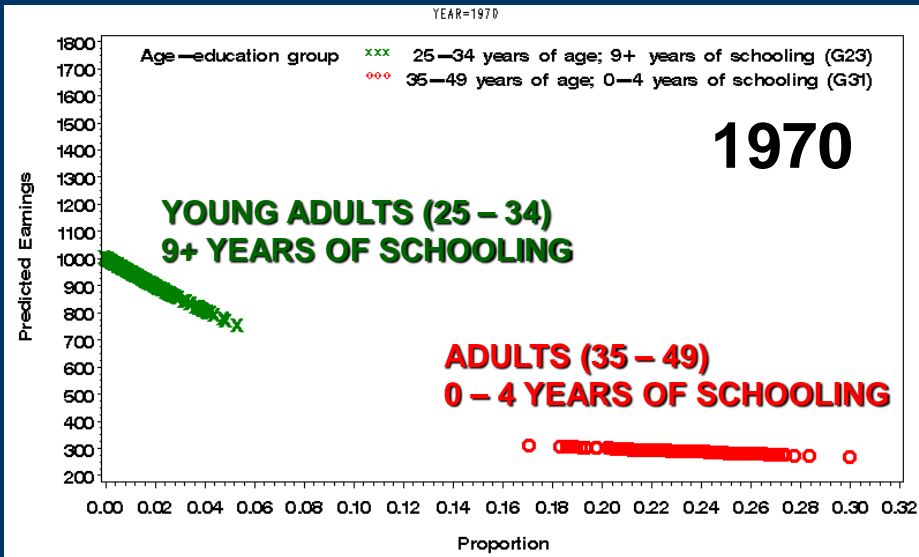
# CROSS-EFFECTS MODELS
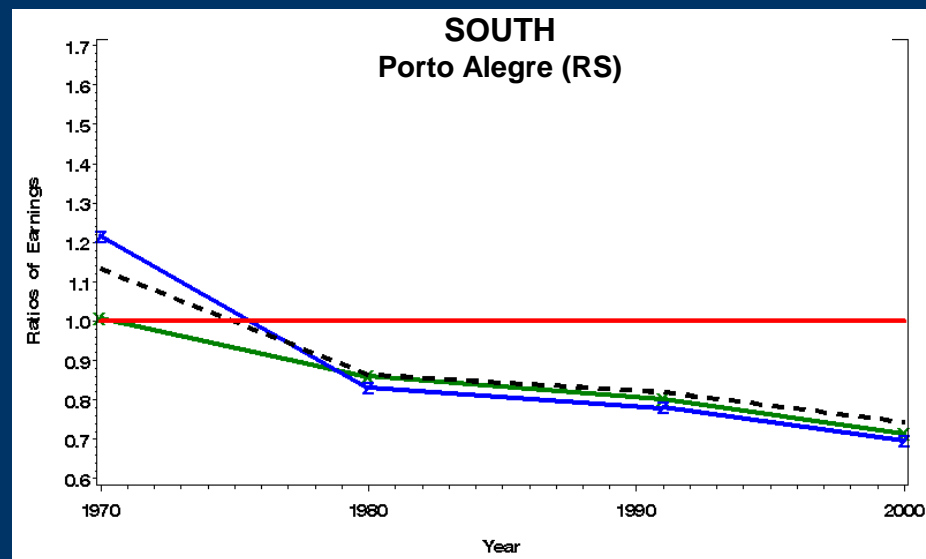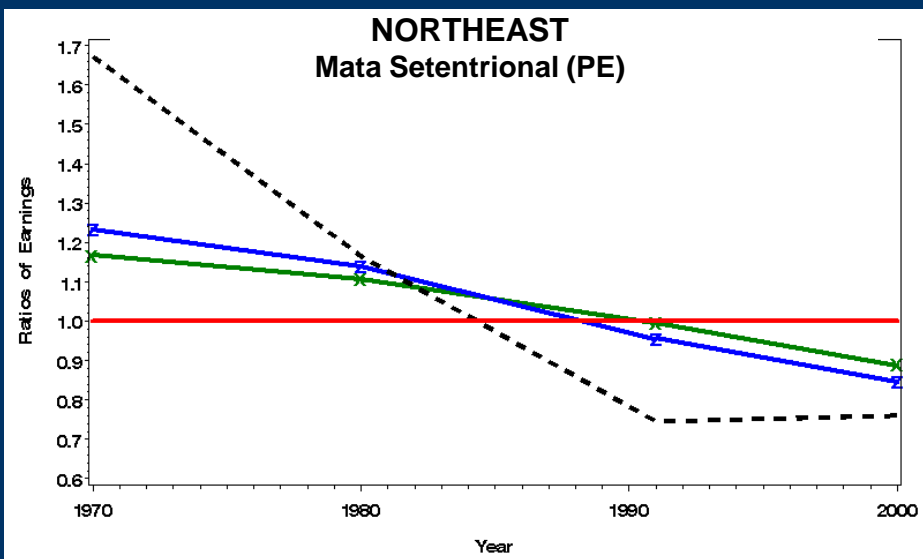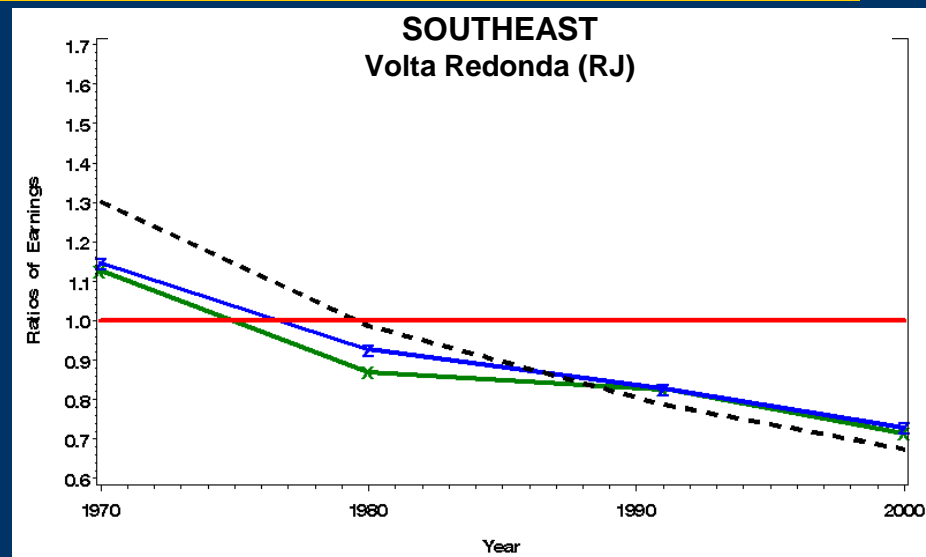
- **EQUATION 2**: allows for cross-effects.

$$W_{itc} = \beta_0 + \beta_1 X_{itc} + \beta_2 X_{itc'} + \upsilon_i + \theta_t + \varepsilon_{itc} \ , \ \ i = 1\ldots K; \ t = 1\ldots T$$

- **EQUATION 2'**: equals Equation 2, adding interactions of cross-proportions with three year indicators.

$$W_{itc} = \beta_0 + \beta_1 X_{itc} + \beta_2 X_{itc'} + \beta_3 \theta_t X_{itc} + \beta_4 \theta_t X_{itc'} + \upsilon_i + \theta_t + \varepsilon_{itc} \ ,$$

$$i = 1\ldots K; \ t = 1\ldots T$$

# CROSS-EFFECTS X YEAR
## Adults (35–49), Medium Education (5–8), 1970–2000
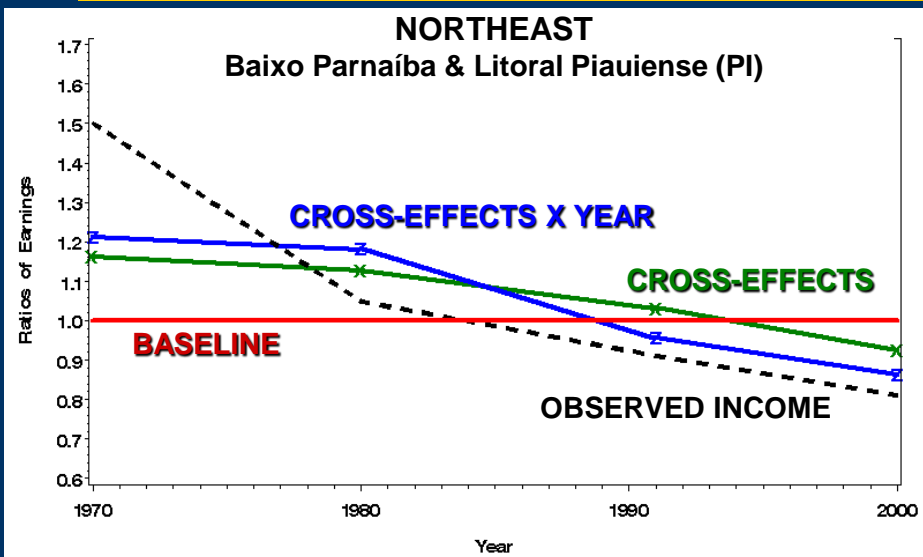
# Micro-region Size & Regions Indicators

- **Models including interactions of age-education proportions with micro-region-size indicators were also estimated:**

  - Offers a way to take into account weights that were ignored in regression models.

  - Results suggest that absence of weights did not significantly affect the estimates.

- **Models need to include interactions of proportions with major-region indicators:**

  - Because there was a better fit to the Southeastern and Southern regions compared to the Northeastern region.

  - Models with own-effects interacted with year and region indicators provided better fit for the data...

# OWN-EFFECTS X YEAR X REGION
## Adults (35–49), Medium Education (5–8), 1970–2000
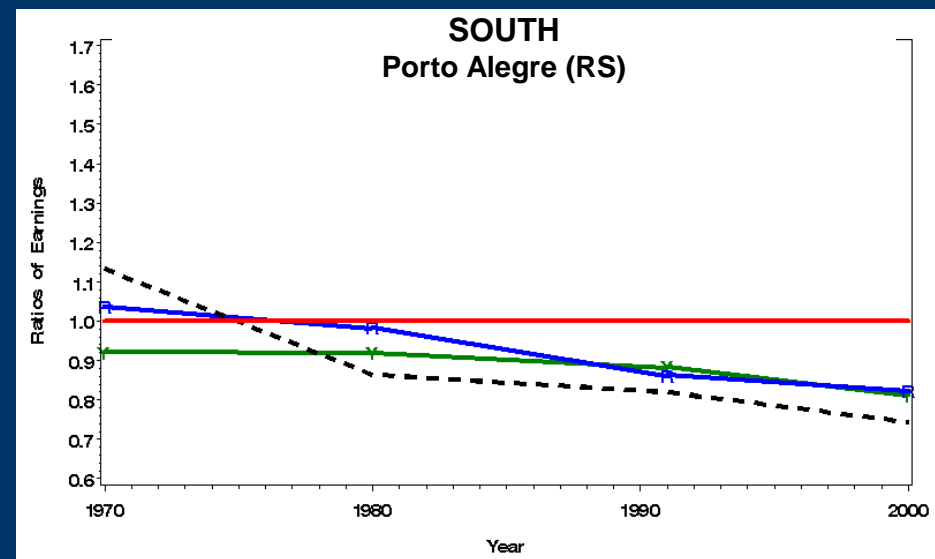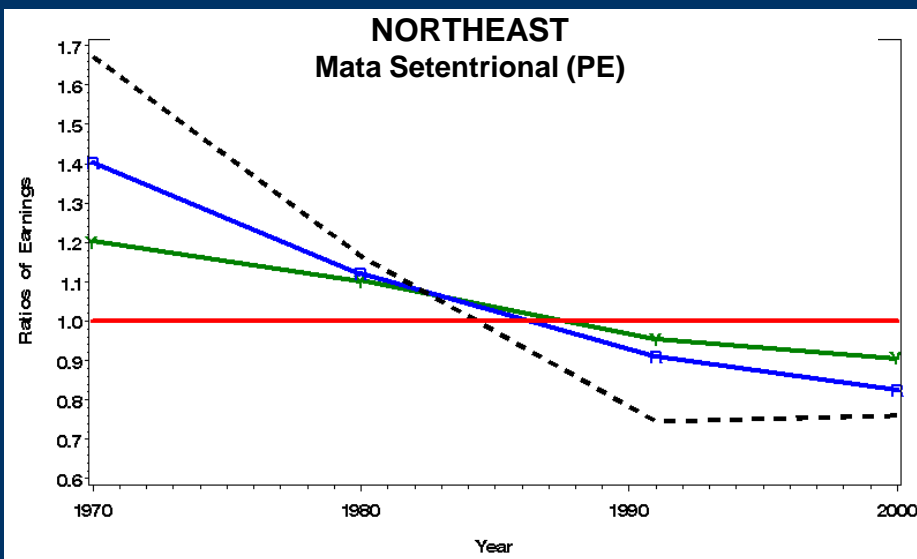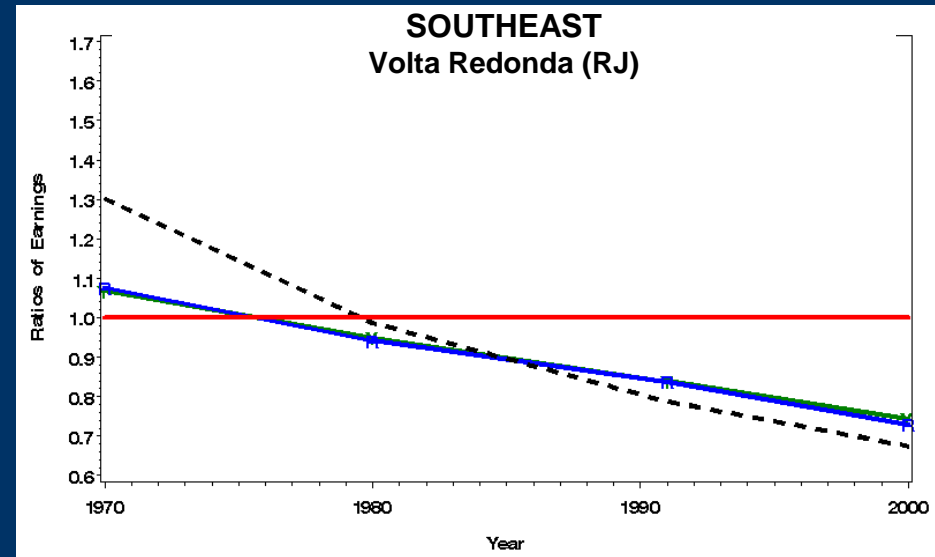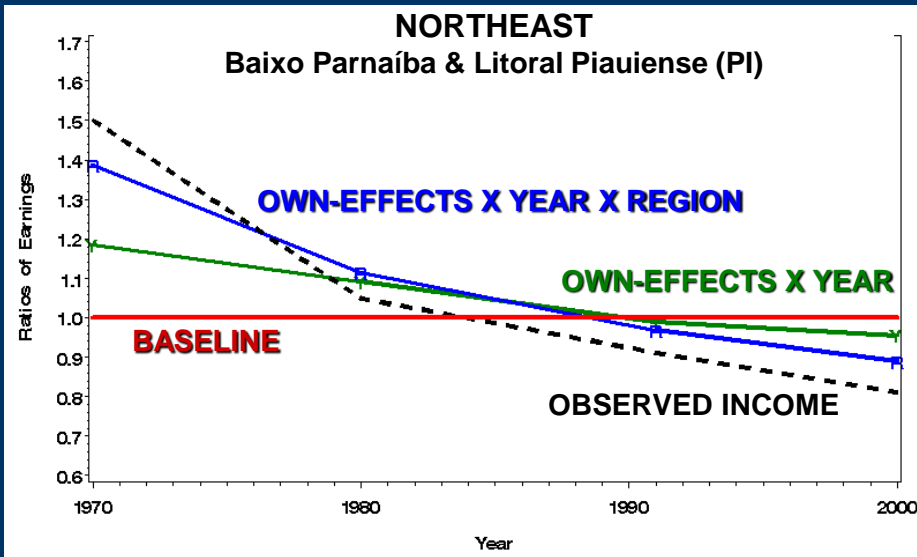
# Are Factor-prices Elasticities Robust?

- **Ignoring inter-micro-regional migration biases the own-wage effects toward zero, i.e. if there were no migration the effects would be more negative than what was found.**

- **The biases induced by young people attaining more schooling, when the returns to education have increased, reduce the absolute values of negative estimates.**

- **The implicit assumption that male labor is separable in production from capital, biases estimated elasticities among more skilled workers toward zero.**

- **Including distributions of female workers is difficult because they are highly correlated with those of males.**

# Conclusions

- **Relative group size matters with greatest negative impacts on income for groups with more years of education.**

- **The increasing relative scarcity of unskilled workers is no longer contributing to an increase in their relative earnings.**

- **Shifts in "own" and "cross" groups are likely to have measurable redistributive effects on earnings.**

- **Relative supply affects relative wages less than in the past, as implied by fewer negative numbers over time.**

- **Results suggest that age and educational shifts of the labor force are influential, and that this approach is fruitful to expand studies in this field of economic development.**

# Future Migration Work

- **Include inter-micro-regional migration in the models, starting with the analysis of the <span style="color:gold">composition of migrants</span> in all micro-regions, for each one of the 12 age-education groups — taking into account proportions of migrants by state of birth and state of previous residence.**

- **<span style="color:gold">Population-weighted gravity models</span> could be used to generate attraction and repulsion measures among micro-regions — taking into account not only distances among areas, but also population growth in micro-regions over time, as well as mean-income trend by area.**

# Planned Future Work

- **Since information on hours worked per week is available in the 1991 and 2000 Censuses, it might be possible to include women in both sides of the equations.**

- **Hierarchical models: set up data with individual-level variables, as well as with micro-region proportions, and run for separate years.**

- **Estimate multinomial models (self-employment, formality, and informality), using available information in the 1991 and 2000 Censuses.**