DEMOGRAPHIC CHANGE AND ECONOMIC DEVELOPMENT AT THE LOCAL LEVEL IN BRAZIL

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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


- 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
Proportion of Men with 35–49 Years of Age and 0–4 Years of Schooling in 502 Brazilian Micro-regions, 1970–2000 Censuses

1970

1980

1991

2000
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:

  \[ q_i = q_i(p_1, \ldots, p_n, Y). \]

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

  \[ p_i = p_i(q_1, \ldots, q_n, Y). \]
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:

\[
W_{itc} = \beta_0 + \beta_1 X_{itc} + u_i + \theta_t + \varepsilon_{itc}, \quad i = 1\ldots K; \; t = 1\ldots T
\]

**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

1970

1980

1991

2000
EQUATION 2: allows for cross-effects.

\[ W_{itc} = \beta_0 + \beta_1 X_{itc} + \beta_2 X_{itc'} + u_i + \theta_t + \epsilon_{itc}, \quad i = 1 \ldots K; \quad t = 1 \ldots T \]

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

\[ W_{itc} = \beta_0 + \beta_1 X_{itc} + \beta_2 X_{itc'} + \beta_3 \theta_t X_{itc} + \beta_4 \theta_t X_{itc'} + u_i + \theta_t + \epsilon_{itc}, \quad i = 1 \ldots K; \quad t = 1 \ldots T \]
CROSS-EFFECTS X YEAR
Adults (35–49), Medium Education (5–8), 1970–2000

NORTHEAST
Baixo Parnaiba & Litoral Piauiense (PI)

SOUTHEAST
Volta Redonda (RJ)

NORTHEAST
Mata Setentrional (PE)

SOUTH
Porto Alegre (RS)
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

NORTHEAST
Baixo Parnaíba & Litoral Piauiense (PI)

SOUTHEAST
Volta Redonda (RJ)

NORTHEAST
Mata Setentrional (PE)

SOUTH
Porto Alegre (RS)

OWN-EFFECTS X YEAR X REGION
OWN-EFFECTS X YEAR
BASELINE
OBSERVED INCOME
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 **composition of migrants** 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.

- **Population-weighted gravity models** 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.