Demographic changes, educational improvements, and earnings in Mexico and Brazil

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Outline

- Research question and background
- Data and methods
- Results
- Internal migration
- Final considerations and future projects

Research question

- Within the labor force (15–64 years of age)
  - Population is getting older and better educated in Mexico and Brazil with regional variation
  - Age and education increase earnings

- **Are there other effects of changing age and educational compositions on male earnings?**

- Larger proportion of older and more educated males
  - Generates competition in the labor market
  - Negative associations with earnings of competing workers

Previous studies

- **Human capital**
  - Schooling and work experience improve earnings (Mincer 1974)
  - Those least likely to attend college benefit most from it (Brand, Xie 2010)
- **Baby boom cohort**
  - Cohort sizes depress earnings, effects increase with education (Bloom et al. 1987; Easterlin 1978; Freeman 1979; Welch 1979)
  - Effects do not diminish with age and persist after retirement (Berger 1985; Sapozknikov, Triest 2007)
- **More effects of cohort size**
  - **U.S.:** improves wages, employment, labor force participation (Autor et al. 1998; Katz, Autor 1999; Katz, Murphy 1992; Shimer 2001)
  - **OECD:** depresses youth employment (Korenman, Neumark 2000)
  - **Europe:** depresses employment and earnings (Biagi, Lucifora 2008; Brunello 2010; Skans 2005)
    - Stronger for those with secondary education (Moffat, Roth 2016)

Main contribution

- Few studies addressed how demographic and educational compositions affect earnings in developing countries
  - **China:** significant cohort-size effects for rural, least educated, and males (Fan et al. 2015)
  - **Brazil:** increasing concentration of educated workers (Queiroz, Golgher 2008), but less is known about effects on earnings

- **Mexico and Brazil**, compared to developed countries
  - Worse income inequality
  - Faster changes in age composition
  - Lower educational attainment
  - More regional variation

Mexico & Brazil

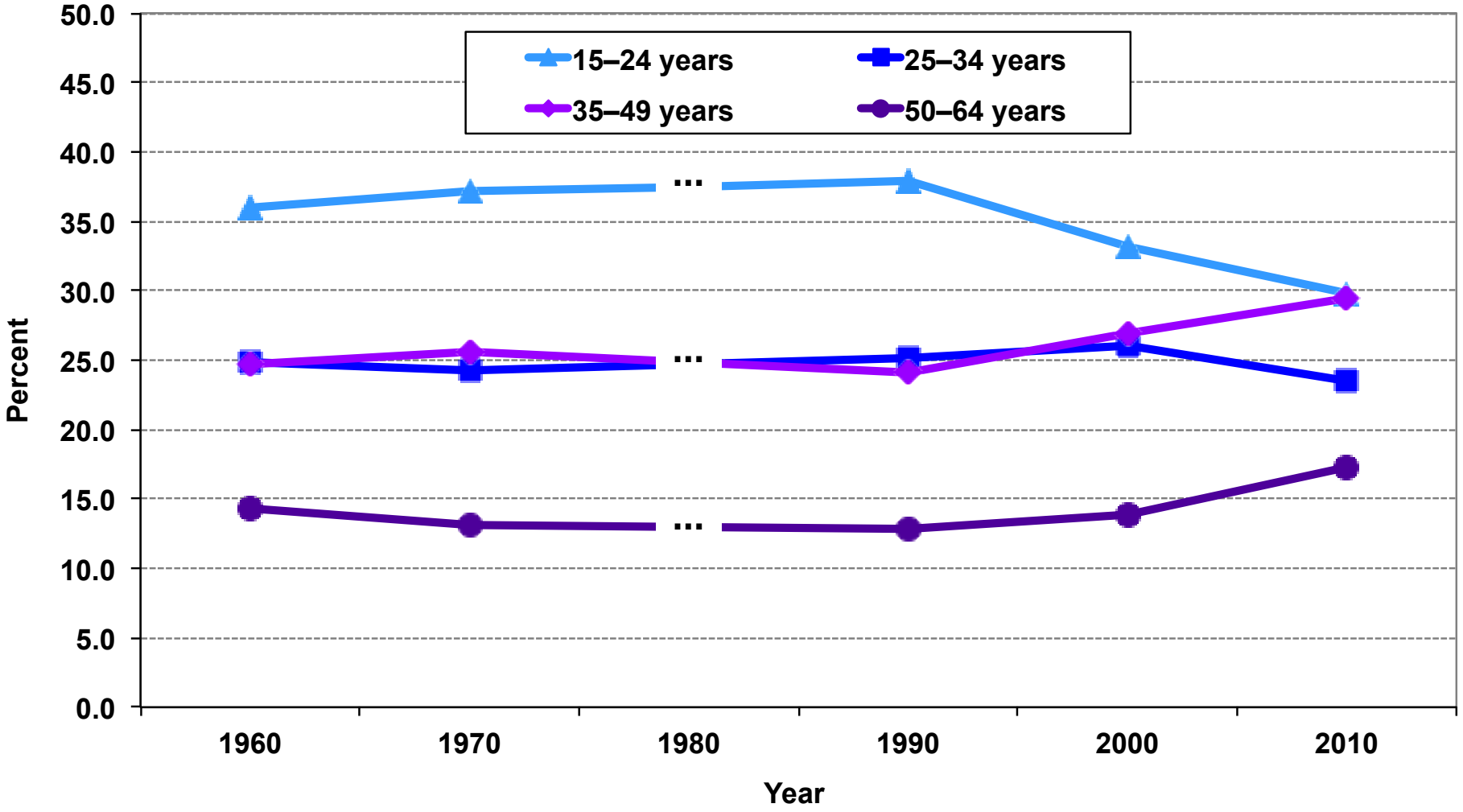
- **Fertility decline** is contributing to changes in age composition (CONAPO 2004, 2014; IBGE 2012)

Total Fertility Rate	1970	2010
Mexico	6.8	2.3
Brazil	5.8	1.9

- **Educational expansion** began late and has a long way to go (Barro, Lee 2001; Marcílio 2001, 2005; Rios-Neto, Guimarães 2010; Lustig et al. 2013)

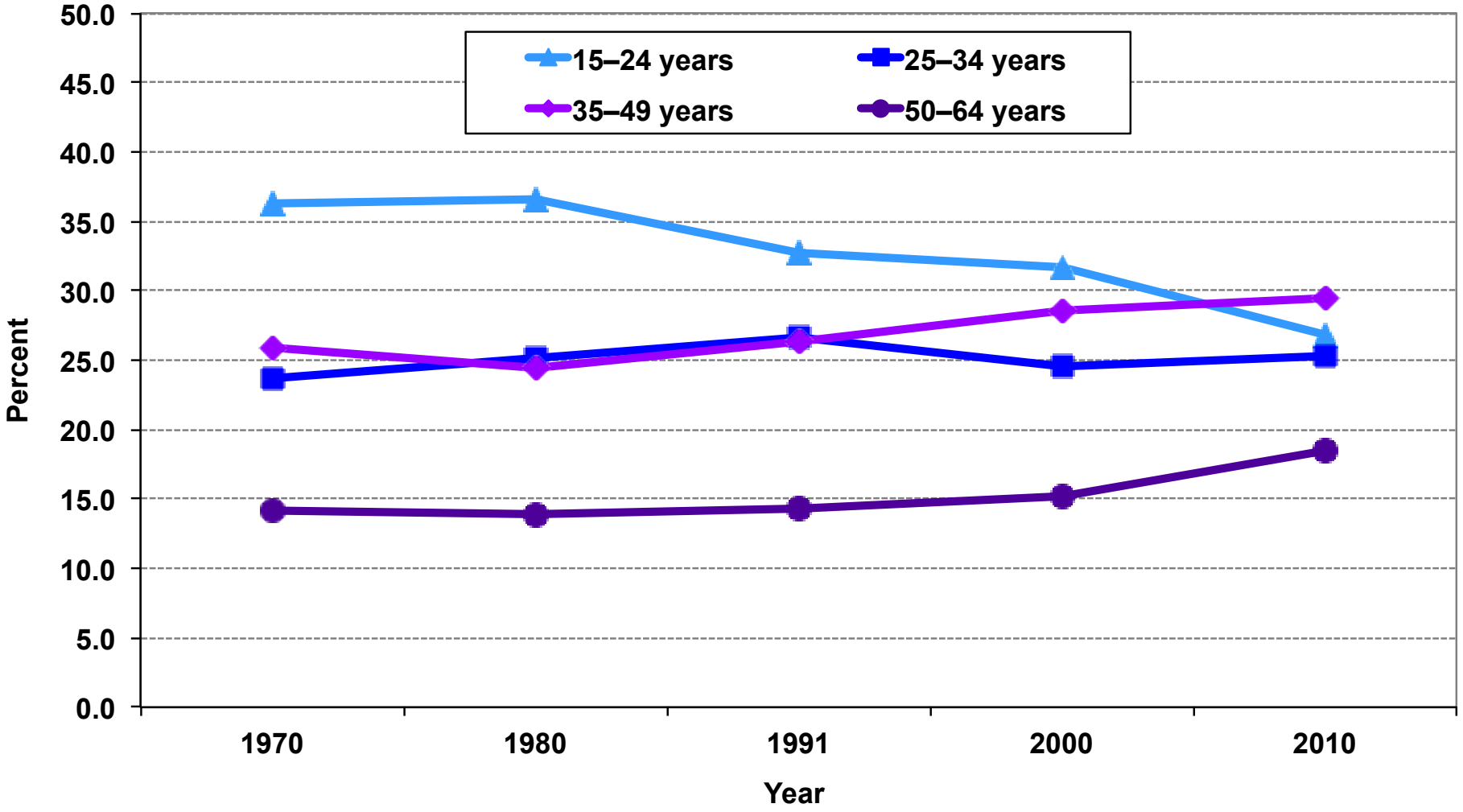
- Improvement in educational attainment coincides with decline in family size and school-age children (Lam, Marteleto 2005, 2008)

Male age composition Mexico, 1960–2010



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

Male age composition Brazil, 1970–2010



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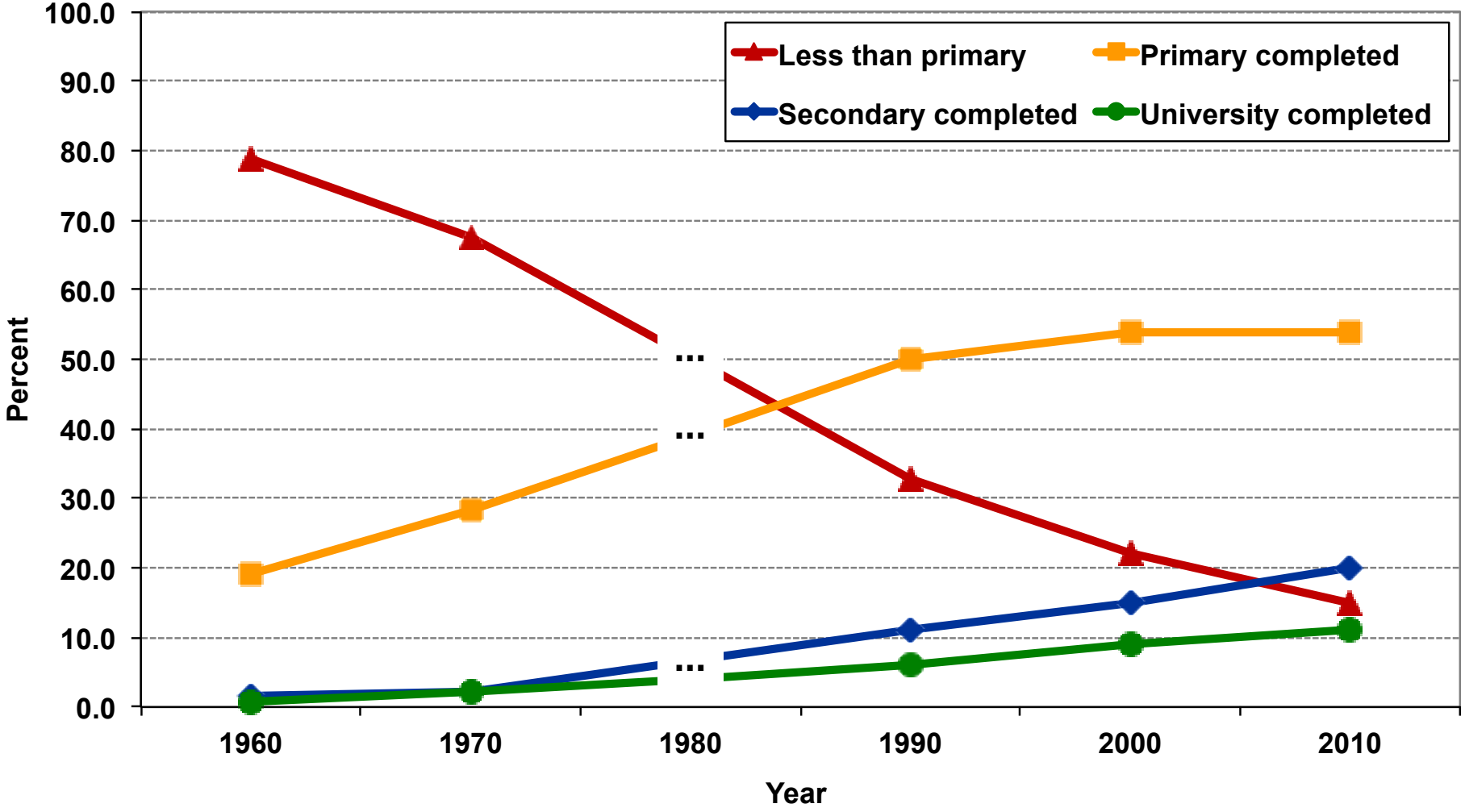
Male educational composition Mexico, 1960–2010



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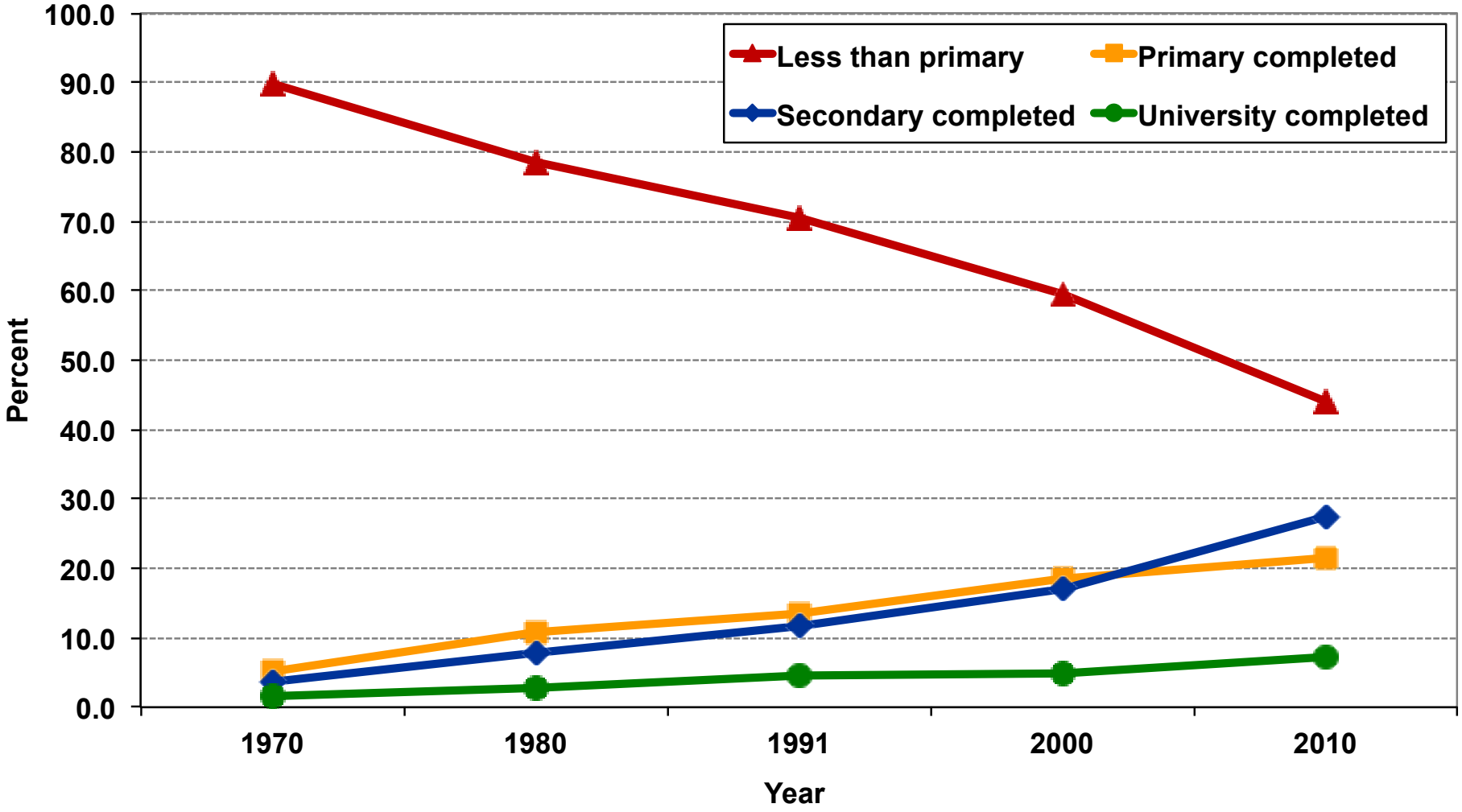
Male educational composition Brazil, 1970–2010



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

Micro-data

	Mexico	Brazil
Years	1990, 2000, 2010	1970, 1980, 1991, 2000, 2010
Minimum comparable areas	2,456 municipalities (consistent boundaries only for last three censuses)	502 micro-regions
Earnings	All occupations	Main occupation
Age	Youths (15–24) Young adults (25–34) Experienced adults (35–49) Older adults (50–64)	
Education	Less than primary completed Primary completed Secondary completed University completed	
Age-education	16 age-education groups	

Aggregate-level data

- **Data** is aggregated by year, area, and age-education groups
  - Mexico: 3 years * 2,456 municipalities * 16 age-education groups
  - Brazil: 5 years * 502 micro-regions * 16 age-education groups

- Cells with less than 25 people receiving income were excluded
  - Mexico: 82,604 observations remained
  - Brazil: 32,201 observations remained

- **Only male population**
  - Labor force participation is not driven by level of earnings, fertility decline, and changes in educational attainment

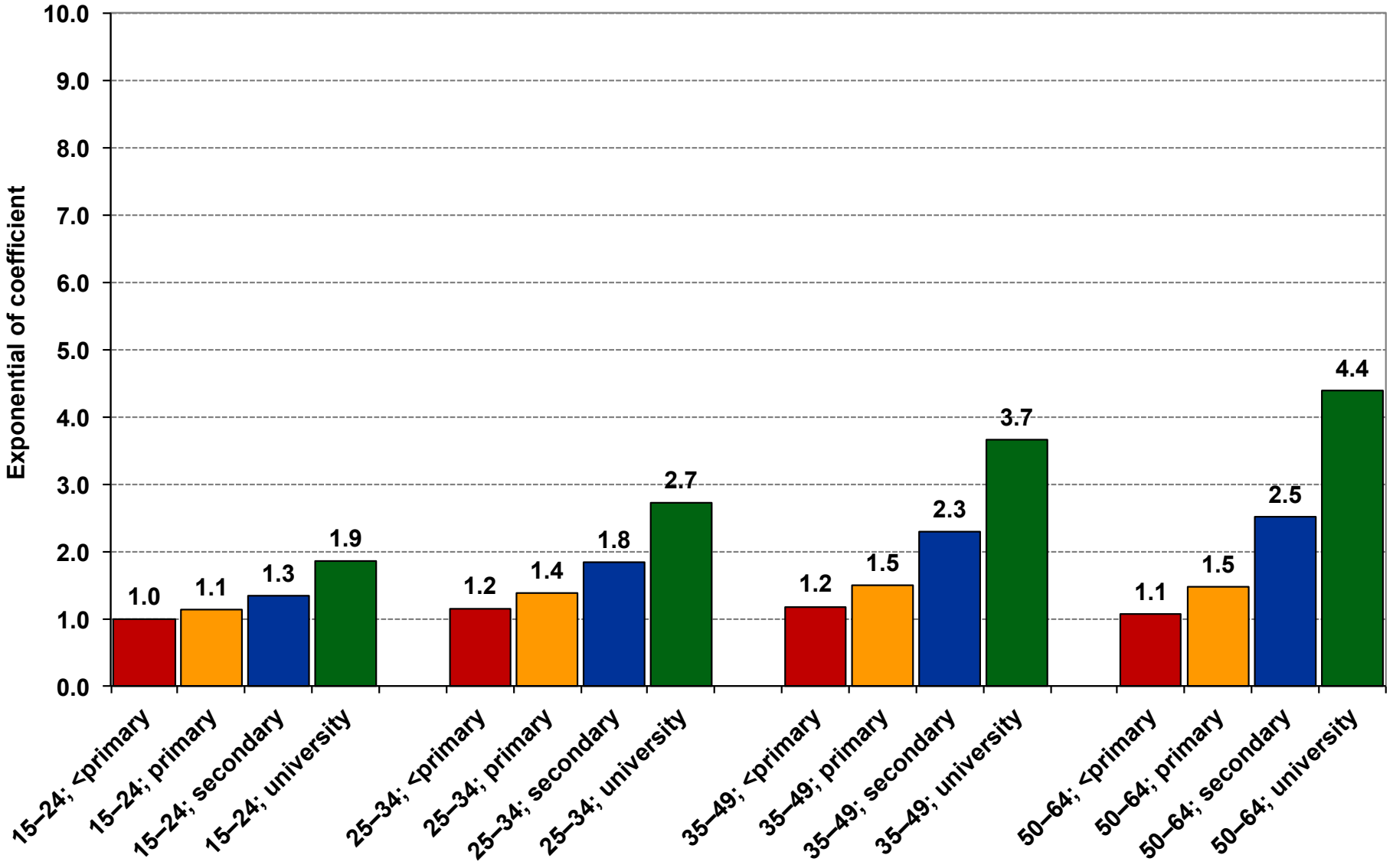
Data setup

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 & < primary	5.80	0.221	0.221	0	0	0	...	0	2,016
1970	110006	15–24 years & primary	6.02	0.102	0	0.102	0	0	...	0	927
1970	110006	15–24 years & secondary	6.57	0.007	0	0	0.007	0	...	0	62
1970	110006	15–24 years & university	7.58	0.001	0	0	0	0.001	...	0	11
...	...	...	...	...	...	...	...	...	...	...	...
1970	110006	50–64 years & university	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}

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



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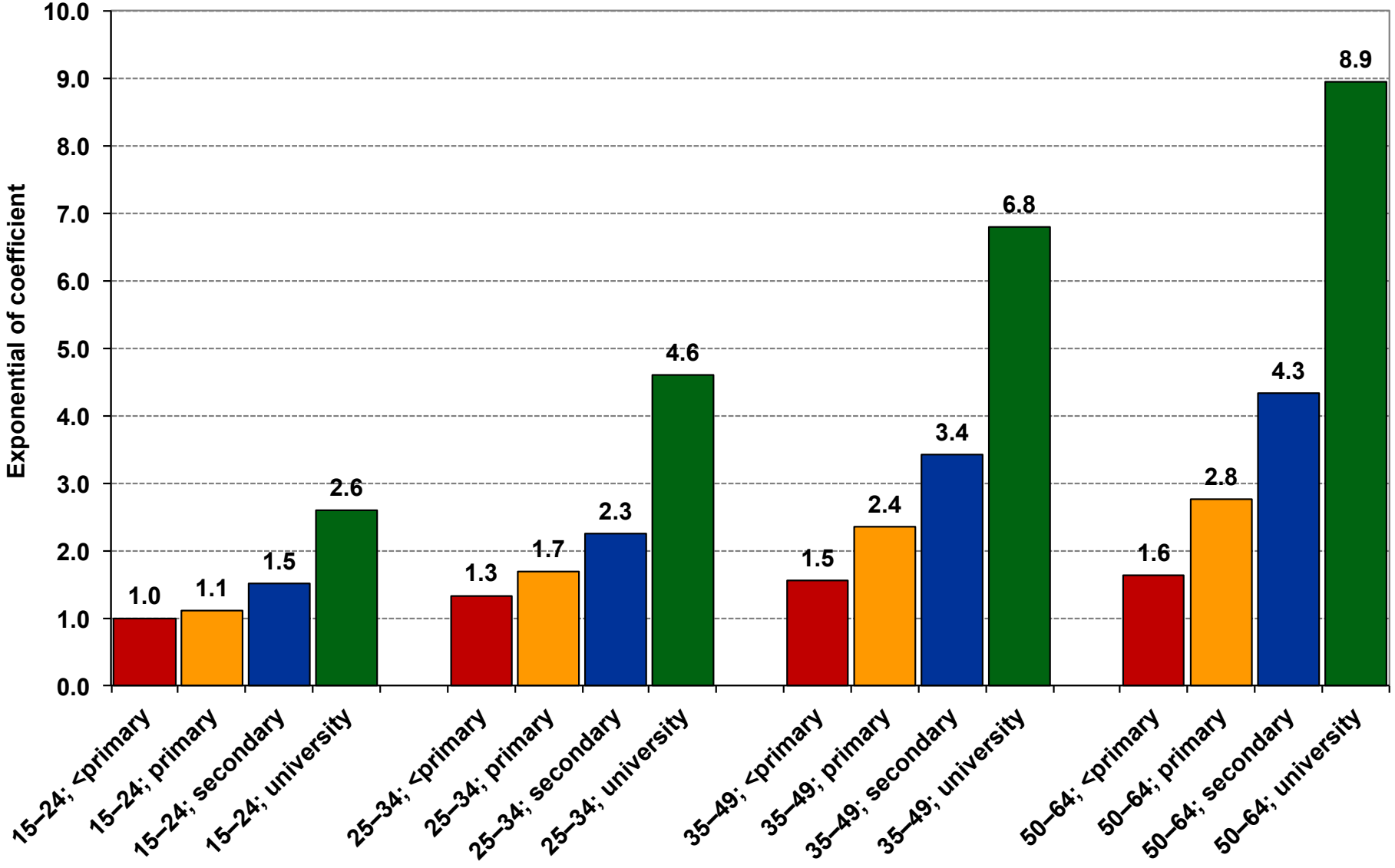
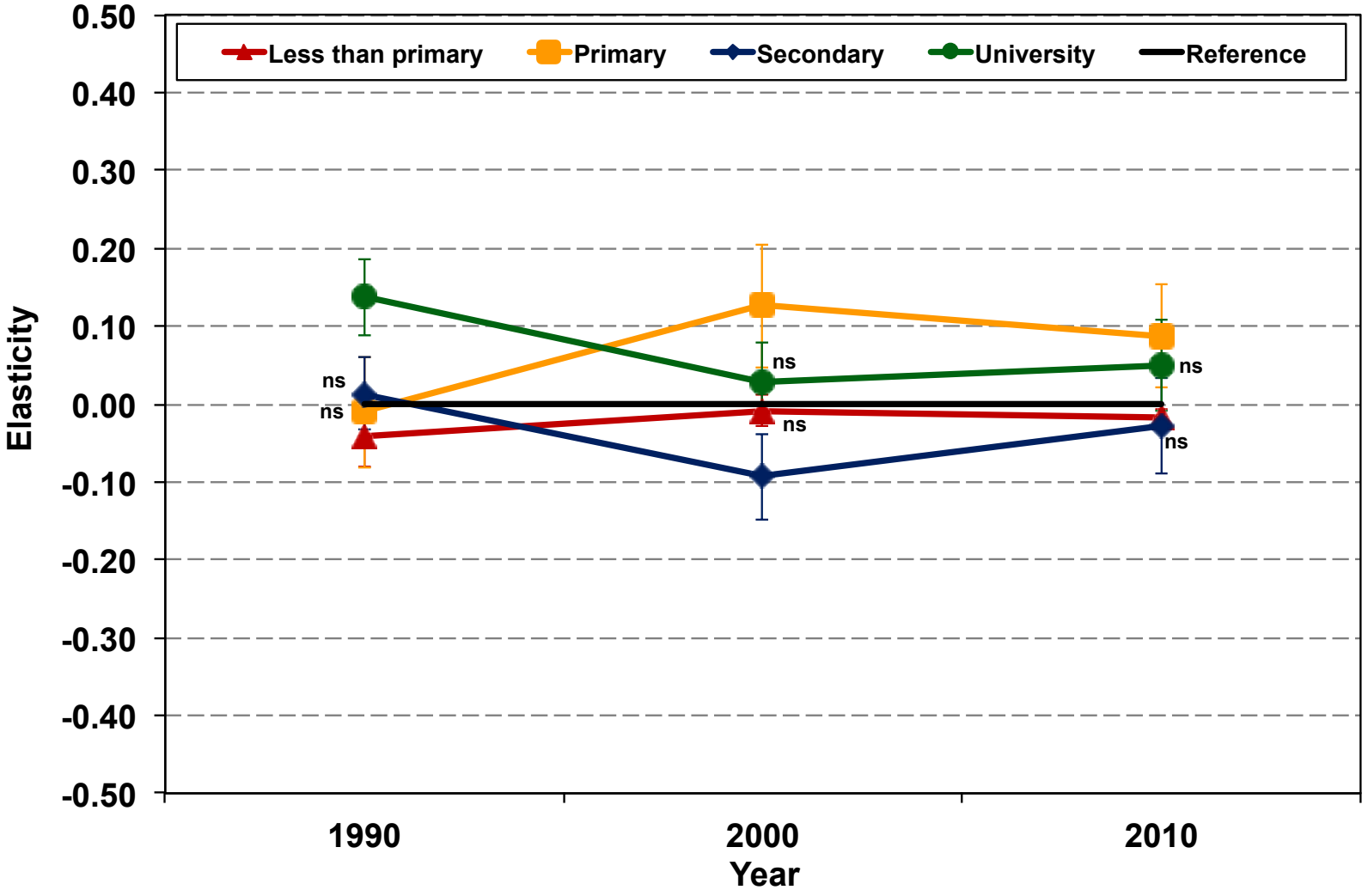


Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

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

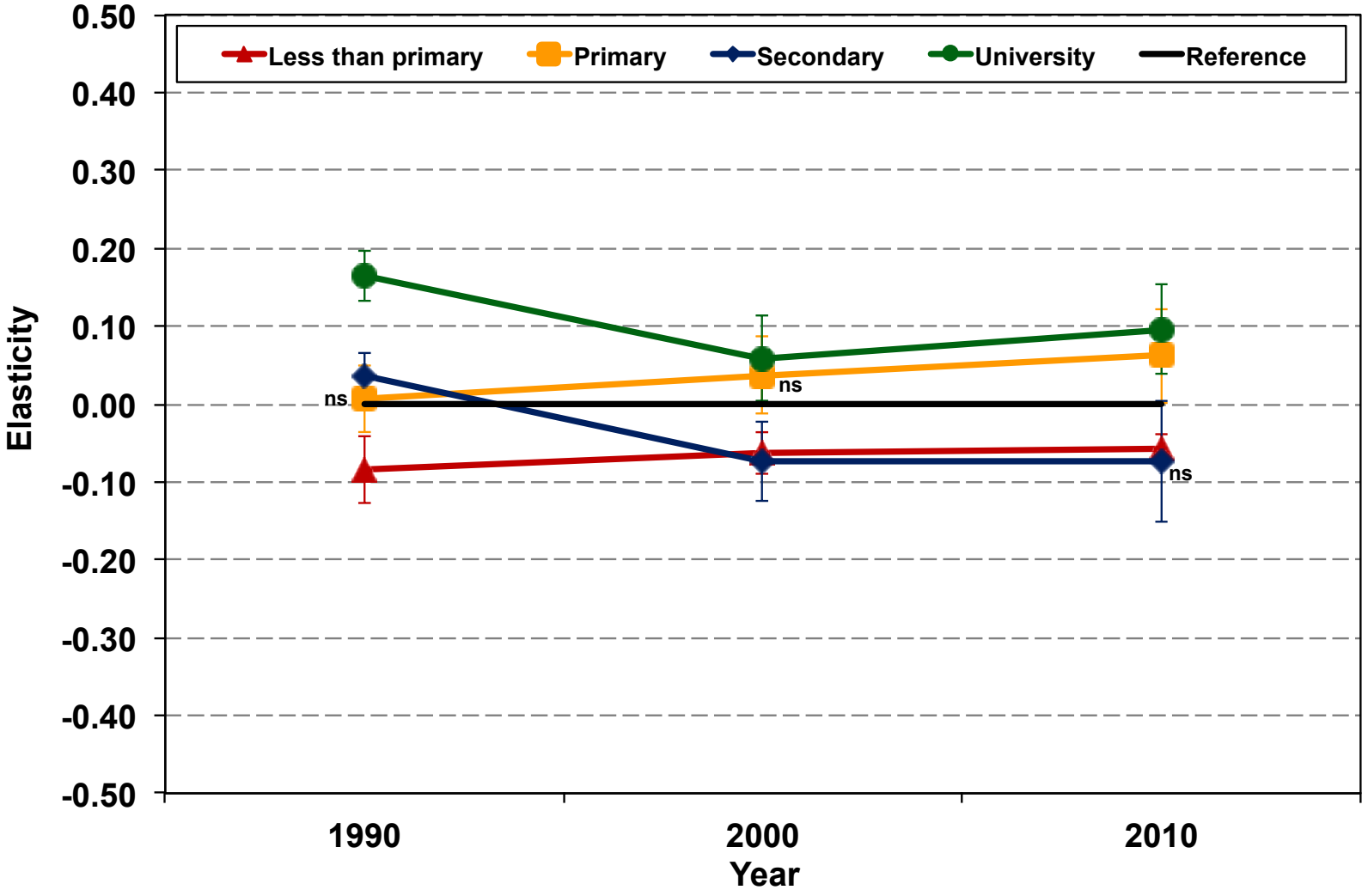
25–34 years



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

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

35–49 years



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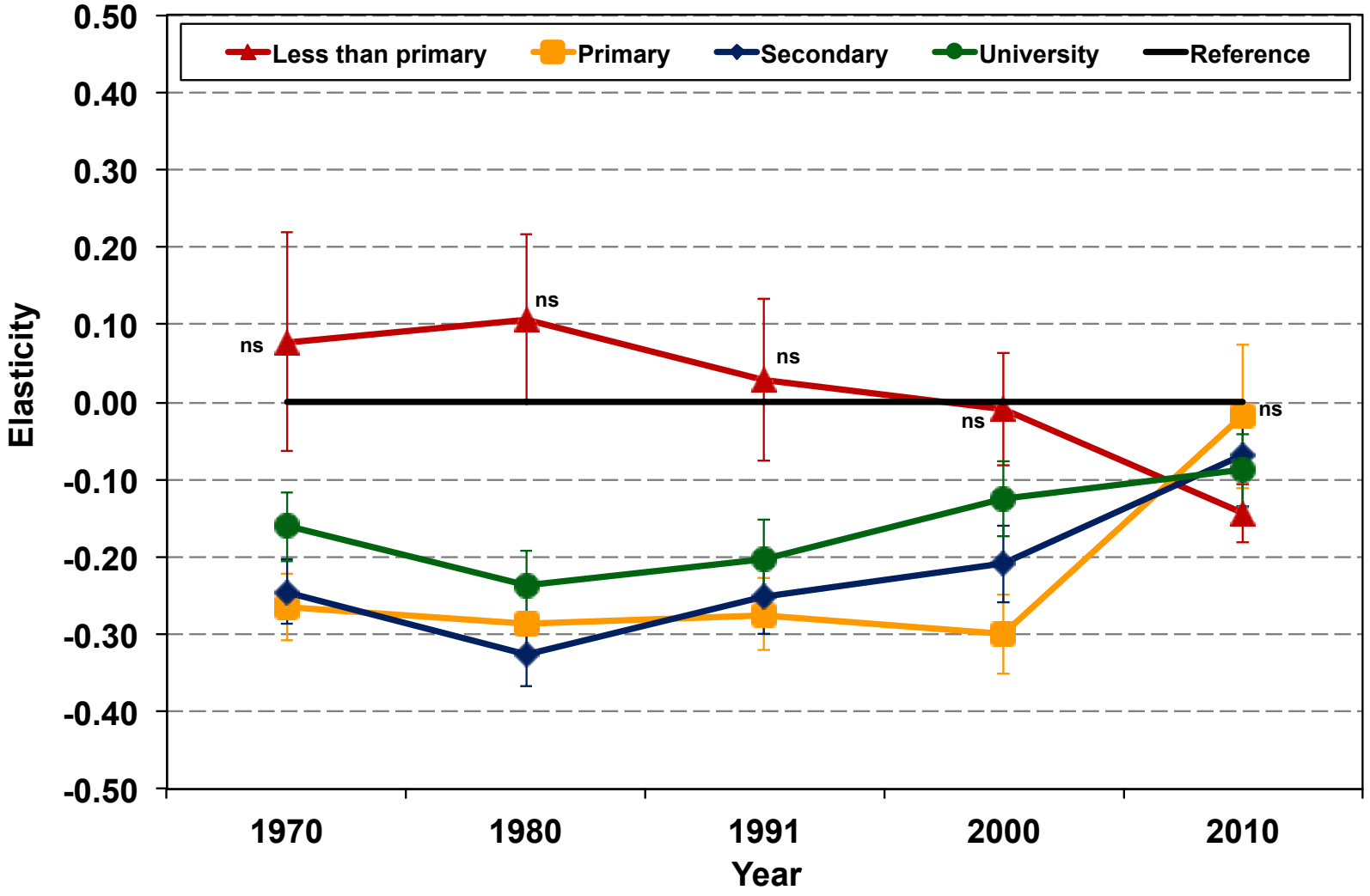

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Effects of group proportions (P_{31}–P_{34}) on earnings, Brazil, 1970–2010

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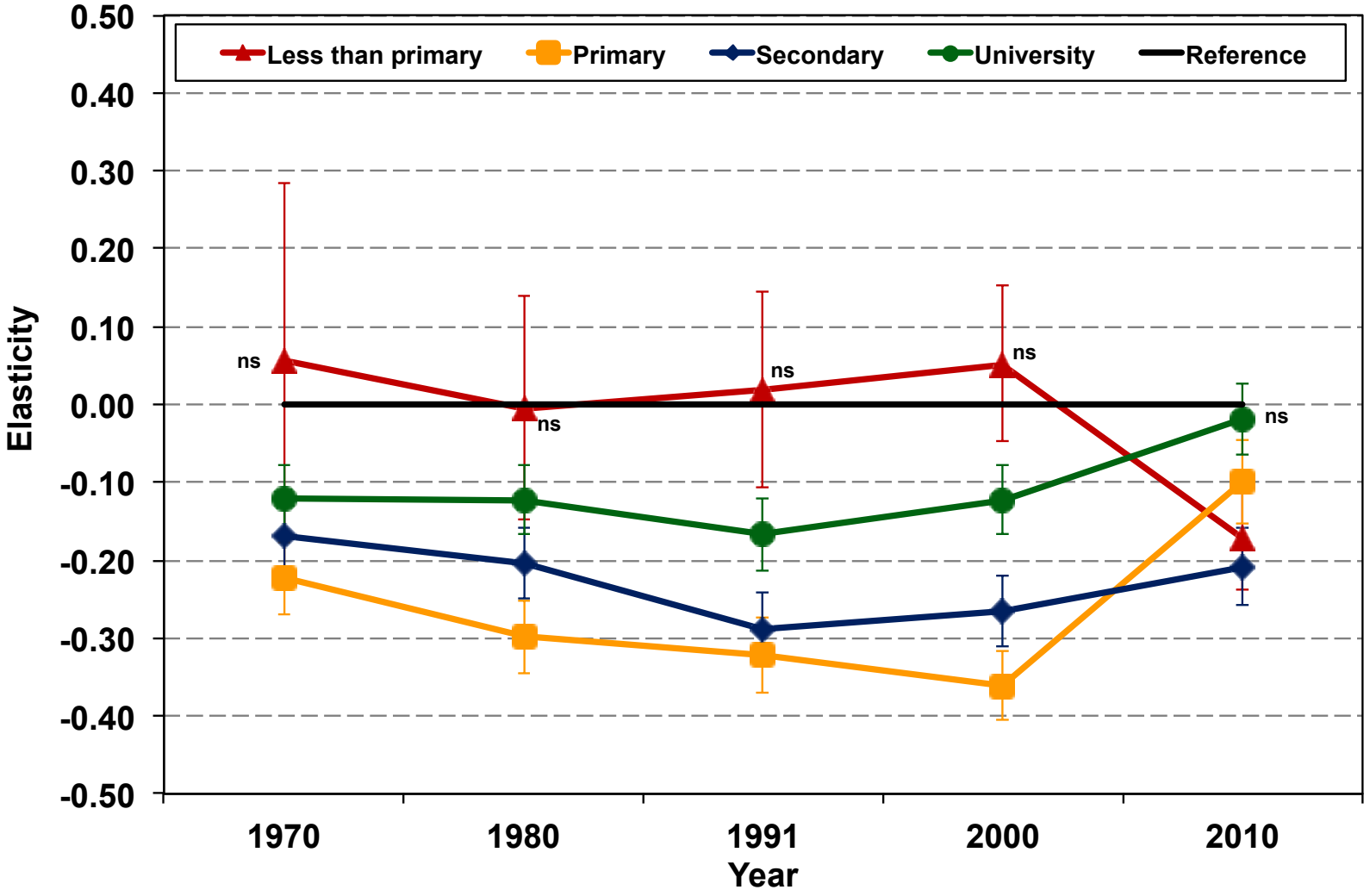


Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

Internal migration

- Analysis at the **local level**
  - Need to consider the effects of internal migration on earnings
- Migration generates **spatial-economic equilibrium**
- **Without migration**
  - Sending areas would have even lower earnings
  - Receiving areas would have even higher earnings
- **Hypothesis**
  - Negative associations of proportions on earnings would be more negative when controlling for migration

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
- **Migration data:** Brazil, 1991 and 2000
  - Municipality of residence five years before the census
- **Education data:** schooling groups divided into three categories
  - No further than the first phase of elementary school (0–4)
  - Second phase of elementary school (5–8)
  - At least some secondary school (9+)

Methodological steps for migration

1. **Level of migration:** between the 502 micro-regions

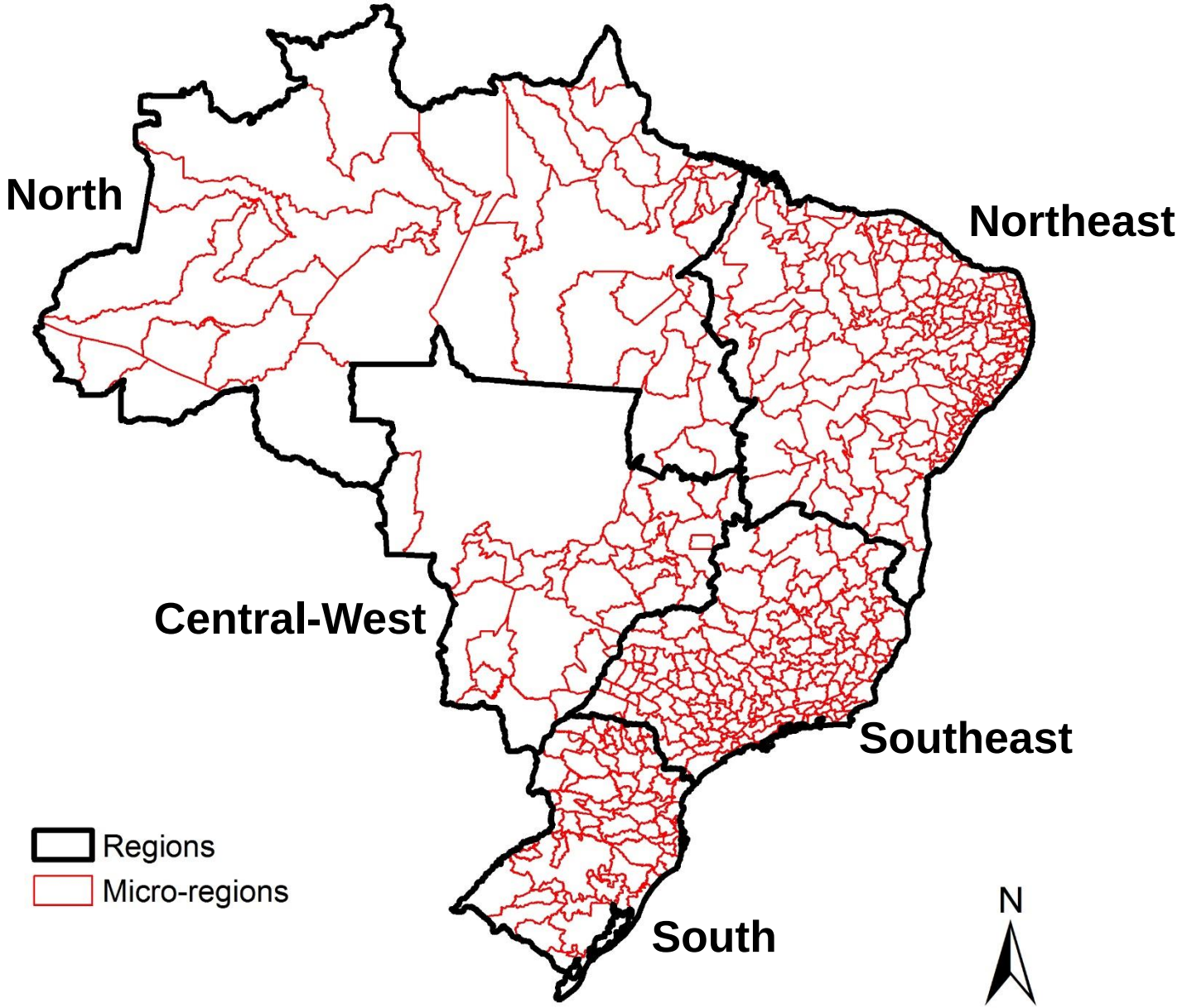
2. **Age pattern of migration:** between the five regions

3. **Modeling age pattern of migration:** smooth curves

4. **Integrating level and pattern**: exercise of standardization

5. **Force of migration:** a measure for each micro-region, year, and age-education group

Five regions & 502 micro-regions



1. Level of migration

- **Gravity models** take into account distances among areas as an instrumental variable for predicting migration
  - Distance is related to migration levels, but not to earnings

    distance ➔ migration ➔ earnings
- **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

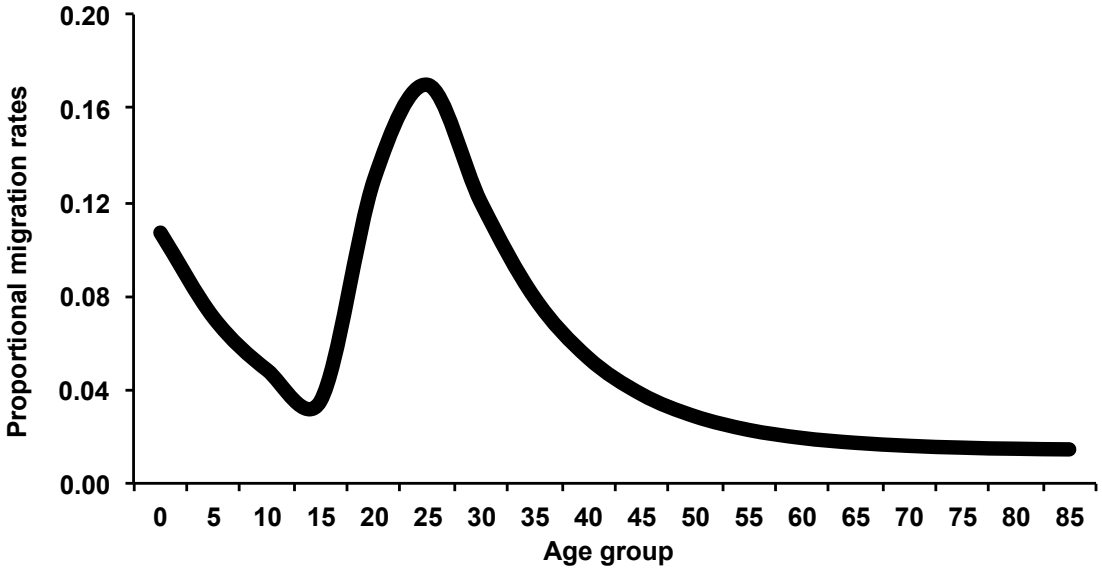
2. Age pattern of migration

- Estimation of migration patterns for all combinations of micro-regions and years would generate low rates
  - 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*)
  - Denominator is an approximation for period person-years lived
  - Average of the starting and ending populations, multiplied by the length of the period

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

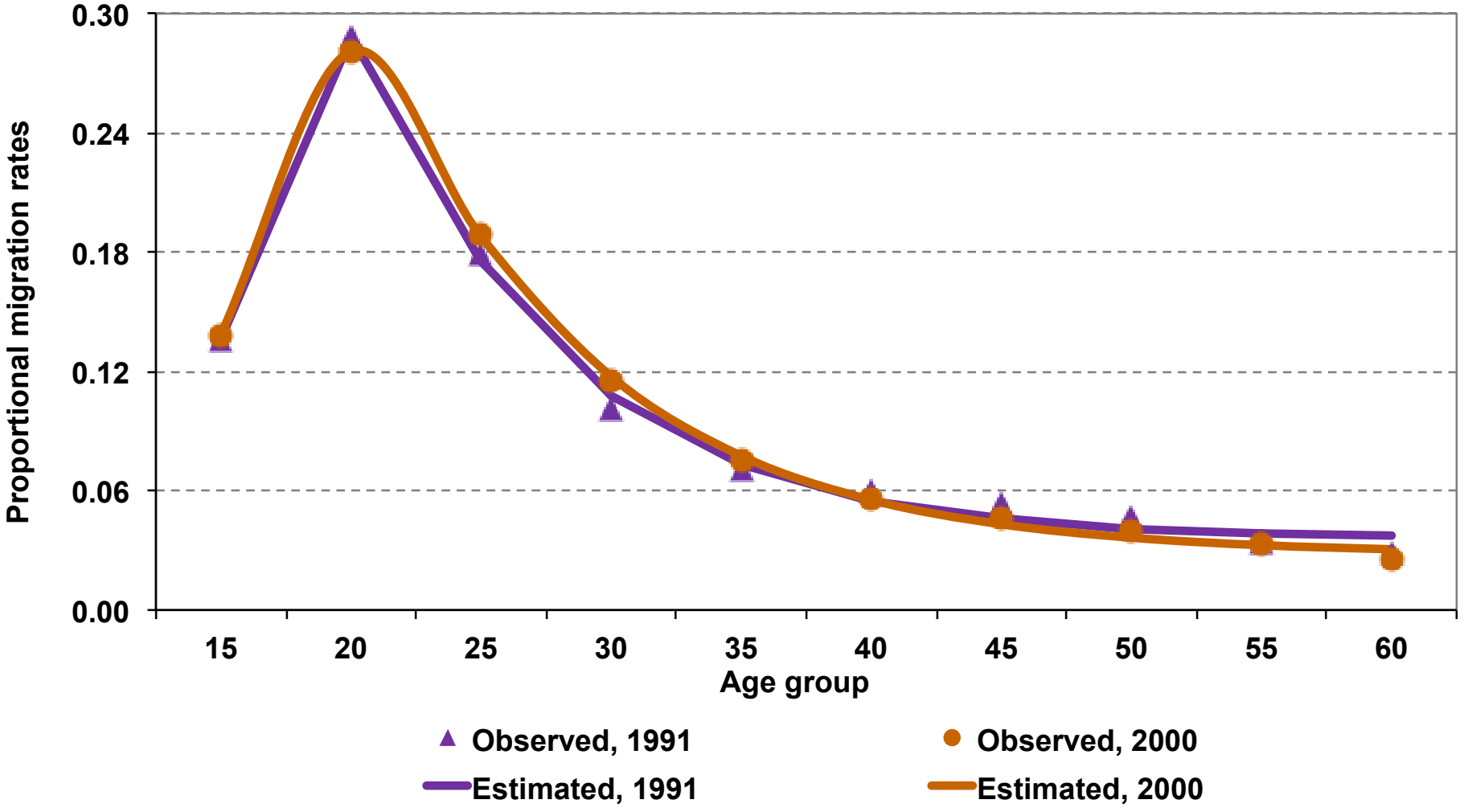
3. Modeling age pattern of migration

- A mathematical equation was used to smooth the rates
(Raymer, Rogers, 2007; Rogers, Castro, 1981; Rogers, 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

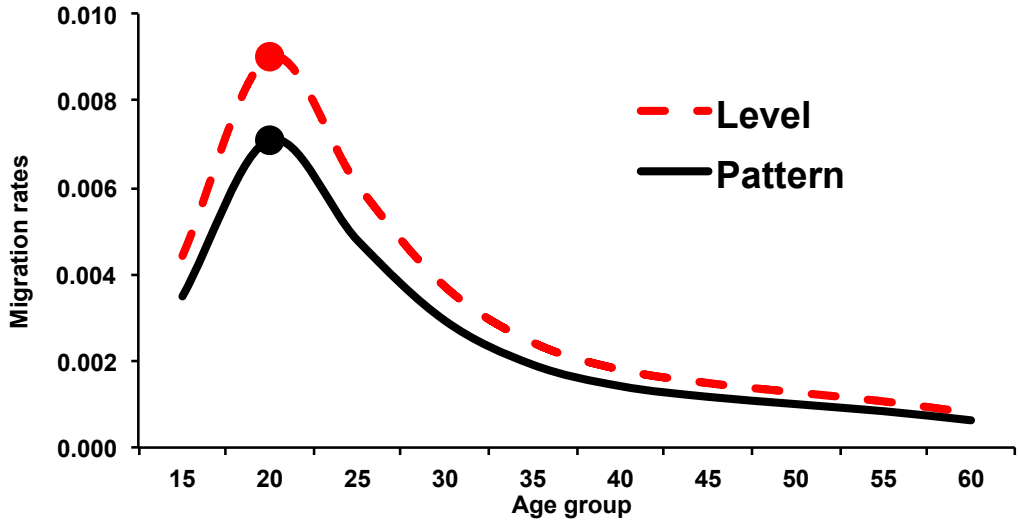
Observed and estimated proportional *ASIMR*, Northeast to Southeast, 1991 and 2000



Source: 1991 and 2000 Brazilian Demographic Censuses.

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



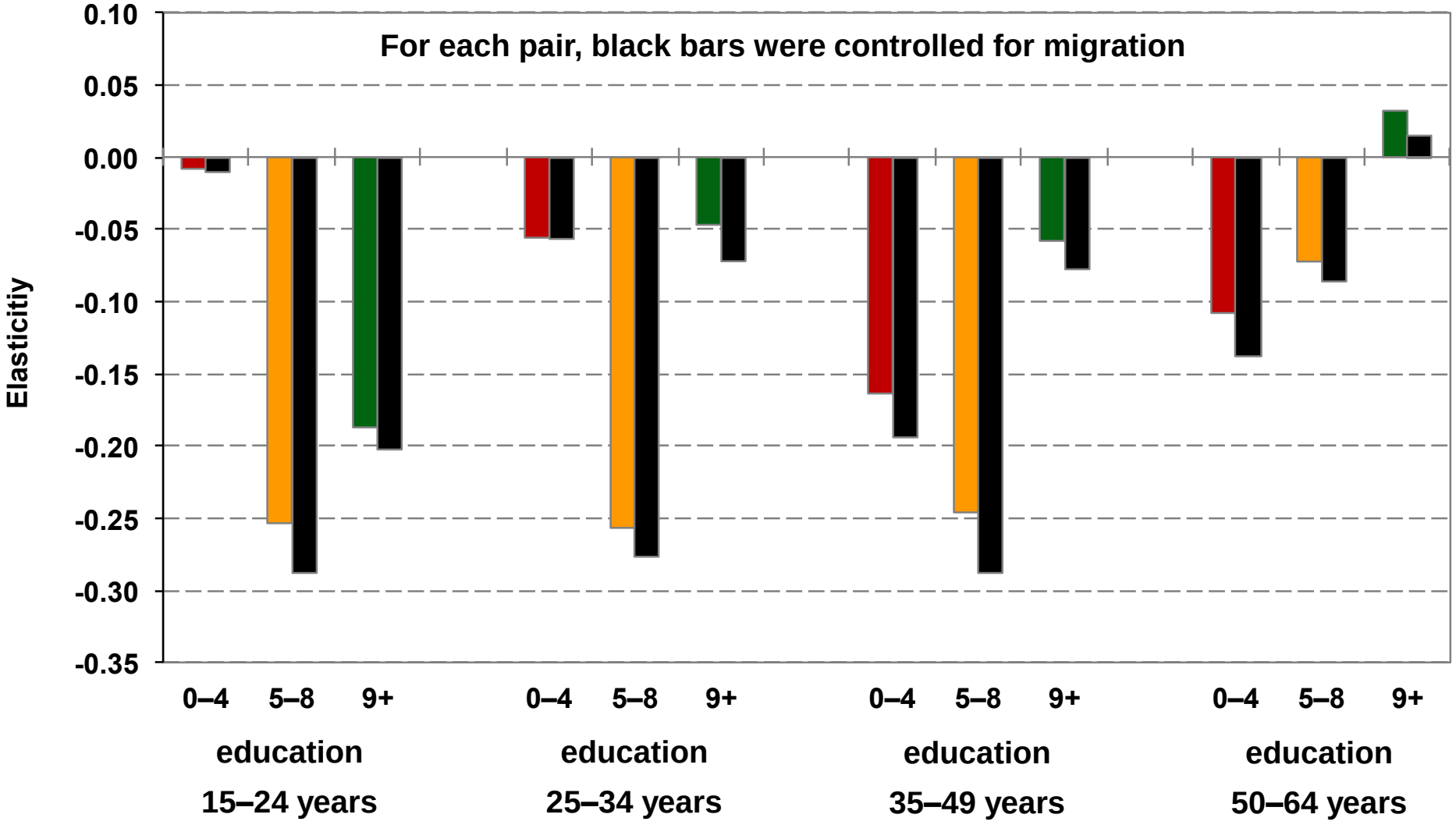
5. Force of migration

- 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 became more negative than the previous estimates

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



Source: 1991 and 2000 Brazilian Demographic Censuses.

Final considerations

- **In line with previous studies**
  - Larger cohort-education size generally depresses earnings
  - **Mexico:** slower changes in age-education composition might be a reason for smaller effects
- **Men with low education**
  - Decreasing over time, but their earnings are not increasing
- **Secondary-school groups**
  - Already have lower earnings than university graduates
  - Moreover, these groups are increasing over time and experiencing negative correlations with earnings
- **Time**
  - Correlations are becoming less negative over the years
  - Still strong for secondary-school groups in Brazil, 2010

Implications

- **Reduction in income inequality**

- **More better-educated men**
  - Negative associations with earnings
  - This reduced differentials in relation to lower-educated men

- **Fewer younger men**
  - Smaller negative associations with earnings
  - This prevented greater disparities in relation to older men

Public policies

- **Demand for education**
  - Improvement of educational levels in areas that still have large proportions of people with low-education

- **Increase coverage for higher education**
  - Scholarships and loans for disadvantaged students
  - Policies to increase university enrollment of low SES groups
  - Expansion and decentralization of public universities (Moretti 2012)
    - We know less about how to implement this policy on a regular basis (Glaeser 2013)
  - Vouchers to relocate disadvantaged populations across areas (Moretti 2012)
    - A possibility is to test with randomized trials

Research papers

- ***Urban Geography*** (2006)
  - How social networks influence migration patterns
- ***Population Review*** (2008) & ***Brazilian journals***
  - Improvements of techniques to estimate migration rates
- ***Demographic Research*** (2013)
  - Age-education composition and earnings
- ***Population Research & Policy Review*** (2012)
  - Decomposition of effects
- ***Bulletin of Latin American Research*** (2012)
  - Projection exercise
- ***Migration and Development*** (2015)
  - Models with migration
- ***IZA Journal of Labor & Development*** (2015)
  - Cohort size and concentration of educated workers
- ***RAND Report*** (2015)
  - Projection of Veterans' population by PUMAs, 2014–2024

Research agenda

- **Economic integration of refugees in Europe**
  - Pardee RAND Global Human Progress Initiative
- **Association of health, migration, and earnings**
  - Institute for Health Metrics and Evaluation (IHME)
  - Latin American Human Mortality Database (LAHMD)
- **Job polarization, migration, and earnings in the U.S.**
  - Increase in low-skill and high-skill jobs, which affects inequality
- **Modeling immigration of Central American children**
  - Immigration research center (CBTIR), University of Houston
- **Micro-simulation models of international migration**
- **Developing immigration policy scenarios**
  - U.S. Census, surveys, Department of Homeland Security data
- **Effects of internal migration on health in Indonesia**
  - 2017 Applied Demography Conference at UTSA; 2017 PAA

Extras

1. Cohort size

Correlation of

changes in age-education compositions

with

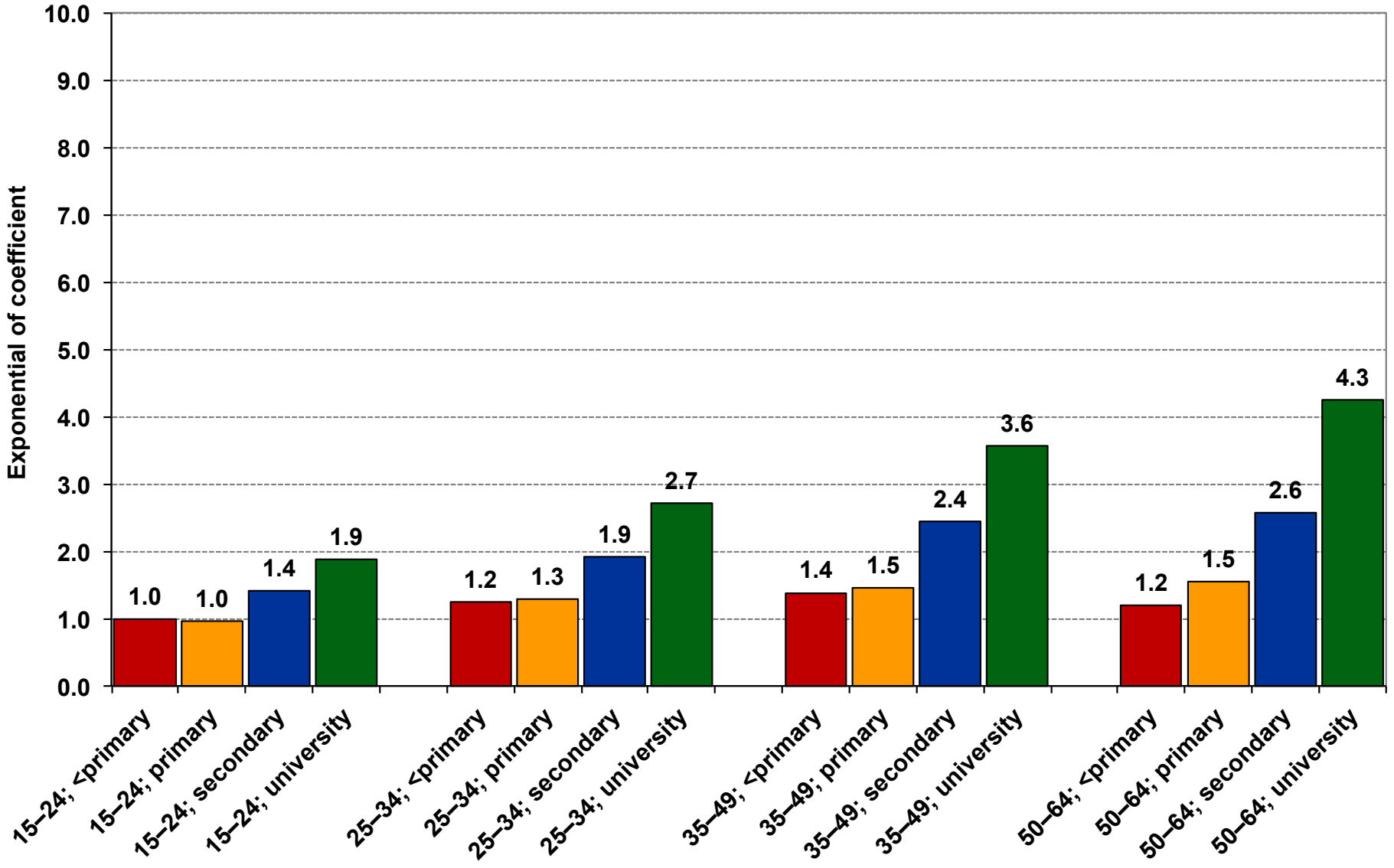
aggregated earnings

Assumptions for cohort size exercise

1. Relative sizes of age-education groups in an area 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 areas 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
   - **We are likely to underestimate the depressing effect of cohort size, if individuals self select into educational groups or regions that are characterized by higher earnings**

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



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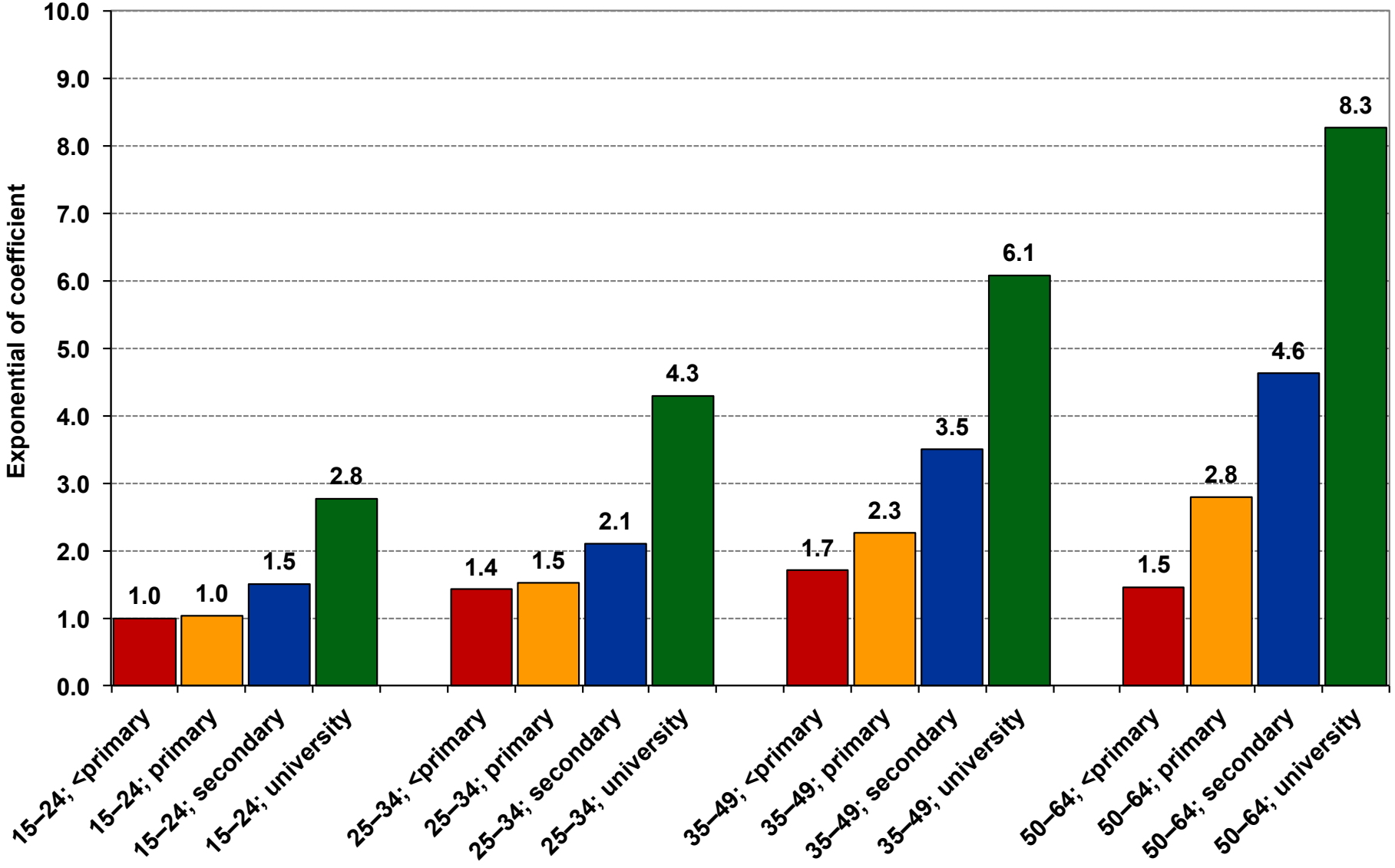
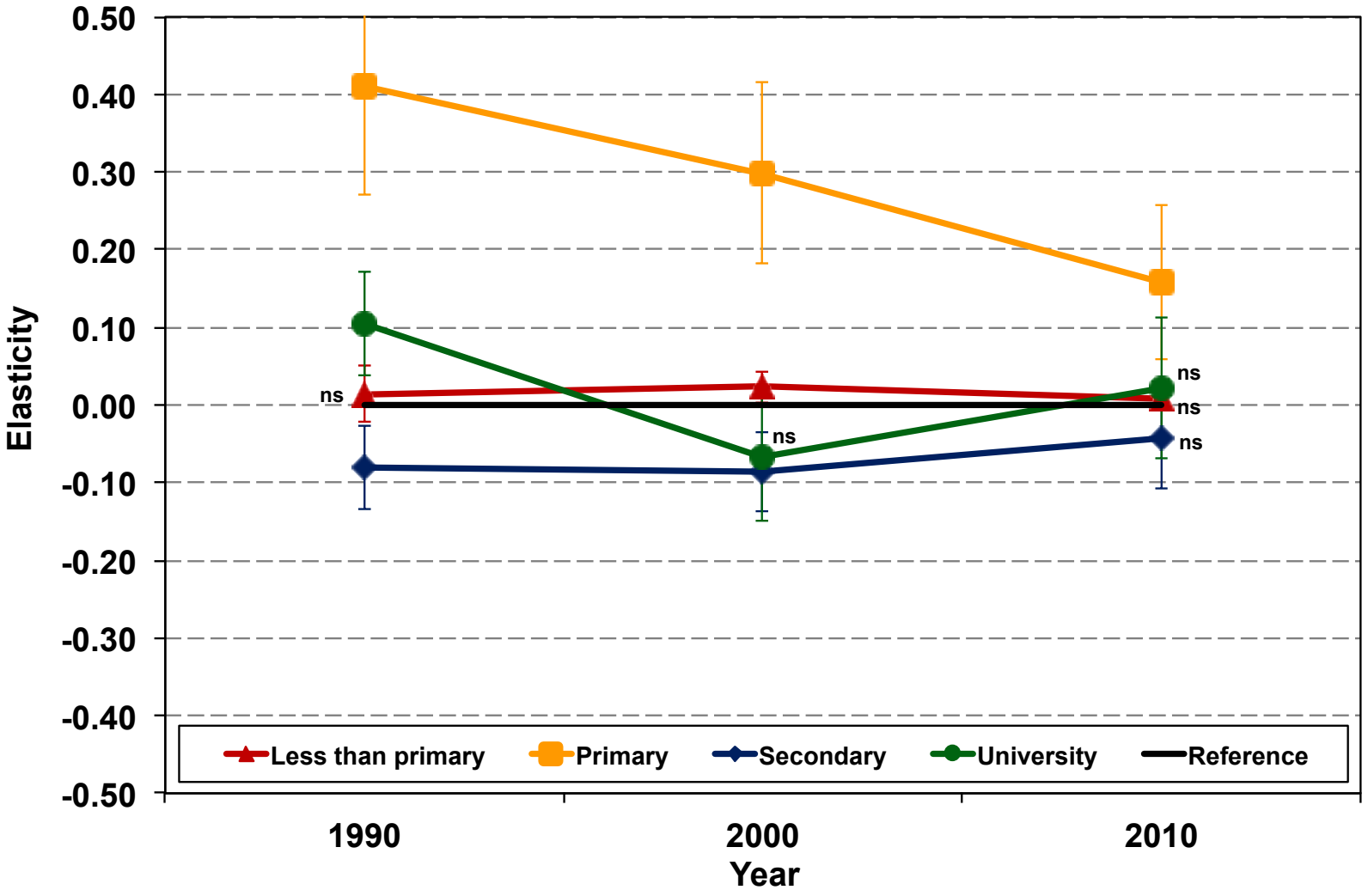


Source: 1970, 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses.

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

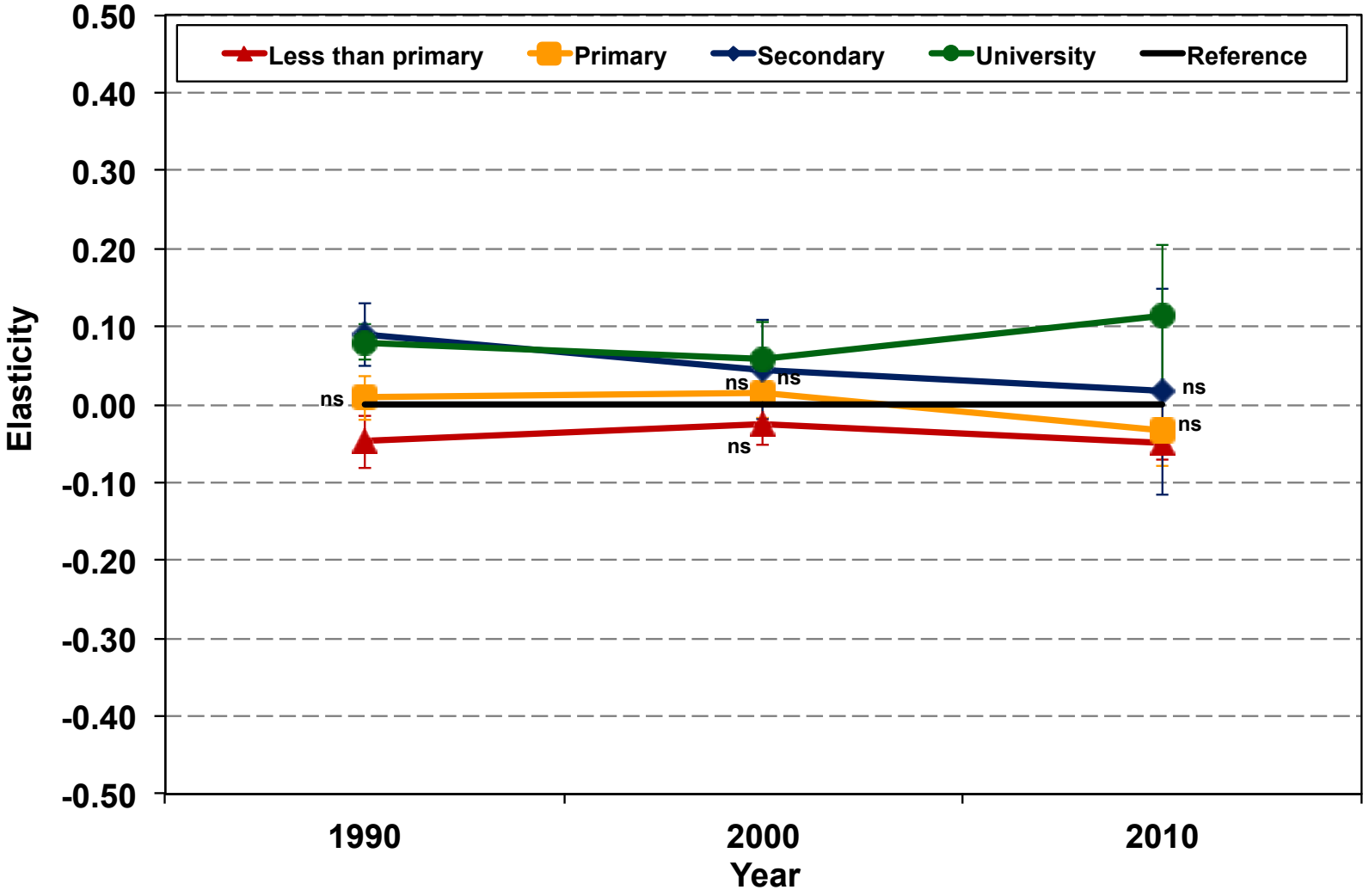
15–24 years



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

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

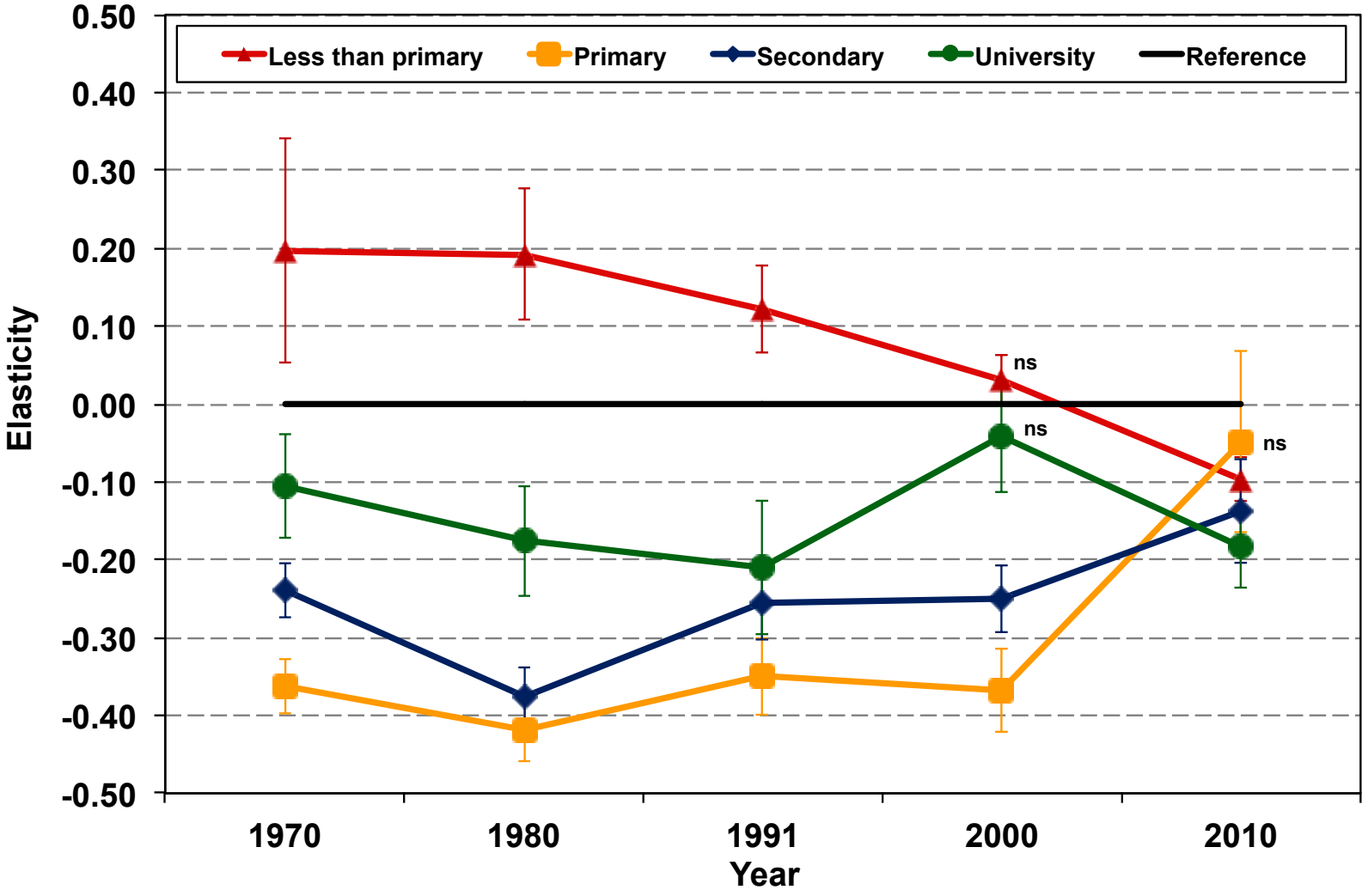
50–64 years



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

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

15–24 years



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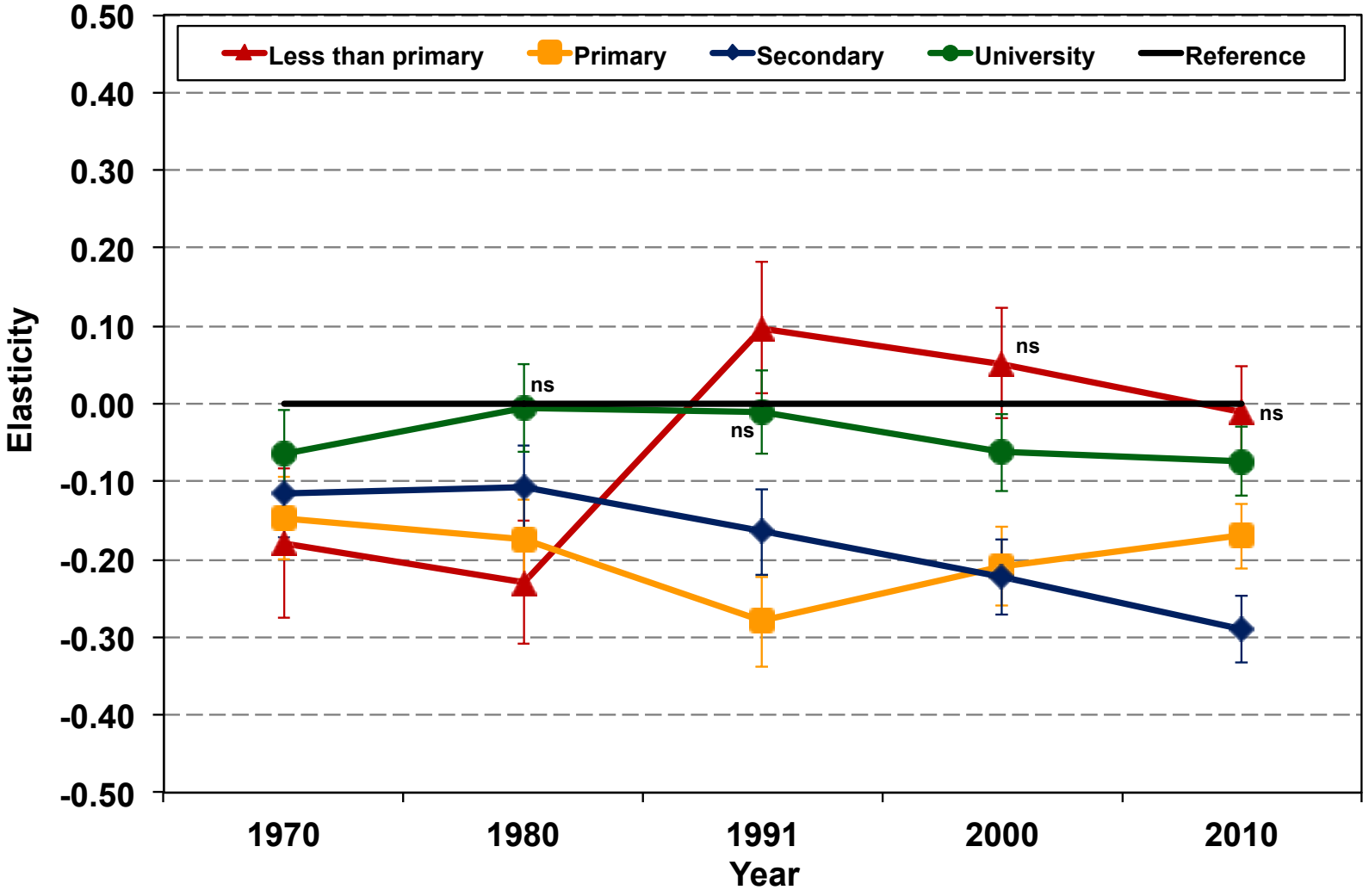
Effects of group proportions (P_{41}–P_{44}) on earnings, Brazil, 1970–2010

50–64 years



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

Other robustness checks

- Extra models for Brazil included as independent variables
  - Cross effects
  - Population size of micro-regions
  - Female workers

- **Original impacts** of distribution of males into age-education groups (P_{11}–P_{44}) remained negative and significant

2. Concentration of educated workers

Correlation of

geographic concentration of educated workers

with

individual earnings

Previous studies

- **Social returns to education**
  - Geographic concentration of well-educated people benefits everyone else in population (Acemoglu 1996; Moretti 2004, 2012; Topel 1999)

- **Differentials**
  - Larger effects are for least educated groups in the U.S. (Hout 2012; Moretti 2004, 2012)
  - Stronger results in suburbs than in urban centers, mainly in mid-size metro areas (Florida et al. 2016)

- **Productivity**
  - Least educated workers improve productivity by interacting with highly skilled workers (Berry, Glaeser 2005; Glaeser 2011; Mas, Moretti 2009)

Individual-level data

- **Males in the labor force:** working or looking for a job
- **Dependent variable:** logarithm of individual earnings
- Independent variables
  - **Age-education groups:** private returns to education
  - **Concentration of educated workers (university graduates):** social returns to education
  - **Control variables:** migration, urbanization rate, unemployment rate, region of residence
- **Data:** 2000 and 2010 Mexican and Brazilian Censuses

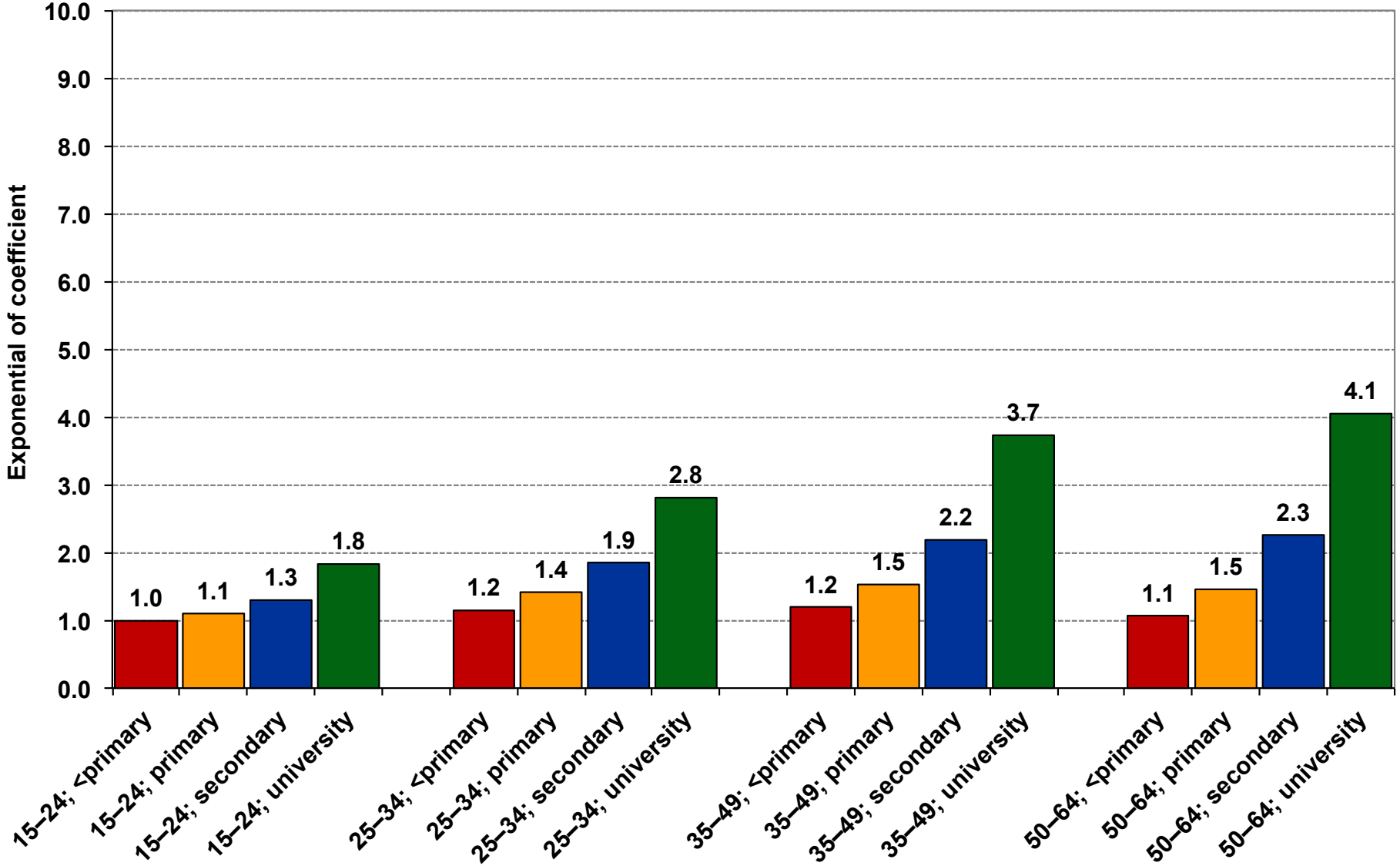
Estimation procedure

- Level of education is **endogenous**
  - Spatial distribution of educated population is associated with unobserved factors (Moffat, Roth 2016; Moretti 2004, 2012)
  - This can be correlated with levels of income

- **Instruments** estimate proportion of university graduates
  - Lagged explanatory variables: enrolment rate in high school, young-age-dependency ratio
  - Instruments were not sufficient to control for endogeneity

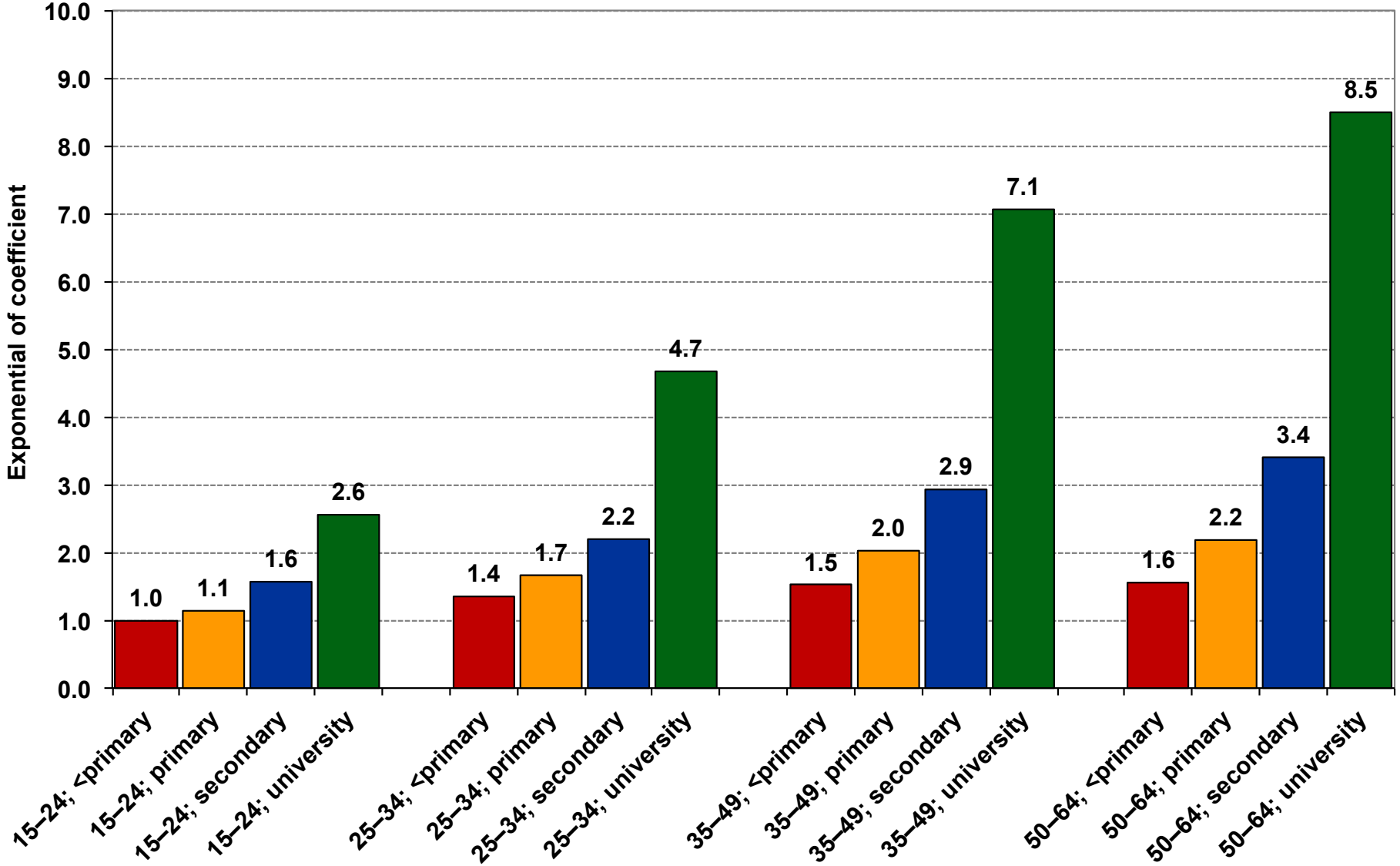
- **Models** were estimated for
  - Overall population
  - By income quantiles: up to 25th, up to 50th, above 75th

Private returns to education, Mexico, 2010



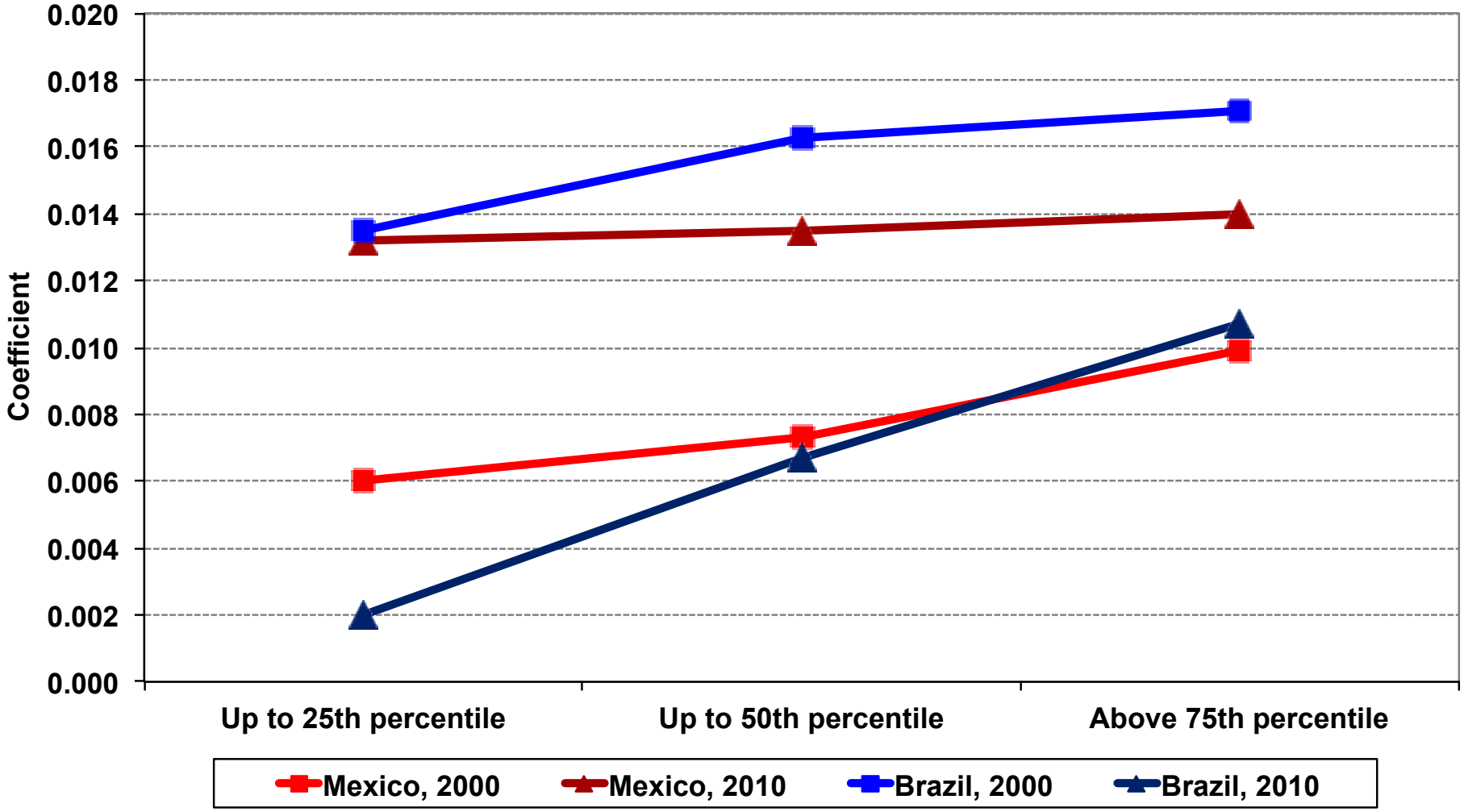
Source: 2000 and 2010 Mexican Demographic Censuses.

Private returns to education, Brazil, 2010



Source: 2000 and 2010 Brazilian Demographic Censuses.

Social returns to education by income quantile, 2000 and 2010



Source: 2000 and 2010 Mexican and Brazilian Demographic Censuses.

Final considerations

- **University graduates:** still a small number
  - More educated workers would benefit the overall population
- **Low-educated workers:** large share generates competition
  - Negative effects are surpassing positive ones

Effects	Mexico	Brazil
Over time	**Increasing correlations** – Maybe due to higher percentage of university graduates (11%), 2010	**Decreasing correlations** – Maybe due to lower percentage of university graduates (7%), 2010
Along income distribution	**Stable correlations** – Markets are more concentrated – Maybe competition reduces earnings of university graduates	**More beneficial to highest quantiles** – Lower concentration of skilled workers benefits their earnings – Income inequality might increase