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The Expansion of Higher Education in Brazil between 1982 and 2006: Disentangling Age, Period and Cohort Effects[1]

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Abstract

Over the last three decades, Brazil has experienced a large expansion of its post-secondary education system. This paper investigates changes in the likelihood of enrolling in post-secondary education in Brazil, given conclusion of secondary education, between 1982 and 2006. An investigation of trends in enrollment over time reveals the existence of period effects. Analysis using both age-period-cohort tables and the APC "intrinsic estimator" model shows that there are age and cohort effects that interfere with the period effects. The intrinsic estimator model reveals consistently declining age effects and an upward period effect after the 1990s, exactly when the educational expansion peaked in the country. Cohort effects, however, indicate an increase in the probability of attending post-secondary education for the early cohorts, but not for cohorts born after 1970. Suggestions are made to explain the findings, and further research is prescribed in order to develop a more precise explanatory model.

Keywords

Post-secondary education, educational expansion in Brazil, age-period-cohort models, intrinsic estimator

Introduction

Most sociological research on recent trends in educational expansion around the world supports the conclusion that the links between social background and educational attainment remain stable (despite the expansion), and generate persisting inequalities (Shavit and Blossfield 1993; Shavit and Westerbeck 1998; Hasenbalg and Silva 2003). Research focusing exclusively on the post-secondary level of education has become more frequent in the last decade (Gerber 2004; Gerber and Cheung 2008; Shwed and Shavit 2006; Shavit, Arum and Gamoran 2007). Research findings on the expansion of the post-secondary level vary by nation, but they point to two main tendencies: increasing access and an increase in horizontal stratification within these systems (Shavit, Arum, and Gamoran 2007).

Comparable research in developing countries has been scarce, mostly due to lack of adequate data to capture longitudinal consequences of changes in these countries' educational systems. In developed nations, higher education has been expanding in a context of saturation or near saturation of previous educational levels, i.e. a large portion of individuals between 14 and 17 years of age are already attending high school. Differentiation within the educational system and increased competition at higher levels may keep relative educational gaps stable, as predicted by the theory of *maximally maintained inequality* (Raftery and Hout 1993). But, in absolute terms, the post-secondary educational system in these industrialized nations have become less selective through expansion, allowing less privileged social groups to move up one step on the educational ladder. In nations with different levels of development and different institutional characteristics, the possible outcomes of educational expansion are still open (Torche 2005). If access to post-secondary education expands concomitantly with expansion in previous levels of education, which are still far from saturation, this expansion may be insufficient to decrease inequalities in the chances of enrollment for different social groups. In such a context, investigation of the mechanisms and outcomes of increased participation at the post-secondary level can bring a relevant contribution to comparative research in education and social stratification.

Brazil has one of the lowest post-secondary enrollment rates in Latin America (around 12 per cent of the 18–24 age cohort in 2006), but in recent decades it has experienced a wide expansion of its post-secondary system. Parallel to that, participation in secondary education increased significantly during the 1970s and 1980s, but growth rates in participation for this educational level decreased after the 1990s (Corbucci 2009). Because secondary school participation has not increased at the same rate as post-secondary school participation, and because the average age of the secondary school graduates has been decreasing, we might expect to see an increased proportion of newly secondary graduates attending post-secondary schools, especially at the traditional age. This expectation assumes that those who are graduating from high school are the ones going to college. However, this might not be the case. Instead, it may be older adults who are returning to school to further their education. This type of educational expansion would not significantly reduce attainment gaps among those in the same age cohort. If true, then policymakers should focus their attention on lower levels of education to reduce these gaps.

The methods used in this paper do not allow for the isolation of the impact of different socio-economic characteristics in the individual probability of going through educational transitions. However, the sample is split into different groups to compare differences in access to post-secondary education over time and investigate the influence of class, race, and other socio-economic factors on this probability. For instance, analyzing group differences based on family income can give a sense of how the interrelation between class dynamics and educational expansion played out over time to provide distinct levels of access to higher education to the Brazilian population. One of the advantages of using age-period-cohort (APC) models, in this case, is that the method allows the researcher to take advantage of twenty-two rounds of data from a nationally representative household survey to assess changes across cohorts, which can provide better estimates of period effects for each specific age cohort.

The expansion of post-secondary education in Brazil: age, period and cohort effects.
Prior research that focused on the expansion of access to education in Brazil usually took into account changes in educational attainment related to socio-demographic factors, such as race, gender, family income, urbanicity and region of the country (e.g. Lam and Marteleto 2005; Hasenbalg and Silva 2003; Fernandes 1999). Researchers have analyzed the improvement in Brazilian educational numbers from the 1970s to recent years as a combination of the increase in school enrollment, which has been occurring since the beginning of the 20th century (Hasenbalg and Silva 2003), and a shift in the demographic characteristics of the country (Lam and Marteleto 2005). Fertility rates in Brazil changed from around 6.2 children per woman in the 1940s to 1960s to 4.35 in 1980 and 2.8 in 2000.[2] Enrollments from the 1970s to 2000 increased thirteen fold for preschool, doubled for elementary school, and increased seven fold for secondary education. For post-secondary education, enrollments increased about five fold (Hasenbalg and Silva 2003).

During the demographic transition, family and cohort size moved in opposite directions, i.e., birth cohorts kept growing until 1982, while fertility rates and family size were falling (Lam and Marteleto 2005). So, in the 1990s there was a sharp fall in the school age population, which contains cohorts born after 1982. These were the first groups to experience a combined fall in family size and cohort size, being able to enjoy the effects of both less diluted family resources (Blake 1981, 1985) and less competition for school vacancies. This period coincided with rapid improvement in school enrollment and attainment, creating a "virtuous cycle" whose effects can still be felt. The changes in the general availability of family resources and of increased access to all levels of education may have affected the probability of enrollment in post-secondary education of each age cohort independently from the influence of individual socio-economic factors. Disentangling cohort effects from age and period effects may give some insights about these demographic changes. Cultural and political changes can also affect students' expectations and aspirations about pursuing higher levels of education, influencing each cohort's enrollment rates. These effects last through the entire life span of individuals belonging to a cohort and must be disentangled from shorter period effects.

Period effects are related to events that occur in a specific period of time, which in the present analysis corresponds to one year. These events can be, for instance, changes in policies and educational laws; the creation and authorization of new educational institutions that increase access to an educational level in a given year; and other factors such as macro-economic changes that affect life costs (e.g. changes in the minimum salary, purchase power, savings and other characteristics of the economic life of the population). All these factors influence life choices and opportunities related to the average age of entering the job market, the choice of pursuing higher levels of education, and the decision to attend a private or public school, among others.

Finally, age is a variable that may have an independent role, helping to understand the dynamics of changes in access to the post-secondary, or any other level of education. In the case of post-secondary education expansion, changes in age of access to the system can reflect not only changes in access and progression in the previous levels, but also changes in the structural characteristics of the system. For instance, the public and private sectors of post-secondary education and the different fields of study attract groups of students with a different average age. Different course characteristics (night or day shift, time investment required, etc.) also impact the age in which students can or choose to attend this level of education. Other factors influencing changes in age of enrollment can be changes in market demands that may incentive workers to go back to school, or to delay entrance into the post-secondary level. Different expansion rates between the public and private sectors, changes in the demand for night or day courses, or for courses in a specific area, or market dynamics, can affect age of enrollment independent from an increase in enrollment rates.

Taking all these factors into account, it is clear that the age at which students enter post-secondary education can be an indicator of the type and quality of post-secondary education they obtain and will have a different impact on their future life and labor market outcomes. In addition, if the target of public policies is to give incentives to post-secondary education attendance for younger cohorts, the isolation of age effects can offer important subsidies to improve the efficiency of these policies. In

what follows, the data and methods used to isolate age, period and cohort effects are defined; the trends in access to post-secondary education in Brazil based are described; and insights revealed by the study are discussed.

Data

Data used for this investigation come from the *Pesquisa Nacional por Amostragem de Domicilios* (Brazilian Household Survey), henceforth referred to as PNAD, and includes 22 years of the survey, applied yearly from 1982 to 2006 with a few interruptions. PNAD, implemented in Brazil in 1967, aimed to increase the amount of available information on the socio-economic development of Brazil.[3] The information collected is multipurpose, with a strong focus in the labor market, and includes questions about general aspects of the population, such as education, income and housing, as well as migration, marriage and fertility.[4]

PNAD has been widely used in educational research in Brazil and has a well-established sampling design. Using these data, it will be possible to analyze trends in the expansion of higher education from 1982 to 2006, the period in which the survey was already reaching a nationally representative sample. As the representativeness of the sample is reasonably constant over the study period, the aggregation of several cross sectional datasets, such as the successive years of PNAD, is a reasonable option, and one often used in APC analysis in many countries with similar data (e.g. Yang, Fu and Land 2004).

Even if the information provided by PNAD is very consistent over time, investigating socio-economic trends over such a large period presents a series of challenges that require a number of strategies from the investigator to avoid compromising the consistency of the comparison across all the years selected. First of all, although the variables employed in the survey have changed over time, there is a core of information that remained reasonably consistent, requiring only minor adaptations year by year to make sure that the variables always represent the same construct. However, changes in the sampling system and in the geopolitical formation of Brazil during the period investigated present a greater challenge.

From 1982 to 2003, the survey was nationally representative with the exception of the rural areas of the northern region, including the states of Amazonas, Roraima, Pará and Amapá. Since 2004 the PNAD sampling system covers the whole territory. In 1988, a new state was created in Brazil by splitting the state of Goiás into two parts and separating the upper part from it. The state of Goiás belongs to the midwestern region of Brazil, or Midwest. After the split, the new state, Tocantins, was incorporated into the North. The North is mostly rural, with more than half of its territory consisting of state parks and native reservations. When Tocantins became an independent administrative unit it developed fast, significantly increasing the general levels of urbanization of the North.[5] To avoid sampling biases caused by all these changes, the entire rural population of Brazil was excluded from this investigation. This population corresponds to less than 5% of the sample analyzed here, i.e, individuals with secondary education or higher. Hence, the sample used in this paper displays a good portrait of the *educated* Brazilian population. The findings are, however, generalizable only to the urban population (including small towns and villages). This is true except for the descriptive analysis, which uses the whole Brazilian population for the years studied.

Summing up all of the cases for all of the years available, the sample used for the descriptive analysis has 8,268,772 cases. The APC analysis restricts the sample to individuals between 18 and 48 years old who have at least secondary education, resulting in a sample of 760,906 cases. Age, period and cohorts are displayed at one year intervals in the descriptive analysis, and are grouped into categories for the second step of the analysis, as it will be described below. APC effects are also compared for separate samples. In this case, data is divided into five geographic regions (North, Northeast, South, Southeast and Midwest), into three different points of the Brazilian distribution of family income, into three categories of race (Whites, Browns and Blacks) and into males and females. Each of these characteristics is analyzed separately.

All the analyses, including the APC tables and the intrinsic estimator results[6], are weighted using an adjusted weight calculated from the population weight contained in the PNAD files for each year. The adjusted weight '*adjwt'* was created by dividing the individual weight provided in the PNAD files (*indwt*) by the sum of all the weights of the sample (Σ*weights*) divided by the specific sample size *N* for each year *i* (because weights are period-specific).[7] The adjusted weight is a more appropriate weight to assess significance levels for the intrinsic estimator model used in this paper, because it provides a more balanced sample size. The individual weights simply multiply the cases in order to reach population size, making the calculation of confidence intervals and significance levels virtually impossible.

Variables

The outcome, *condpse,* is a dichotomous variable in which 1 indicates enrollment in post-secondary education for respondents in each year of the survey, and zero indicates conclusion of secondary education only. It therefore shows the rate of enrollment in post-secondary education in a given year relative to the total number of people who concluded secondary education (in that year or before).

The independent variables of interest are indicators of age (in years), cohort (year of birth) and period (year of the survey). Age is divided into six categories that range from 18 to 48 years old. Age intervals are: 18-22, 23-27, 28-32, 33-37, 38-42 and 42-48 years. Period corresponds to years of the survey aggregated into 5 year groups, creating 5 categories. Period years were grouped in the following manner: 1982-1986, 1987-1990, 1992-1996, 1997-2001 and 2001-2006. Period and age are also presented disaggregated in table 2. For tables 1 and 2, cohort effects are read in the diagonal of the table. For the calculation of cohort effects using the *intrinsic estimator* the variable *cohort* was created as linearly dependent from age and period groups, by subtracting the variable age from the variable period (cohort = period – age). This direct calculation created nine categories for the cohort variable, indicated by the birth year of the group median, which are: 1939, 1944, 1949, 1954, 1959, 1964, 1969, 1974 and 1979.

Other variables that were used to split the sample into groups of different socio-economic characteristics are:

1) Race. The question about race of the respondent was only asked in the main questionnaire of PNAD after 1986. Data about race in 1982 and 1984 comes from the special supplement of the survey, and this information is not available for 1983, 1985 and 1986. Moreover, the category "Indigenous" was only included after 1992. Before 1992 it was aggregated with the category "Browns" (mixed). Specific calculations were run for Whites only, for Blacks only, and for Browns only, and then compared. Indigenous and Asians were excluded from this comparison.

2) Gender. The models were run separately for males only, and for females only, and then compared.

3) Family income. Family income is a derived variable in PNAD questionnaire; it was transformed by using a deflator to convert income levels to the monetary value of 2002, and a "convertor" to account for the currency changes that occurred in Brazil during the period studied.[8] The resulting income was divided by the square root of the number of individuals in the family (Garner, Ruiz-Castillo and Sastre 2003). Finally, using the income distribution cut points of 25% of the distribution and 75% of the distribution year by year, family income was separated into three groups: the group below the 25% cut point (in each year), the group between the 25% cut point and the 75% cut point, and the group above the 75% cut point.

4) Region. Data were split into five regions: North, South, Southeast, Northeast and Midwest. APC effects were calculated separately for each region for comparison.

Methods

The traditional APC table

Table 1 is the age by period table conventionally used in many demographic papers to analyze APC data. It contains the five-year age and period groups, and the values in the cells are the per cent of individuals that graduated from secondary education in Brazil in a given year or group of years, and who were enrolled in post-secondary education within this group of years. Values in parenthesis are the exposure rates for that age group in the period of five years, i.e., the weighted (using the adjusted weight) pool of individuals that concluded secondary education and either dropped out or enrolled in post-secondary education. The evolution of a cohort over time can be seen in the diagonal of the table. Highlighted values indicate the evolution of the 1955-1963 cohort over time.

In this table, period effects are read comparing columns over the entire age span, and each column indicates the conditional chances of enrollment in post-secondary education for different ages in the same period. This means that period effects are read *across* periods, i.e., they indicate changes over time. Age effects can be read across the rows, and each row indicates the particular effects of being of a certain age in the conditional chances of enrolling in post-secondary education, across the entire period studied. This means that age effects correspond to the effects of aging for the same time period, and should be looked for along each column and across age years. Finally, cohort effects can be read in the diagonal of the graph, e.g., in cell $x_{1,1}$ compared to cells $x_{2,2}$, $x_{3,3}$ and so on, in any possible diagonal of the table. The diagonal follows a single birth cohort across the part of its life span available in the data.[9]

There are some unbalances in table 1, as some age and period groups do not correspond exactly to five years. The last age group corresponds to six, and not five years of age (43 – 48 years). Although most periods start five years after the first year of the previous period, the three middle periods have only four years of data. The period that goes from 1987 to 1991 has only four years, as there was no PNAD in 1991 (a census year), and the same happens between 1997 and 2001, as there was no PNAD in 2000 because of the census. The period between 1992 and 1996 also has only four years as there was no PNAD in 1994. This unbalance should be kept in mind in interpreting the results, but it will not represent a problem for the estimation, as the exposure rates are more affected by sampling choices occurred in each year of the PNAD than by the number of years aggregated, and the outcome variable is a relative percentage conditioned by these exposures. In the results section the APC table is analyzed using all years available disaggregated, i.e., displayed one by one. The goal in performing this descriptive analysis is to understand the evolution in the access to higher education in Brazil from 1982 to 2006 by isolating the APC effects and describing their specific impact on the likelihood of being enrolled in post-secondary education in Brazil in each year or group of years and after graduating on secondary education.

The intrinsic estimator (IE) model

Table 1 is the conventional tabulation of data in demographic papers for estimation of APC effects, and is usually modeled through the *accounting or multiple classification model*. A well known problem of attempting to model this table to obtain age, period and cohort coefficients is that there is a perfect linear dependency between these three factors. This generates an identification problem when attempting to model the table using generalized least squares models.

The identification problem happens because one of these variables is always directly derived from the other two. For instance, birth cohort can be calculated by subtracting age from year: COHORT = YEAR – AGE (Yang 2006; Yang, Fu and Land 2004; Yang et al. 2008 etc). Many different modeling strategies have already been suggested to solve the identification problem, as for instance the use of proxy variables that substitute for either age, period or cohort coefficients (Land and Yang 2007)[10], or defining a non linear parametric function for one of the coefficients, or, most frequently, using the

constraint approach that consists of imposing linear constraints to the coefficients to make the model just identified (see Yang 2006, and Firpo, Gonzaga and Narita 2003 for a discussion and examples of these methods).

The main problem of the constraint approach is that it is sensitive to the arbitrariness of the constraints chosen (Yang 2006). In this paper, the IE model is used as a good solution to the arbitrariness of the equality constraints (see Yang et al. 2008). The IE model is basically a special case of the principal components analysis that uses the Moore-Penrose generalized inverse to provide the "best fit" (least squares) solution to the APC matrix. This way, it removes the influence of the design matrix (which is fixed by the number of age and period groups and not related to the outcome) on coefficient estimates, and transforms the coefficients of the principal component analysis back to the space of age, period and cohort coordinates, generating coefficients that are "directly interpretable as age, period, and cohort effects and that can be compared to corresponding effects estimated by the conventional imposition of equality constraints on parameters" (Yang et al. 2008 p. 1708). The IE model provides a unique estimable function that satisfies the identification problem. The algebra of the IE model was described in detail by Yang, Fu and Land (2004) and Yang et al. (2008). It works through generalized linear models, and in this specific case, as the outcome *condpse* is a binary variable with a binomial distribution, the logit-link function is used to estimate the coefficients. The model is weighted using the adjusted weight described in the data section.

Results

General trends: an overview of access to Brazilian post-secondary education

Given the high rates of expansion of Brazilian post-secondary education in the last decades, the usual expectation would be that the traditional age cohort for post-secondary education, the 18—24 year old cohort, would be increasing its participation in this level of schooling. Given that the share of young adults that are attending post-secondary education in Brazil is increasing (from 1982 to the present), that expectation is reasonable. Moreover, the per cent of this population (among those enrolled in some kind of education) that is attending secondary or elementary education is decreasing, meaning that more students from this group are entering the level of education in which they are expected to be according to their age.

Graph 1 (all graphs and tables are displayed in the appendix) shows that raw (weighted) enrollments in secondary and tertiary (or post-secondary) education have been increasing consistently in Brazil for the period studied. It also shows that the expansion of secondary education in Brazil has been even higher than the expansion of post-secondary education in early years, but there has been an almost stagnant growth for the secondary level in recent years. This decrease in expansion rates for secondary education is happening way below saturation levels. As of today, only around 40% of the students at the traditional age for attending secondary education, the 14-17 year old cohort, is attaining this level. [11]

Graph 2 shows the enrollment of Brazilians from the traditional age population for secondary and post-secondary education in Brazil between 1982 and 2006. It also shows the trends in post-secondary enrollment for older populations. The trends indicate an increase in the rates of expansion of post-secondary education in recent years, both for the traditional age population and for the older population, as well as a decrease in the rates of expansion of secondary education for the traditional age population. Moreover, the per cent of this 18-24 years old population (among those enrolled in some kind of education) that is attending secondary or elementary education is decreasing, meaning that more students from this group are entering the level of education in which they are expected to be according to their age.

It is important to highlight the changes in age of enrollment that followed these trends. The population attending secondary education in Brazil became much younger over time during the period studied, whereas the population attending post-secondary education actually became somewhat older. This

interplay between age of enrollment and rates of expansion raises some important questions. Graphs 3 to 6 compare the share each age cohort has in secondary and post-secondary education in Brazil for the first and the last years of the period analyzed, 1982 and 2006. These graphs show that the share of 14-17 year old students in the secondary level increased from 43% to 60% (graphs 3 and 4), while the share of 18-24 year olds in the post-secondary level decreased from 63% to 57%. At the same time, the share of older students between 33 and 48 years of age increased in the post-secondary level (graphs 5 and 6).

Since secondary school participation has not increased at the same rates as post-secondary participation, one would expect to see an increased number of newly secondary graduates attending post-secondary schools. In other words, as the population in secondary education not only experienced a decrease in growth rate but also a decrease in average age, we would expect, if those students were transferring straight to post-secondary education at higher rates, a decrease in the average age of the post-secondary student population over time. Nonetheless, the retention rate in lower levels of education in Brazil is very high. Thus, secondary students might be transferring to post-secondary education at an older age than what would be expected. Even in this case, the share of the younger age cohorts within the post-secondary students' population should be increasing, which is not what graphs 3 to 6 illustrate.

The insight from the last graphs is reinforced by the information displayed in graph 7. This graph displays the share of each age cohort within post-secondary education over five time periods: 1982-1986; 1987-1990, 1991-1994, 1995-1999 and 2001-2006. As seen in this graph, the per cent of students in post-secondary education that belong to the younger cohorts (18 to24 years old and 25 to 32 years old) is actually decreasing, while it is increasing for the older cohorts (33 to 40 and 41 to 48 years old). The change is small for both age groups, but it suggests that part of the growth in vacancies in Brazilian post-secondary education is benefiting the group of individuals that are already in the job market and may be looking for this kind of education as a way to increase their credentials and advance their careers. As PNAD does not provide information about the number of people *concluding* each level of education, but only the number of people actually enrolled in each level in a given time, these graphs might also be an indication of high levels of retention in the secondary level, or of the existence of a large lag period between concluding secondary education and entering tertiary education. The public sector of post-secondary education in Brazil is, in general, competitive, and students sometimes prepare for several years for the admission exams, failing successively in these exams until they manage to enter the system. On the other hand, although the private sector is, in general, less competitive, it might be expensive, and students may need to spend some time in the job market to save money to attend (Schwartzman 2006, Corbucci 2007).

One possible way to investigate this question in more depth is by disentangling age effects from period and cohort effects to see if the trends described above will hold, which is done in the next sections.

The APC table

Table 1, an age-by-period table, displays the chances of enrolling in post-secondary education after the completion of secondary education. Given the unbalanced design of this table, in this section the table will be disaggregated into table 2, for descriptive purposes. Table 2, as in table 1, has years (periods) displayed in the columns, and age in years displayed in the rows. However, it contains *all* ages from 18 to 48 years, and *all* years available in the data. To check the findings from graph 7 the same age span of that table was maintained, i.e., 18 to 48 years, but without grouping it in categories.

Cohort effects should be interpreted as being relative to each year, but not for the exact same people, because the data are cross sectional and each cell contains different individuals. For instance the main diagonal of the table, which is highlighted, shows changes in *condpse* for the birth cohort that was 18 years old in 1982, 19 years old in 1983, and so on, until this group reaches 48 years old in 2006. The diagonal that starts in 1992 (also highlighted) indicates the effects of *condpse* for a group of individuals that were 18 years old in 1992, 19 years old in 1993 and 32 years old in 2006. However,

the individuals that were 18 years old in 1982 or 1992 are not the same individuals captured by the survey in the following year at 19 years of age. As the subject of this paper is the effect of a given year on post-secondary education access for individuals that are of a certain age in that given year, it is reasonable to ignore the cross-sectional structure of the data for this analysis.

Although table 2 is used here mostly as a descriptive resource, it can point to some interesting trends. Looking at the row of 18 year olds, which means looking at period effects for 18 year olds, we notice that the chances of enrolling in post-secondary education (given the conclusion of secondary education) for individuals of this age increased during the 1980s, peaked in the first half of the 1990s and started decreasing during the late 1990s and the beginning of the twenty first century. In 1982, 35.23 per cent of 18 year olds that had concluded secondary education entered post-secondary education, but this percentage was smaller by more than 5 per cent points in 2006 (29.83). The same tendency of decrease is observed for the next few groups of age, until 20 year olds. For the middle of the age range of the table the curve starts flattening, and almost reverts as we go down in the table to individuals at their forties. For these older individuals, the chances of enrolling in higher education at that age are naturally smaller than for individuals in their twenties, but they show a growth tendency.

Age effects in table 2 are in the expected direction. For each year or period, the probability of participating in higher education (*condpse*) is higher for younger ages than for older ages. However, when age and period effects are combined we notice that in recent periods the difference between younger individuals and older individuals in their chances of enrollment is slightly decreasing. For instance, the difference between chances of participation for individuals 18 years old, if compared to individuals 28, 38 and 48 years old is, in 1982, 20.51, 26.12 and 31.48 points respectively. In 2006, this same difference is, respectively, 15.12, 20.59 and 25.56 points. The same is true for practically all ages.

Graph 8 displays age enrollment trends over time for some selected years, and shows the upward curve in the early twenties, the somewhat downward curve during the thirties with the lowest peak happening in the same period in which the curve for younger individuals is higher. Finally, for individuals in their forties, it shows that *condpse* is invariably higher in 2006 than in 1982, indicating a small but consistent increase in the chances of this age group of enrolling in PSE in more recent years.

Cohort effects correspond to the effects that individuals who were born in the same year will experience over their life span. The effect of being 18 years old in 1982 (i.e., of being born in 1964), can be followed along the main diagonal of the table, as it is highlighted in table 2. Cohort effects are harder to follow visually through the table. Moreover, some cohorts have more data points than others, making comparisons of similar age groups difficult. In order to allow this comparison, graph 9 shows ten cohorts identified by year of birth forming two age groups: the trends of five of these cohorts are shown from their 18 to their 24 years of age (the traditional age for participation in post-secondary education). The other five cohorts are followed from their 33 to their 41 years of age, to show trends for the late years. All the cohorts have the same number of data points except the group born in 1966, which is only followed from 33 to 39 years of age.

Graph 9 suggests that there are specific cohort effects for the probability of participation in post-secondary education in Brazil over time. The cluster of lines in the left side of the table shows the cohorts followed in their younger age, from 18 to 24 years old. The trends for this age group have been similar over time, as all lines are close together and decrease consistently as each cohort ages. It is important to point out, though, that despite the expansion of higher education, the probability of individuals who are 18 to 24 years old of participating in this level of education is not significantly higher for individuals born in 1980 than it is for the older cohorts. Probabilities are basically the same for individuals born in 1980, 1977 and 1964, for instance.

For individuals in their late thirties and mid-forties, the trends seen in the right side of the graph, the picture is very different. First, probabilities differ widely by cohort, with very low probabilities of

participating in post-secondary education for individuals in their late thirties, i.e., those born in 1949, 1953 and 1957. For individuals of this age born in 1963 and 1966, probabilities of attending post-secondary education are much higher, almost as high in the early thirties as the probability of participation for the cohorts followed at younger ages (left side of the graph), although it decreases rapidly with age.

All the trends shown by the APC table indicate that participation in post-secondary education in Brazil has increased over time for practically all age groups, but it increased more for older individuals than for individuals at the traditional age for this level of education, i.e., individuals that are 18-24 years old. The APC table does not provide sufficient information to understand the isolated implications of APC effects for the "aging" of Brazilian post-secondary education. However, the table clearly shows that APC effects seem to be all related to this phenomenon at the same time, justifying the use of more sophisticated analysis to obtain a better understanding of these three dimensions within Brazilian education.

The intrinsic estimator model: general trends and socio-economic differences

The descriptive analysis suggests the existence of separate effects for the probability of enrolling in higher education for age, periods and cohorts. Using only the visualization tools of APC tables, it is still hard to disentangle these effects, as both the graphs and the two by two tables always show at least two effects at the same time. A regression analysis can be useful to "clean" each of these effects from the influences of the other two, estimating coefficients for the three dimensions. The *intrinsic estimator* model solves the identification problem of APC regression models and provides a better picture of each effect. The results are displayed in table 3. Nearly all values in the table are significant. It is, however, important to remember that coefficients *cannot be interpreted* by their face value, but only in relation to one another. There is also no "omitted category" in each group, as the intrinsic estimator is based on a principal components' analysis and not on a regular logistic regression.

Table 3 shows constant and decreasing effects for age groups, an initial decrease followed by an increase in period effects and an increasing trend for the cohorts born from 1934-1939 to 1970-1974, followed by a decrease for recent cohorts. All the values in the table are significant. The only non-significant coefficient in this model is the value for the cohort with midpoint birth year in 1956. The results from table 3 are represented in graphs 10 to 12, for each one of the effects.

These results confirm the suggestion from the descriptive analysis that there are distinct effects of age, period and cohort on the changes in post-secondary education in Brazil in the period analyzed. Table 2 shows a decreasing effect for age consistent in all years, but a small decreasing effect for period in early ages, almost no period effect for the middle to late twenties, and finally a small increase in the chances of enrolling in post-secondary education later in life. Table 3, or the IE model, shows that age effects decrease consistently over time, but the slope of the decrease is attenuated from mid to late years, i.e. from 28 to 48 years of age. Period effects in this table are compatible with historical accounts of the expansion of the higher education system in Brazil, which was somewhat stagnant in the decade of 1980 and had a growth spurt after the nineties (see graph 2). Finally, cohort effects in table 3 increase with a steep slope for earlier cohorts, but start decreasing for cohorts born in 1974 and after. As the calculation of cohort effects depend on the number of data points available, and the data for earlier cohorts only examine them at a young age, the decrease in cohort effects might indicate an increase of average age of enrolling in post-secondary education in Brazil (that is, the relative chances of participation of younger students, *given conclusion of secondary education*, are decreasing in the country). The discussion section presents possible explanations for this phenomenon.

APC effects: socio-economic influences

The above description of APC effects did not take into account the possible influences that other socio-economic and demographic factors can have in the relations observed. Several factors can alter the effects: whether the student is in an urban or rural setting; family material resources; gender and race of the students; region of the country, or a combination of two or more of these factors. The fact

that only APC variations can be included in regular APC models restricts the descriptive power of this technique in the present case, as educational attainment has been demonstrated to be very sensitive to socio-economic characteristics. To investigate if the findings described in the last section are influenced by socio-demographic characteristics, and to set up a better explanatory theory for the effects observed, the analysis is extended to include some of the most common controls used in educational research, which have been demonstrated to affect educational attainment in the Brazilian case (e.g. Hasenbalg and Silva 2003).

The strategy used to investigate the influence of socio-demographic factors on the APC effects is to split the sample into different groups, and then to compare these groups. The only drawback of this strategy is that, by doing so, only one factor can be observed at a time. The results of this analysis will be presented only in graph format for greater visualization power. In these graphs, average APC results are displayed in the dotted purple line so that the results from the split samples can be compared to the mean. T-tests were performed to assess differences between the coefficients of all race groups, all regions, between different income levels and between males and females.

The influence of race

Race differences in the APC effects are displayed in graphs 12 to 14. All age differences across race categories are significant, except the difference between 28-32 years old Whites and 28-32 years old Blacks and Browns. The age effects' graph shows that Whites enter post-secondary education in greater numbers at younger ages, followed by Browns, with a sharp decline across ages. For Blacks, chances of entering post-secondary education at youger ages are smaller than for the other groups, and the decline in these chances by age is not so sharp, indicating that they might be entering the higher education system later in life. A possible explanation for this is that they might be concluding secondary education at an older age. It can also be that they go straight to the job market after secondary education and only try to enter post-secondary education some years after graduation.

Differences in period effects for Whites and Browns are significant for almost all periods except the period from 1997 to 2001. Participation in higher education after the conclusion of secondary education is not significantly different for any race group in this specific period. For Whites compared to Blacks, and Blacks compared to Browns, only the periods of 1987-1990 and 2001-2006 are significantly different in post-secondary enrollment. Despite differences across race groups, period effects indicate a decline in the ratio of enrollment in post-secondary education over conclusion of secondary education in Brazil for the first two periods, and a strong increase in the last three periods, for all races. The strongest increase seems to have happened among those self-identified as Browns, or of mixed race. Finally, cohort effects look sharply different for Blacks and Browns, but almost all the differences across race groups for the earlier cohorts are not significant. For almost all cohorts born in or after 1968 the differences between cohorts are significant, showing that chances of attending higher education after graduating in secondary education for Blacks born after 1957 have been steadily increasing, while this ratio declined for the two other race groups for individuals born after 1974.

The influence of income

Graphs 15 to 17 display differences in the chances of participation in post-secondary education in Brazil, after concluding secondary education, based on family income. To build these graphs,three groups were created, based on the distribution of family income in the sample. These groups are the first 25% of the distribution, i.e., the lower family income group, the group between 25% and 50% of the distribution, or the average family income group, and the group above 75% of the family income distribution, or the high family income group. Family income is not the ideal measure for income differences across individuals in post-secondary and secondary education, as it can mean two different things for two different groups: for students that are heads of household, usually the main component of their self-declared family income is their own income, while students who leave with their parents are declaring mostly the income of their parents,especially if they are not yet in the job market. As PNAD data does not allow a distinction between parental income and family income, this construct is imperfect. The paper assumes, however, that for comparing across income groups, family income is a

better variable than individual income (as many students do not have an individual income), and it is a *proxy* for the individual's socio-economic status.

Age differences are significant across almost all age groups for all income levels, except the age group 28-32 years old for low and average and high and average income groups. Those within the higher income group have a greater chance of enrolling in post-secondary education at a younger age, and the chance drops more sharply than for the other groups, meaning that the higher the income, the higher the chances of attending post-secondary education at a younger age. Differences in period effects across income levels are almost all significant at the $p < .01$ level, and some of them at the $p < .05$ level, except the difference between the high and low income groups for the first period, 1982-1986, which is not significant. Period differences across income groups indicate that only the high income group had a steady increase in the chances of participating in post-secondary education after 1987. The other groups started increasing participation only after 2001, but with a less steep slope than the high income group.

The difference in cohort effects between low and average family income is significant for groups born between 1964 up to 1983, and not significant for the youger cohort. For the difference between low and high family income, and middle and high family income, almost all coefficients are significantly different except the coefficients for the last cohort and the cohorts born between 1953 and 1960. The comparison of cohort effects for middle and high family income groups is only marginally significant. Despite these differences, the trajectory of cohort effects across cohorts for these three income levels is very similar, differing more for early cohorts than for the late ones, which suggests that post-secondary education in Brazil is significantly less selective for younger cohorts than for older ones.

The influence of gender

As is the case in most countries, gender disparities in higher education in Brazil have shifted from a male advantage to a female advantage over the last decade (Hasembalg and Silva 2003, Fernandes 2005). Graphs 19 to 21 show the comparison of APC effects by gender.

Differences in age effects by gender are all statistically significant, but minimal. Both males and females have the same age trajectory in their chances of enrolling in post-secondary education in Brazil. Period effects are also all significantly different by gender except for the last five-year period, 2002-2006. Although period differences for the last period are not significant, the period trajectory for males and females indicates that females are surpassing males in their chances of enrolling in post-secondary education in Brazil. The fact that the difference in the last period is not significant suggests an increase in the variability of outcomes for males and females during these five years. Cohort differences between males and females are significant for the first two and the last four birth cohorts, however cohort trends are similar for both groups.

The influence of region of the country

Brazil is officially divided into five administrative or geo-political regions, and these regions differ dramatically in levels of development. The South and Southeast are the richest regions, and they are the ones with a higher number of students in private schools, and a higher growth in the number of private post-secondary schools, due to the close link between these institutions and the market (Duham 2004). Graphs 22 to 24 show comparisons of APC effects by region. The "total" line is omitted from these graphs for ease of visualization.

Differences in age effects of participation in post-secondary education across regions are significant for practically all age groups. However, all age effects have a very similar trajectory by region, decreasing consistenlty as individuals age, as seen in graph 22. Differences in period effects across regions are all significant, except for the period 1992-1996 for almost all comparisons. The trajectory of period effects is also different across regions. Although all the slopes decline from the first to the second five-year periods, and increase from then on, the North and the Midwest start with much lower chances of participation in post-secondary education than the other three regions but have a steep increase, surpassing all three of them in the last two periods, as indicated in graph 23. The North also

presents a slightly higher increase than the South and Southeast if only period effects are taken into account. Finally, comparisons of cohort effects across regions (graph 24) become significantly different for cohorts born after 1959, and are usually not significant for the younger cohort, i.e., individuals born in 1982 or later. Graph 24 shows that cohort effects follow a similar trajectory in all regions.

Discussion

The results from table 2, represented in graphs 10, 11 and 12, confirm the insight from the APC table that each one of these dimensions has distinct effects on the conditional probability of enrolling in post-secondary education in Brazil for the period between 1982 and 2006.

Table 1, the APC table, shows a decreasing effect of age consistent in all years. It also shows a small decreasing effect for period in younger ages, almost no period effect for the middle to late twenties, and finally a small increase in the chances of enrolling in post-secondary education later in life (see graph 8). These results are consistent with the trends displayed in graph 7, which indicate that the share of post-secondary education attended by younger individuals is decreasing while the share attended by older individuals is increasing. Finally, graph 9 shows that cohort effects follow similar trends if examined while individuals are at a younger age. The first part of graph 9, seen in the left side of the graph, follows several cohorts of individuals from when they were 18 years old to when they turned 24. This set of lines shows that the cohort effects for younger individuals are at most difficult to explain. There is a lot of variation, but no clear trend of increase or decrease of conditional participation in post-secondary education from one cohort to the other. The right side of the graph, however, shows cohorts followed when individuals were in their late thirties and forties (from 33 to 41 years old). In this side the picture is very different, as all cohorts displayed suffer a decline in the conditional probability of participating in post-secondary education as they age, but the decline is much more accentuated in the two more recent cohorts than in the three earlier ones. Moreover, these two more recent cohorts have much higher chances of being enrolled in post-secondary education than the earlier ones, confirming that the effects observed in graph 7 have been affecting recent cohorts more than earlier cohorts.

The APC effects calculated using the IE model do not contradict these results. On the contrary, they offer a few more elements to explain them. Graphs 10 to 12 represent these results separately, showing that age effects decline consistently, but have a flatter slope after 28-32 years old (graph 10); that period effects decline during the 1980s, increase during the 1990s and increase at even higher rates in the first years of the twenty first century (graph 11); and that cohort effects increase consistently until the group whose midpoint birth date is 1976, declining sharply from that. The flattening slope for age effects in graph 10 confirms the fact that for the group of individuals above 28 years old, the chances of participating in post-secondary education do not decline so sharply. This fact, combined with the fact that cohort effects are declining for individuals born after 1974, and that these individuals are only captured by the data from 18 years old to their early twenties (graph 12), is an indication that older individuals are the great beneficiaries of the growth in participation in higher education observed in graph 11.

This does not necessarily mean that public policies targeted at the individuals leaving secondary education are being ineffective. Graph 2 indicates that the growth curve of secondary education enrollments flattened after the year 2000. One possible explanation for this stagnation in the growth of secondary education is that there are high rates of retention in this level of education, creating a bottleneck that prevents younger individuals from entering post-secondary education (Schwartzman 2006). In this case, individuals might be exiting secondary education at an older age, and only then taking advantage of the growth in vacancies in post-secondary education. Another explanation is that there is no bottleneck; instead, individuals leaving elementary education at an older age are not attending regular secondary education, but are attending a modality of it called “adult education”, which is not captured by the category “secondary education” in PNAD (Corbucci 2009). Adult education rarely leads to the transition to tertiary education. This would confirm the hypothesis that

the increasing number of 33 to 41 year old individuals attending tertiary education consists of those returning from the labor market and seeking to improve their careers by adding new credentials.

Graph 2 also helps to understand the declining effects of period on conditional participation in post-secondary education: while secondary education was growing faster than post-secondary education, the chances of enrollment in post-secondary education relative to the number of people who concluded secondary education in the country were declining in the first decade examined. When the growth in post-secondary education became faster than the growth in secondary education, at some point the effects became positive and the rate between post-secondary and secondary education started growing.

The decrease in the chances of participation in post-secondary education for younger individuals is only one of the outcomes observed. Another important outcome is the increase in participation for individuals after their thirties. Regarding this increase, the first observation to be made is that in recent years the age distribution of post-secondary students is wider. Whereas in early cohorts it was much more likely that individuals would enroll in post-secondary education at younger ages, for more recent cohorts there is more variation in the timing and age of enrollment. In addition, the results from the IE model show that the probability of attending post-secondary education in Brazil has increased steadily over time for most cohorts, except for those born after the early 1970s. This probability started decreasing sharply for the more recent cohorts (graph 12).

Although this recent decrease is almost counter intuitive, as it happens exactly when period effects show an increase in the chances of participation in post-secondary education, there is a simple explanation for it that confirms once more the "aging" of post-secondary education in Brazil. Because the cohorts born after 1970 were only measured in the data when they were younger, the decline in their probability of participating in post-secondary education reflects a combination of the decline in the probability of participation for younger ages and other cohort effects. These other cohort effects can be, for instance, greater incentives to enroll in post-secondary education at any age, either because of the increase in the value of this credential in the market or because of an increase in the competition for job positions by individuals with higher credentials as post-secondary education diplomas become more widespread. Moreover, it is important to reiterate that the expansion of higher education in Brazil, until recently, had been achieved mostly by the increase in the number of private institutions (Duham 2004). These institutions are, in many cases, less selective, and they tend to focus on courses and careers that do not demand high technical investments. They are more convenient for individuals who are already in the job market, mainly because they offer a greater number of night courses and, with few exceptions, "specialize in the social professions – administration, accounting, law, economics and education." (Schwartzman 2004, p. 175).

In 1982, according to PNAD data, for all the 18 year olds enrolled in post-secondary education, 32.5 % were in the public sector. For older students, 28.18 % of the 28 years old students, 13.78% of the 38 years old students and 31.37 % of the 48 years old students enrolled in post-secondary education were in the public sector. In 2006, the respective percentages of enrollment in the public sector of higher education were 22.53 % for 18 years of age, 16.47% for 28 years, 19.94 % for 38 years and 8.35 % for 48 years. These calculations show that, as the participation of older students in post-secondary education increases, their participation in the public sector decreases sharply. They are being more and more absorbed by the private sector. The superior growth of the private sector over the public sector can, therefore, explain a considerable portion of the age and cohort effects found in this analysis.

Summarizing, as described in the introduction, higher education has been expanding in Brazil at high rates in the last few decades. However, as shown in graph 2, the rates of expansion for *secondary* education from the early 1990s to the first years of the twenty first century have been even higher. In spite of the flattening of the growth slope for secondary education after 2003, it is presently easier for Brazilians of all socioeconomic backgrounds to attain secondary education than it was in 1982. These trends indicate that, at least for the traditional age cohorts, the distance between secondary and post-

secondary attainment may be increasing, not because the post-secondary level is becoming more selective, but because the secondary level is becoming less selective. However, changes in age and cohort effects over time cannot be thoroughly explained by the simple impact of educational expansion. They also vary and are affected by many other socio-economic factors.

Differences by gender in age and cohort effects are not very marked according to graphs 19 and 21, but period effects indicate that participation levels in post-secondary education by females surpassed participation levels for males in the mid nineties. Results by region are significantly different from each other. The more developed South and Southeast have a steeper age slope, indicating that individuals attend higher education at earlier ages in these regions, while period effects indicate that the less populated North and Midwest regions have expanded participation in post-secondary education at a faster pace and at higher rates than the other regions.[12] Race and income are intrinsically connected in Brazil, and some of this connection might be observed if one looks at age effects for income and for race groups in graphs 19 and 22. The middle and lower income groups have flatter age slopes, indicating a wider age distribution in the chances of post-secondary education participation, meaning that individuals with lower family income take longer on average to enroll in higher education. The same phenomenon is observed for race: Blacks and Browns also have flatter slopes for age.

However, time-conditioned effects, such as period and cohort, indicate that the distribution of post-secondary education in Brazil is becoming less unequal over time by race, *but not by family income levels*. On one hand, graphs 13 and 14 show that period effects in participation in post-secondary education for Browns are positive and stronger than effects for Whites, and for Blacks the growth in participation is more variable but is still similar to that of Whites. Cohort effects for Blacks show that for this group the decline in participation rates in post-secondary education for more recent cohorts is not happening. The cohort effect for Blacks is steadily increasing. On the other hand, graph 16 indicates that the growth in post-secondary participation over time happened at much higher rates for individuals in the last 25% of the family income distribution. This income effect can have the same explanation as the total age effect. As the expansion of the private sector was much larger than the expansion of the public sector of higher education in the period investigated, the increase of family income influence in the probability of participating in higher education reflects increasing tuition costs, as private institutions charge high tuition fees, while the public sector is tuition-free.[13]

Conclusion

This paper investigated changes in the probability of participation in post-secondary education after the completion of secondary education in Brazil from 1982 to 2006. The main goal was to disentangle APC effects in order to provide a better understanding of these changes. By splitting the sample into groups of different socio-economic status and comparing these groups, it was possible to provide some insight on the impact of some socio-economic factors on these effects. The findings from the APC models indicate that there was a decline in chances of participating in higher education in the 1980s, a strong increase in chances of participation after the 1990s and an even stronger increase at the turn of the century. However, the findings also indicate a slight "aging" of the pool of individuals that were participating in post-secondary education in more recent years.

Some explanations for these findings need to be highlighted. First, the higher rates of expansion of secondary education until 2003 decreased the selectivity of this level of education *in relation to the post-secondary level*, a fact that is represented by the decrease in rates of enrollment in post-secondary education for the traditional age group over time *relative* to conclusion of post-secondary education. In absolute terms, enrollment rates are increasing for both groups, and in terms of rates of growth, after 2003 post-secondary enrollment levels have been growing at much higher rates than the secondary sector. This explains, at least partially, the initial decline in post-secondary education participation in the 1980s. Second, the rates of growth of secondary education are decreasing, probably due to the high retention rates in this level (Schwartzman 2006), or to the fact that older individuals are attending different modalities of secondary education not captured by the data. In any

event, this creates a bottleneck between the secondary and post-secondary levels that decreases the number of students 18 to 24 years old that exit secondary education and are able to transfer to the next level. Finally, as the vacancies in the private sector of education (which is less selective than the public sector) are not being absorbed by the traditional age cohort, they have been increasingly taken by students in their thirties and forties (see graphs 3-7).

Finally, findings from the comparison of groups of different race, family income, gender and from different regions of the country indicate some positive outcomes from the expansion of higher education in the last two and a half decades, until 2006. Period effects indicate that the distribution of the conditional chances of participating in post-secondary education for this period became more even by region, as the increase was larger in the less developed regions. Period and cohort effects indicate that Blacks and Browns increased their chances of participating in higher education relative to Whites. In addition, the increase in the chances of participation of females surpassed that of males. Despite this good news, the effects of family income on participation in post-secondary education increased over time. It was argued earlier in the paper that family income is not the best variable to assess the influence of socio-economic status on participation in higher education, especially if individuals of all ages are taken into account. In this specific case, parental education, occupation and income would be better constructs. As these are not available for all the years of PNAD, the effects of income found in this study still deserve further scrutiny.

In conclusion, this study attempted to demonstrate that important insights about the expansion of higher education in Brazil in the last decades can be achieved by disentangling APC effects associated with this expansion. APC tables and graphs are an important resource to provide insights on the interplay of these three variables. The IE model singles out the effects of all the three dimensions by solving the identification problem, giving a "cleaner" picture of the changes in age of participation in post-secondary education, period changes, and cohort changes in the probability of participation in post-secondary education in Brazil. Moreover, applying the IE model to different samples, this study provides further insight into the differences across groups of different race, gender, income levels and regions of the country in their probabilities of participating in higher education in Brazil over time, by age and across cohorts.

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Appendix – Tables and Graphs

Table 1: Per cent of graduates from secondary education in Brazil participating in post-secondary education in a given year, 1982-2006.

	Period									
Age	1982-1986		1987-1990		1992-1996		1997-2001		2002-2006	
18-22 ...	30.9	(37754.07)	29.5	(19564.15)	35.6	(18157.67)	33.23	(31787.02)	30.73	(70034.75)
23-27 ...	18.71	(40199.29)	16.2	(24619.37)	19.21	(21192.99)	19.8	(29522.36)	21.02	(65264.23)
28-32 ...	10.73	(26444.81)	8.75	(18369.84)	9.13	(18815.34)	11.06	(22918.10)	13.67	(44060.36)
33-37 ...	7.69	(16134.42)	5.87	(12382.32)	6.32	(14781.57)	7.71	(20247.78)	11.05	(35429.37)
38-42 ...	5.39	(9938.79)	4.54	(7839.51)	4.04	(10633.97)	5.67	(16130.67)	8.32	(31016.14)
43-48 ...	3.72	(7889.09)	2.84	(5495.67)	2.8	(8097.20)	4.26	(13033.46)	6.29	(27027.52)

Source: PNAD, Brazilian Institute for Statistics and Geography (IBGE)

(Table 2 is on the next page)

Table 3: Participation in post-secondary education in Brazil for individuals between 18 and 48 years of age, from 1982 to 2006

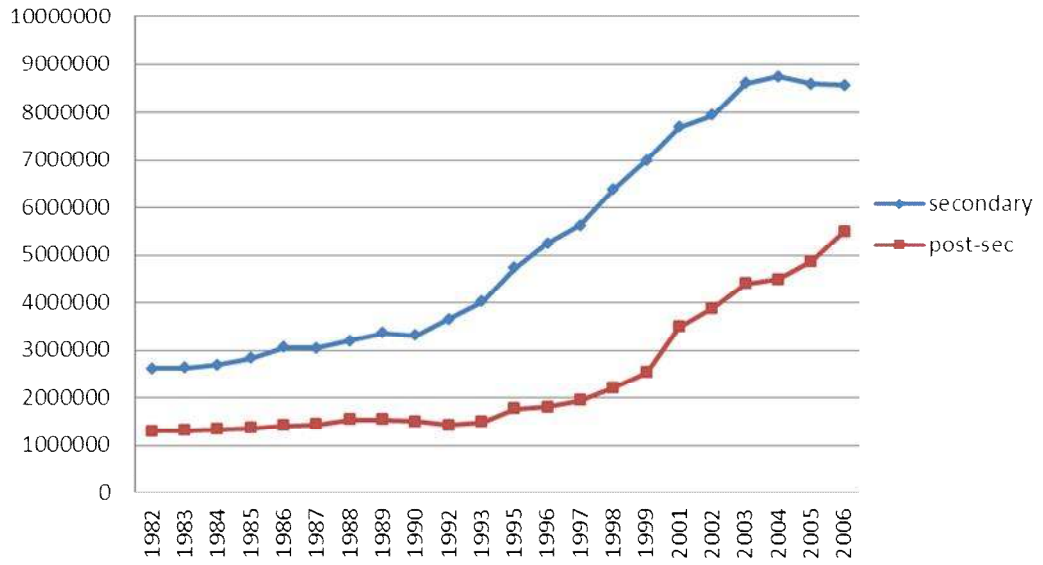
age group	18-22	1.264	0.011	118.91	**
	23-27	0.534	0.008	65.84	**
	28-32	-0.094	0.009	-10.01	**
	33-37	-0.336	0.012	-28.55	**
	38-42	-0.550	0.014	-38.59	**
	43-48	-0.817	0.017	-47.89	**
period	1982-1986	0.097	0.009	10.27	**
	1987-1990	-0.147	0.010	-15.11	**
	1992-1996	-0.069	0.009	-7.78	**
	1997-2001	-0.032	0.008	-3.97	**
	2002-2006	0.151	0.010	15.4	**
cohort midpoint by year of birth	1941	-0.355	0.044	-8.15	**
	1946	-0.273	0.035	-7.71	**
	1951	-0.153	0.027	-5.75	**
	1956	-0.042	0.020	-2.12	
	1961	0.059	0.013	4.4	**
	1966	0.068	0.010	6.72	**
	1971	0.239	0.010	25.03	**
	1976	0.309	0.008	37.02	**
	1981	0.199	0.009	22.38	**
	1986	-0.051	0.014	-3.53	**
	constant	-2.177	0.008	-261.78	**

Table 2: Age, period and cohort effects of participation in post-secondary education in Brazil. *

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1992	1993	1995	1996	1997	1998	1999	2001	2002	2003	2004	2005	2006
18	35.23	33.72	34.17	28.87	33.33	33.67	37.43	34.65	32.64	39.96	42.9	42.27	38.06	35.83	34.39	37.79	33.09	31.33	30.41	27.51	29.85	29.83
19	29.29	33.31	33.18	30.85	31.05	29.09	34.06	31.53	36.03	39.72	39.38	41.77	36.21	37.2	35.26	35.52	30.68	30.75	32.55	29.44	30.47	32.79
20	33.07	33.12	32.95	31.17	32.75	31.58	30.85	29.44	29.39	34.43	36.48	38.7	35.9	35.39	35.33	34.12	34.36	31.95	31.63	31.34	31.52	32.92
21	33.36	29.33	30.38	30.84	28.36	29.26	28.94	31.15	29.31	32.84	33.35	38.36	33.97	32.7	32.81	31.63	31.59	32.32	32.11	30.03	29.39	31.91
22	31.78	29.35	27.27	27.71	28.58	24.71	25.1	25.47	24.15	29.87	29.77	34.24	30.69	33.51	31.27	31.17	30.08	30.54	30.09	28.91	28.09	29.4
23	27.18	25.04	22.24	23.08	22.64	23.13	21.26	20.13	23.06	23.31	26.17	26.36	24.92	22.89	28.17	25.25	26.51	26.11	27.12	26.07	25.31	26.91
24	22.76	21.44	20.28	18.82	19.47	17.85	17.75	18.46	20.2	22.52	21	23.65	24.21	21.82	21.17	21.53	24.1	23.43	23.7	21.61	22.74	22.89
25	22.11	18.14	18.89	15.35	16.64	15.23	14.74	16.53	14.85	17.11	17.35	18.89	19.15	17.26	17.34	18.31	18.74	20.51	20.57	20.38	18.87	21.37
26	20.89	16.25	13.31	12.86	13.68	14.82	12.14	12.55	12.3	15.18	14.97	16.42	15.43	16.34	14.12	16.47	17.46	17.12	17.95	16.18	17.79	19.11
27	15.72	14.68	11.92	11.88	11.44	10.92	12.14	10.96	10.81	13.65	14.16	12.34	12.84	13.18	13.42	13.7	16.92	14.32	17.31	14.66	15.77	14.95
28	14.72	14.07	12.15	11.17	11.75	11.66	9.64	10.76	9.41	11.39	10.86	11.81	11.53	11.7	12.26	12.25	15.12	16.12	14.78	15.43	16.04	14.71
29	13.79	12.75	11.39	10.63	9.97	7.87	9.67	9.54	9.86	8.26	9.43	9.75	8.3	10.52	12.59	10.75	14.55	14.15	13.33	13.75	13.84	16.34
30	12.03	11.07	9.9	8.5	9.48	9.36	8.26	8.13	7.84	7.85	9.93	9.99	7.9	8.5	9.89	13.15	12.92	12.45	12.97	14.45	12.44	13.92
31	13.14	7.7	8.78	8.49	9.58	7.47	10.14	7.46	8.11	7.15	7.33	8.04	9.98	4.98	7.88	10.39	12.72	12.25	15.23	12.63	11.3	11.77
32	10.79	8.64	9.03	7.79	7.58	9.98	7.29	5.98	5.3	7.73	8.18	8.01	8.02	7.54	8.48	10.12	10.66	11.99	12.05	11.5	13.15	12.38
33	10.93	8.75	7.57	8.44	4.97	8.12	7.15	7.01	4.65	7.87	6.12	7.56	7.6	6.84	9.66	7.36	11.44	10.9	12.46	11.6	10.06	12.75
34	10.76	7.82	7.28	6.44	7.96	6.96	5.24	5.19	6.04	7.1	7.75	5.02	5.24	6.66	7.08	7.73	10.46	8.5	10.6	12.61	11.5	11.88
35	9.36	8.14	7.75	6.81	8.35	5.26	4.86	6.67	4.21	4.52	6.54	6.76	7.49	6.37	7.08	6.34	10.33	10.5	11.6	12.64	10.32	12.56
36	8.05	8.22	7.04	8.6	7.15	6.47	7.49	6.84	3.33	7.38	4.83	6.19	4.67	5.28	6.02	7.91	10.67	10.12	10.47	9.46	10.53	9.89
37	9.44	5.86	5.06	3.89	6.53	5.97	6.57	4.94	5.07	7.72	5.7	4.49	5.41	6.45	4.75	4.96	7.48	9.48	12.05	10.69	10.99	10.89
38	9.11	5.79	5.08	3.37	4.42	4.3	4.6	5.32	3.48	4.33	3.98	5.09	4.93	4.22	5.96	6.99	7.91	8.35	9.82	8.45	10.34	8.56
39	8.17	6.4	6.66	5.27	3.43	5.42	6.14	3.99	3.39	3.09	4.02	3.64	3.58	4.2	3.98	5.45	8.79	8.18	10.18	9.6	9.93	8.21
40	6.21	7.25	4.78	4.79	6.03	5.53	5.56	5.21	4.53	7.2	3.08	4.04	2.76	3.83	3.82	5.71	7.26	6.35	8.23	7.56	7.24	10.57
41	5.02	6.17	5.3	3.59	3.05	3.74	5.99	2.73	4.54	4.4	2.9	4.16	2.3	4.45	3.95	7.74	7.97	8.01	7.12	7.53	7.14	7.63
42	3.96	4.95	6.54	3.48	5.01	4.88	3.84	3.42	3.99	4.8	5.06	4.81	3.28	3.76	3.98	3.39	5.31	6.14	7.55	8.26	6.9	8.72
43	5.65	5.94	4.03	4.84	3.72	5.41	3.75	3.78	3.29	5.07	2.15	4.14	3.75	2.82	9.94	6.08	8.29	7.78	10.33	6.27	6.68	6.89
44	4.28	4.69	6.44	3.32	3.88	2.1	1.33	4.88	3.07	2.38	2.94	2.66	3.31	3.44	4.59	3.2	5.29	6.69	7.47	6.43	7.01	6.65
45	4.63	5.29	1.53	4.66	5.5	4.68	4.51	2.42	3.11	2.79	2.56	1.78	1.95	2.82	3.7	5.09	5.53	5.92	7.43	5.89	5.88	7.42
46	2.71	3.05	1.22	4.04	1.06	1	1.2	3.07	1.22	1.57	1.86	2.65	2.28	2.75	1.29	4.48	5.04	5.93	6.3	5.53	5.35	6.32
47	2.9	3.01	3.58	2.53	2.34	4.24	2.1	0.44	3.11	4	2.88	1.46	3.39	2.06	1.14	5.1	5.47	5.05	7.67	5.11	5.03	5.08
48	3.76	1.25	1.72	1.63	5.14	2.83	0.58	1.45	2.99	3.95	3.09	4.42	1.78	1.83	3.27	3.65	4.07	4.35	5.24	5.64	5	4.27

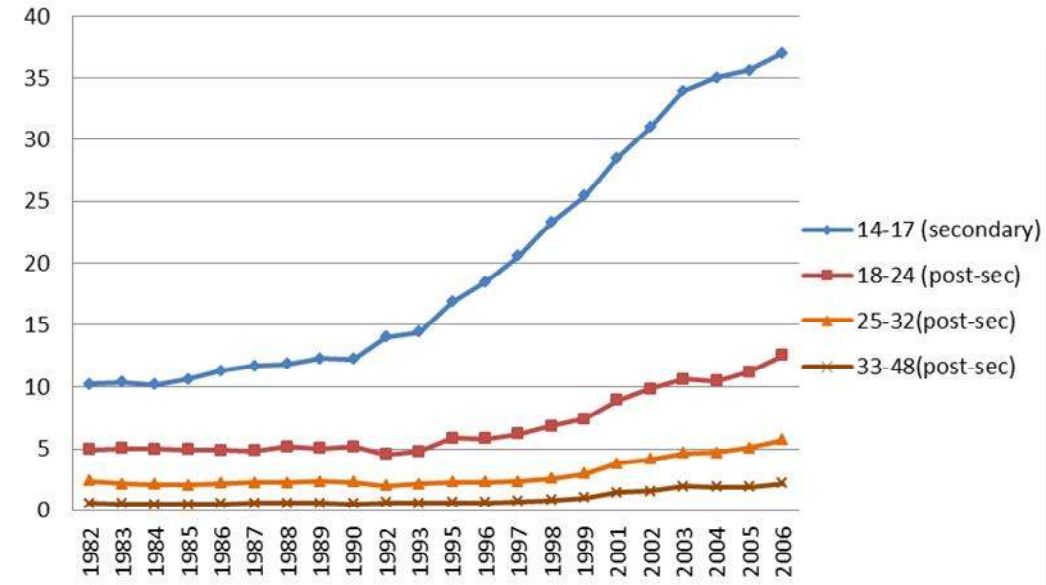
* Source: PNAD, IBGE

Graph 1: Raw enrollment in secondary and post-secondary education in Brazil (1982-2006)



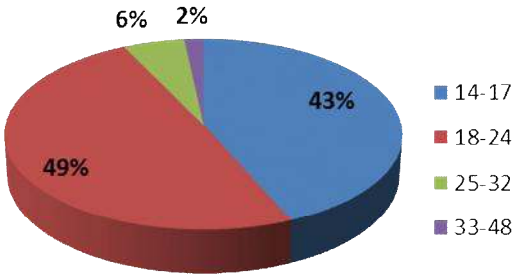
Source: PNAD, IBGE

Graph 2: Percent of Brazilian population on secondary and post-secondary educational levels according to age, 1982-2006.



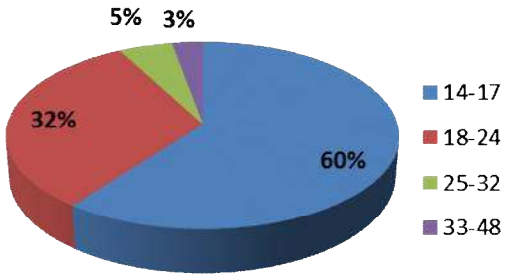
Source: PNAD, IBGE

Graph 3: Proportion of each age group within secondary education, Brazil 1982



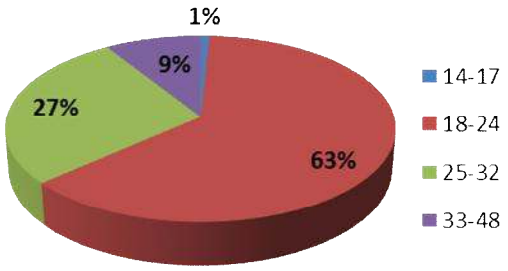
Source: PNAD, IBGE

Graph 4: Proportion of each age group within secondary education, Brazil 2006.



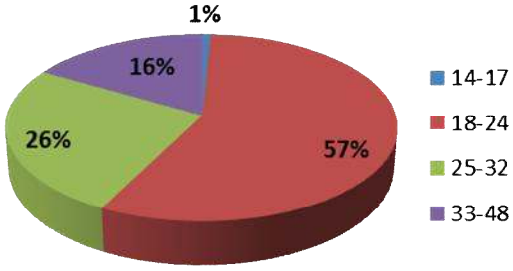
Source: PNAD, IBGE

Graph 5: Proportion of each age group within postsecondary education, Brazil 1982.



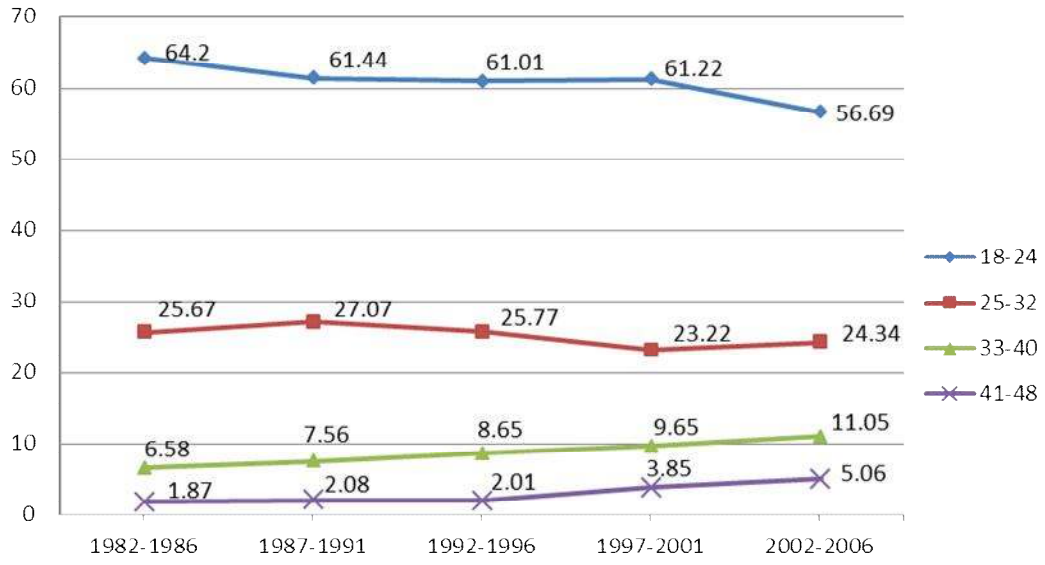
Source: PNAD, IBGE

Graph 6: Proportion of each age group within postsecondary education, Brazil 2006.



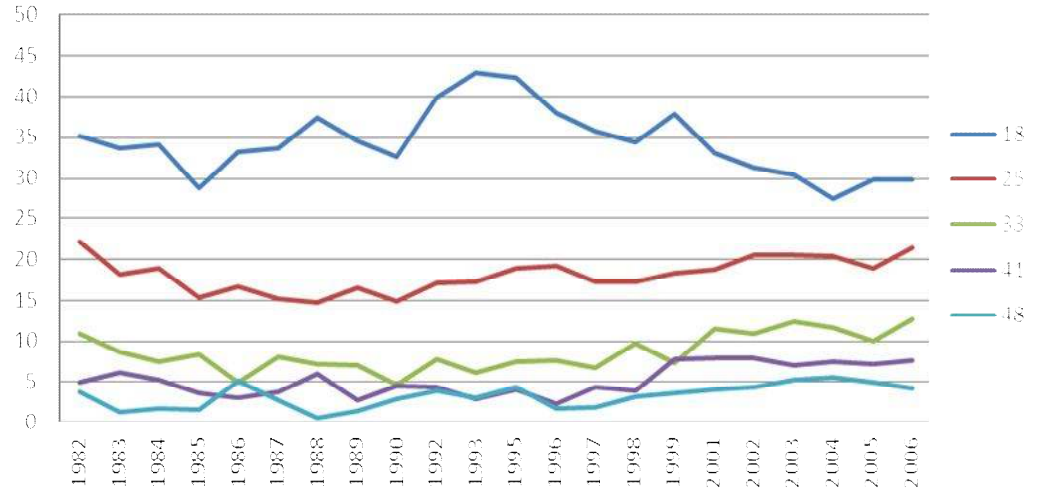
Source: PNAD, BGE

Graph 7: Percent of Brazilian post-secondary education population, by age cohorts, over time



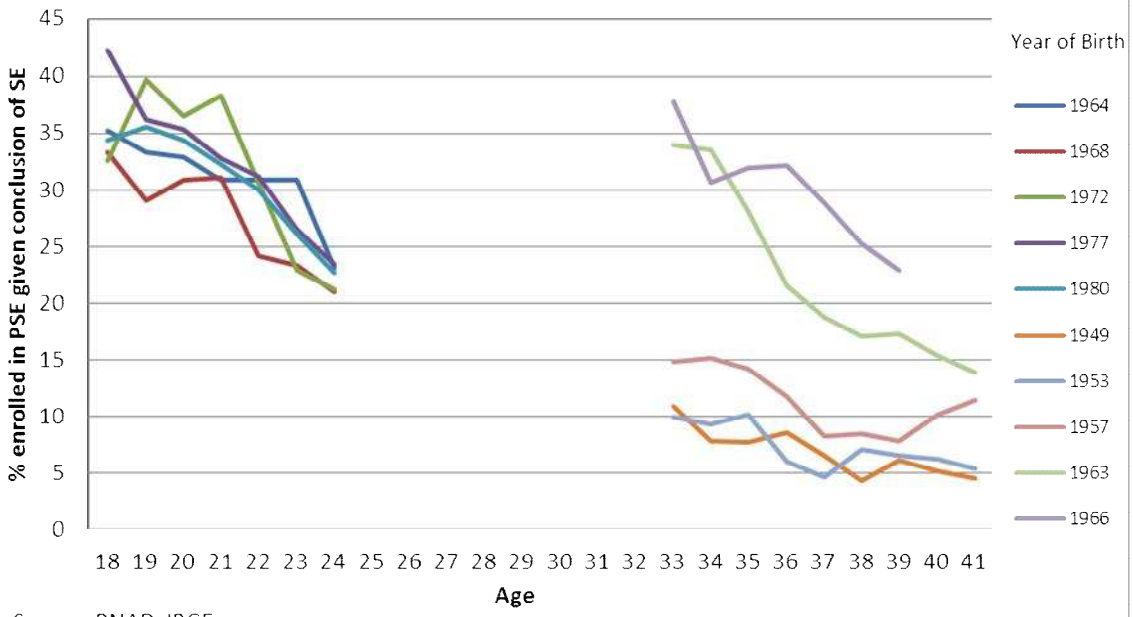
Source: PNAD, IBGE

Graph 8: Period effects in the probability of participation in post-secondary education in Brazil, 1982-2006.



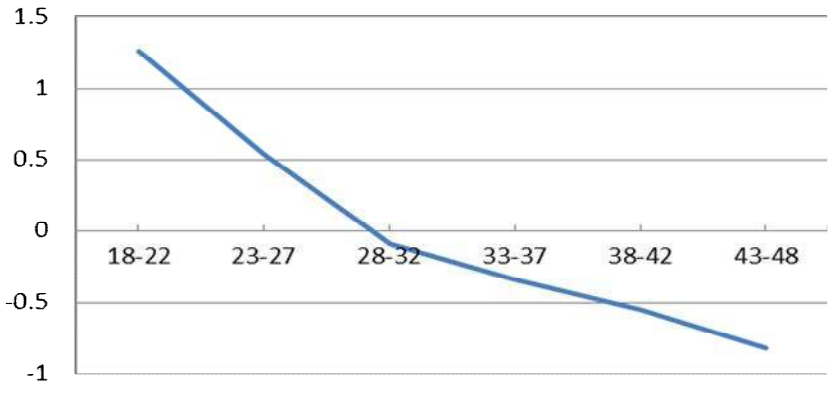
Source: PNAD, IBGE

Graph 9: Cohort effects for participation in post-secondary education in Brazil. Cohorts identified by year of birth, from 1949 to 1980.



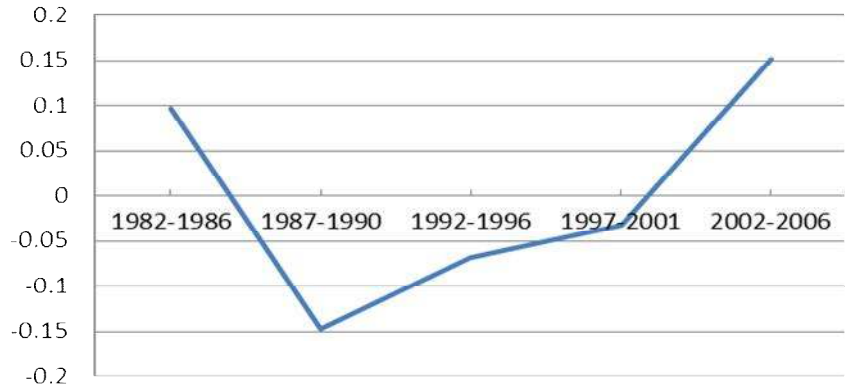
Source: PNAD, IBGE

Graph10: Probability of participation in post-secondary education in Brazil, 1982-2006, age effects.



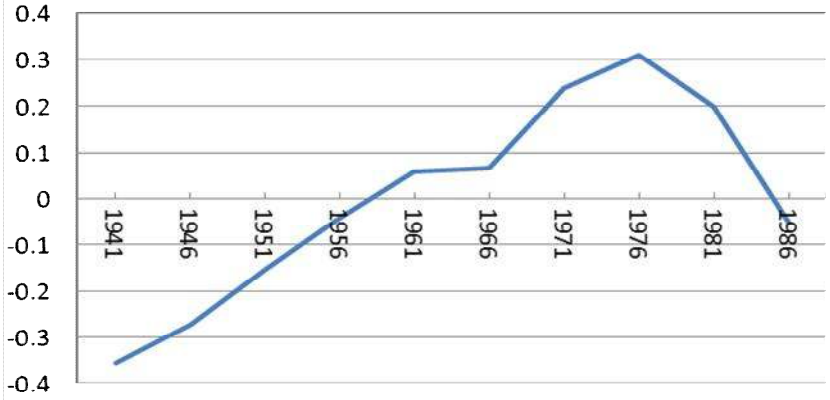
Source: PNAD, IBGE

Graph 11: Probability of participation in post-secondary education in Brazil, 1982-2006, period effects.



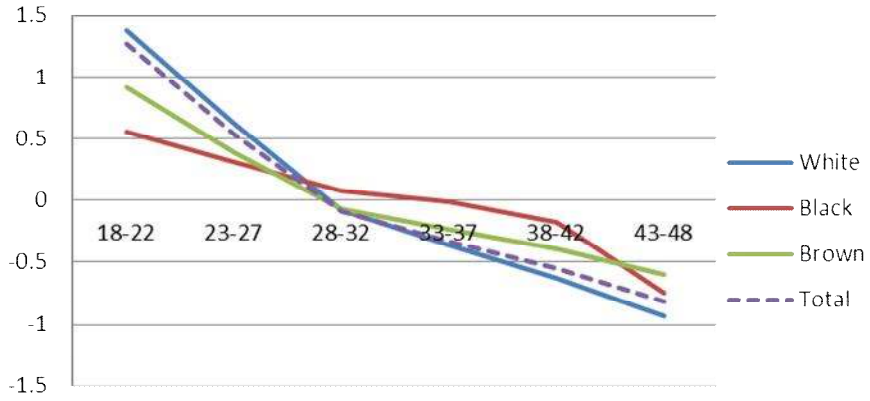
Source: PNAD, IBGE

Graph 12: Probability of participation in post-secondary education in Brazil, 1982-2006, cohort effects.



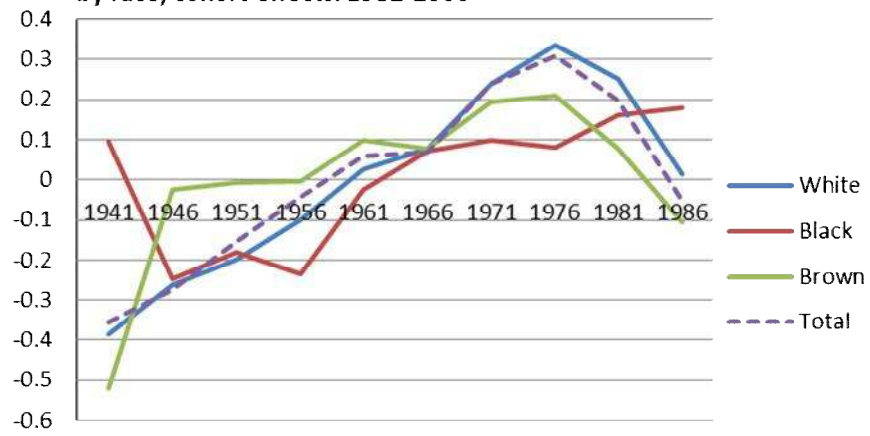
Source: PNAD, IBGE

Graph 13: Participation in post-secondary education in Brazil by race, age effects. 1982-2006



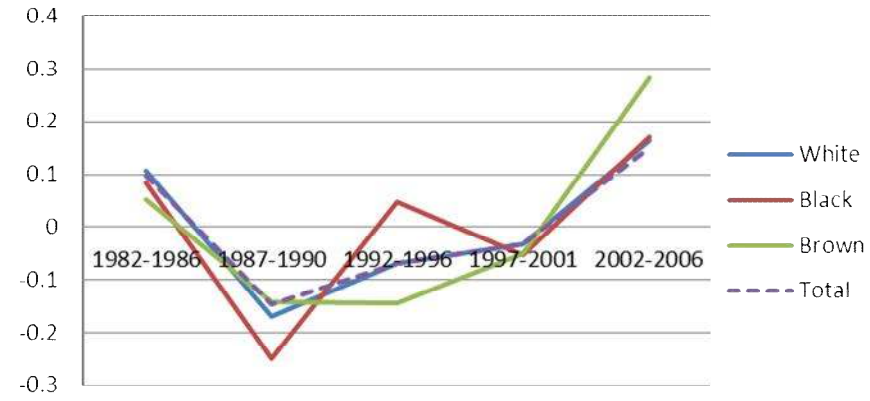
Source: PNAD, IBGE

Graph 14: Participation in post-secondary education in Brazil by race, cohort effects. 1982-2006



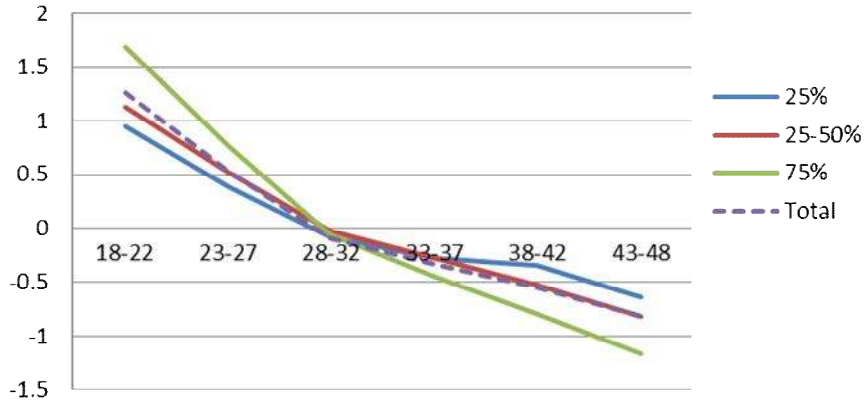
Source: PNAD, IBGE

Graph 15: Participation in post-secondary education in Brazil by race, period effects. 1982-2006



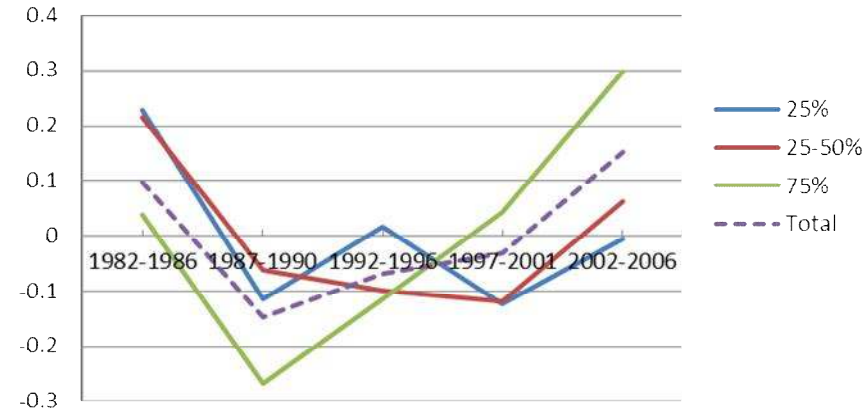
Source: PNAD, IBGE

Graph 16: Participation in post-secondary education in Brazil by family income distribution, age effects. 1982-2006



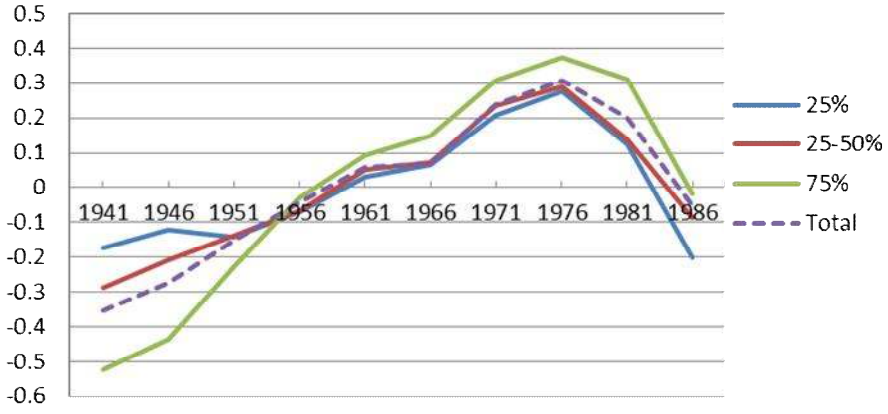
Source: PNAD, IBGE

Graph 17: Participation in post-secondary education in Brazil by family income distribution, period effects. 1982-2006



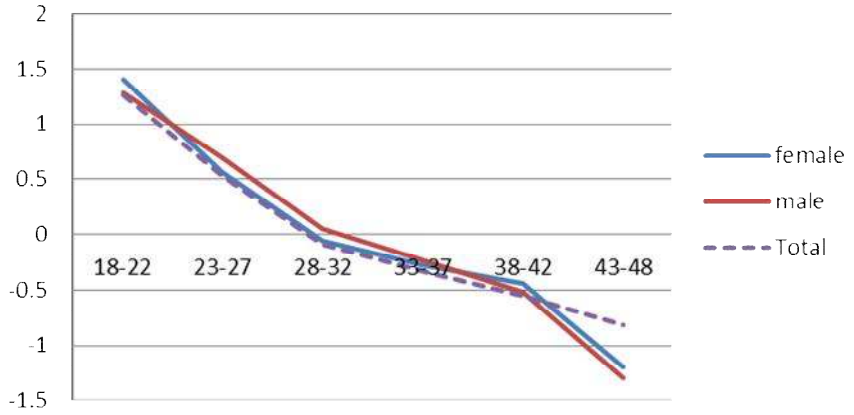
Source: PNAD, IBGE

Graph 18: Participation in post-secondary education in Brazil by family income distribution, cohort effects. 1982-2006



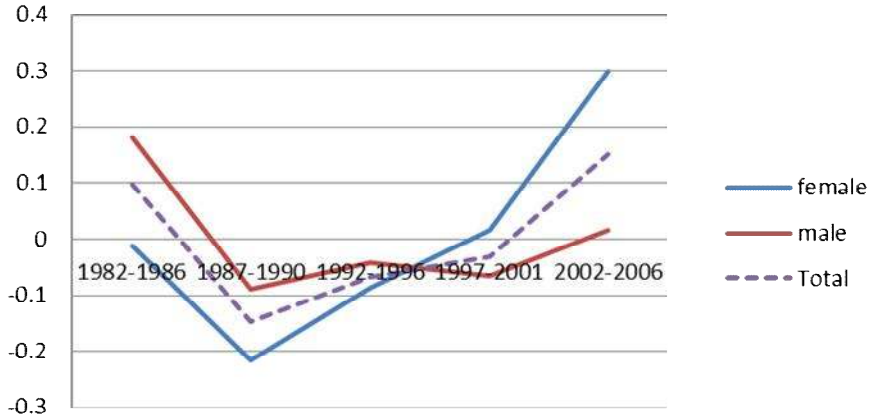
Source: PNAD, IBGE

Graph19: Participation in post-secondary education in Brazil by gender, age effects. 1982-2006



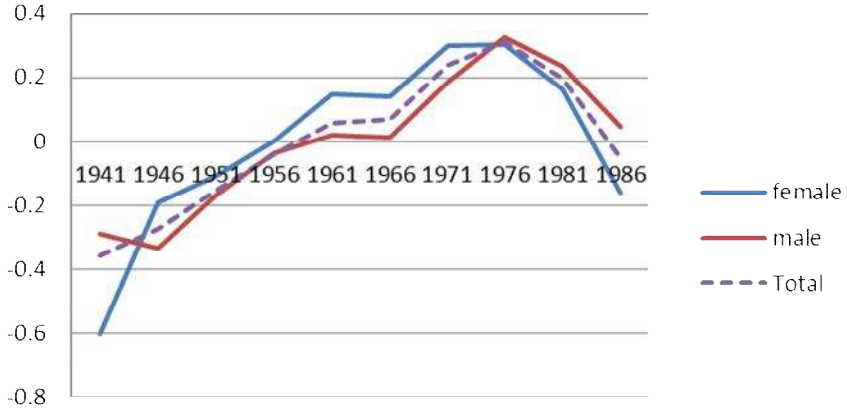
Source: PNAD, IBGE

Graph 20: Participation in post-secondary education in Brazil by gender, period effects. 1982-2006



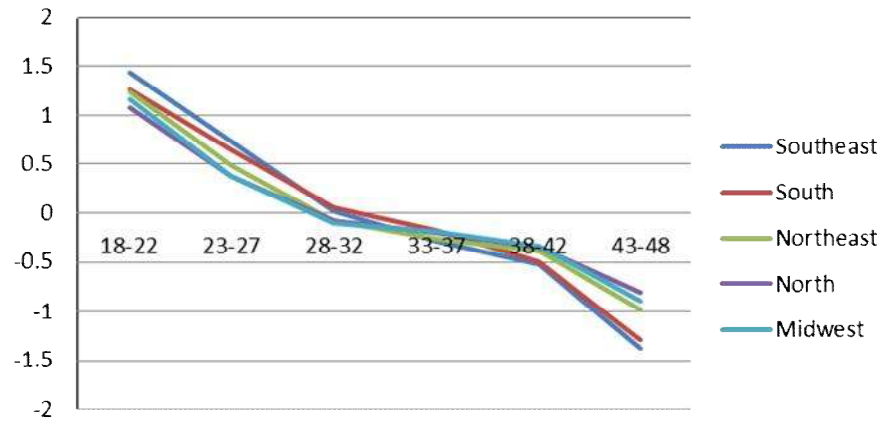
Source: PNAD, IBGE

Graph 21: Participation in post-secondary education in Brazil by gender, cohort effects. 1982-2006



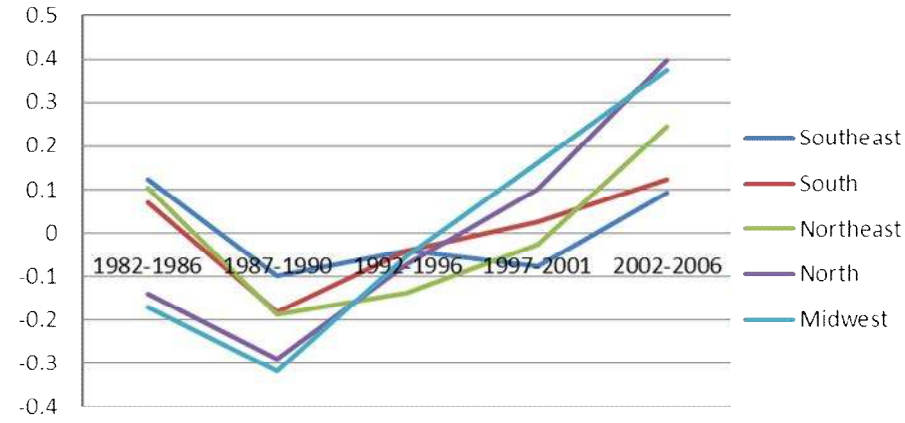
Source: PNAD, IBGE

Graph 22: Participation in post-secondary education in Brazil by region, age effects. 1982-2006



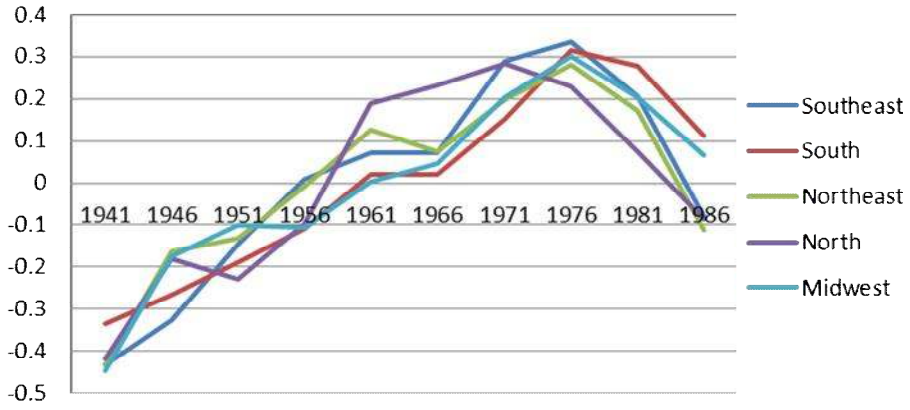
Source: PNAD, IBGE

Graph 23: Participation in post-secondary education in Brazil by region, period effects. 1982-2006



Source: PNAD, IBGE

Graph 24: Participation in post-secondary education in Brazil by region, cohort effects. 1982-2006



Source: PNAD, IBGE

Endnotes

[1] A preliminary version of this paper was presented at the conference of *the Associação Nacional de Pós Graduação e Pesquisa em Ciências Sociais* – ANPOCS, in 2009. In most part, the research that originated this paper was sponsored by CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), Ministry of Education, Brazil.

[2] Source: Instituto Brasileiro de Geografia e Estatistica - IBGE (Brazilian Bureau of Estatistics).

[3] Most of information about PNAD described here was taken from the codebook of the survey of 2005, translated and adapted to fit to the purposes of this section.

[4] From 1970, information started to be collected annually, with periodic interruptions in the years where there was a Demographic Census in Brazil (i.e., up to now, 1970, 1980, 1991, 2000 and 2010). Exceptionally, there was also no survey in 1994, for historical and economic reasons.

[5] Source: Instituto Brasileiro de Geografia e Estatistica - IBGE and Tocantins government website (http://to.gov.br/tocantins/2).

[6] See methods section.

[7] Adjusted weight: $$Adjwt = \frac{indwt}{\frac{\Sigma weights}{N_{year(i)}}}$$

[8] These calculations were based on the historical series provided by IPEA (Instituto de Planejamento economico e Analise), and available in Corseuil and Foguel, 2002.

[9] In this case, the variable *cohort* is not necessary. It is employed only for the analysis using the Intrinsic Estimator.

[10] Land, Kenneth and Yang, Yang (2007) "Distinguishing Age-Period-Cohort Effects." Didactic Seminar at the Annual Meetings of the American Sociological Association, New York, NY, August, 2007.

[11] See Schwartzman (2006) and Corbucci (2009) for a discussion of this "stagnation" of secondary education in Brazil.

[12] This might have been helped by the creation of the state of Tocantins in 1988.

[13] The lack of data in PNAD that distinguishes participation by sector of higher education before 2001 prevents me to investigate this issue further in this paper.