Financial Aid Policy and Higher Education Access:
A Statistical Analysis of International Indicators

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University of Houston Law Center/Institute for Higher Education Law and Governance (IHELG)

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Introduction

Many countries, both developing and developed, have struggled with the student financial aid policy issues associated with mass higher education in the recent decades. They have reformed their financial aid systems toward a global trend of privatization and tried to maximize the utilization of scarce resources to provide people, especially the economically disadvantaged, access to higher education on a reasonably equal basis. In this context, it is crucial to discuss the impact of these changes in financial policy on access to higher education in different countries in order to explore the relationship between financial aid policy and access to higher education. However, due to methodological limitations, comparative researchers have not reached common understandings with regard to whether the changes in financial aid programs (i.e., grant, loans) are related to the changes of college access across countries. To address this question and provide policy implications, this paper presents statistical analyses of international indicators for nations that consistently report education, public finance and demographic statistics to the Organization on Economic Cooperation and Development (OECD). This study is one of the first comparative projects employing a statistical method to analyze a cross-sectional and time-series panel dataset comprised of equalized international indicators on financial aid policy and college access.

In the first section, previous related literature is reviewed and the theoretical framework and analytical approach are illustrated. The second section introduces the dataset and methodology, while the third presents the results of analysis. Finally, some discussions and conclusions are drawn in the last section.
Literature Review

This section reviews the literature in English concerning the impact of financial aid policies on access to higher education in several countries. It is presented from two perspectives: content and methodology. The content-based literature review investigates trends and practices in the financial aid policies of both developed and developing countries, and focuses on how researchers approach the effects of financial aid policy in relation to access, including the economic (direct effect) approach and the student choice (indirect effect) approach. The methodology-based review summarizes the limitations of analytical approaches employed in existing comparative research.

Content-based Literature Review

Trends and practices of financial aid policy in developed countries. In the United States, some scholars have reached agreement on the positive effects of financial aid on college enrollment. For example, Heller (1996) examines how, in the U.S., tuition increases and financial aid influence the enrollment of students based on different income levels, race groups, and types of public higher education institution. According to Heller, tuition increases negatively influence college enrollments, particularly for low-income and minority students, indicating they are more price-sensitive to college costs. He concludes that financial aid has positive effects on access to college, particularly in the case of need-based grants. When comparing different types of financial aid, grants have a much greater effect on enrollment than student loans. St. John and Noell (1989) estimated the effects of financial aid offers on student enrollment decisions for three U.S. high school classes in the 1970s and 1980s. They separately analyzed the effects of each type of financial aid (grants, loans, and work study), along with a combination of two or more types of aid, controlling for students’ social background, academic
achievement, high school experience, and postsecondary aspirations. They concluded that all forms of financial aid had a strong positive impact on students’ decisions to enroll in college.

Although many European countries remain the bastions of “free” higher education, depending heavily on public financing, increased privatization and cost-sharing have become evident in recent decades. In the early 1990s, in Germany, Denmark, Greece and Luxembourg, free access to college was widespread, and grants were the most common form of basic assistance (EURYDICE European Unit, 1993; Psacharopoulos, 1992). However, in later years Germany, Luxembourg and Greece began to operate a mixed system of grants and loans, 18 other countries offered unconditional loans, and seven countries had means-tested or merit-based loans. More countries are charging or increasing tuition for domestic students or students within the European Union (Vossensteyn, 2004). For example, in 1998 the U.K. introduced higher education tuition fees and income-contingent loans\(^1\) (Barr, 2004). Against this trend, Sweden was the only country that increased the availability of grants, while charging neither tuition nor fees in the last decade (Vossenteyn, 2004). In 1985, Sweden introduced income-contingent loans that tied repayment to an individual’s income and increased the availability of grants to 30 percent of the total aid (Reuterberg & Svensson, 1994).

Many other Western countries were also adopting privatization and cost-sharing approaches by charging tuition and gradually replacing grants with student loans. Barr (1993, 2004) examines the financial policies of the U.S., Canada, Sweden, Australia, and New Zealand, and finds that overall college participation in those countries has increased since the introduction of loans. The author concludes that while the income-contingent loans in Australia, Sweden, and

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\(^1\) Income contingent loans are different from ordinary loans to students in having no fixed interest and repayment terms. If loans are not income contingent, then they lack means of equalizing opportunity (Lleras, 2004)
New Zealand did not compromise student access to higher education, the mortgaged loans\(^2\) of the U.S. and Canada resulted in student indebtedness and high default rates.

While comparative scholars find that changes in student support programs are often related to changes in college access, they realize that differences in the effects of financial aid systems is more evident among low-income students in many countries. Reuterberg and Svensson (1994) reveal that student financial aid, both grants and loans, has had a positive impact on increasing the number of students entering higher education, especially in recruiting female and low-income students in Sweden between 1970 and 1990. Conlon (2006) finds that recent policies in Canada, such as the deregulation of tuition fees in universities, the reduction of direct expenditures on education, and the shift from direct federal expenditures to education-oriented tax credits, have all resulted in a decline in the college participation rates of low-income students. However, Palfreyman (2004) compares the U.S. and U.K. higher education systems and finds that the U.S. high-fee, mixed economy, and public-private higher education system recruited more poor students than the U.K.'s low-tuition and nationalized-industry higher education system.

*Trends and practices of financial aid policy in developing countries.* Several developing countries introduced tuition fees and student loans as a means of financing higher education while overcoming public financial austerity. In Russia, attending universities is legally free, but the dual tuition program (free higher education for the regularly admitted, state supported students, and a special tuition-paying track) allows up to one-half of all Russian university revenue to come from tuition and fees (Johnstone, 2004). Most Sub-Saharan African countries introduced tuition and fees and student loans in higher education (Johnstone, 2003b). In India, due to the continual financial constraints of the government, higher education has been

\(^2\) Unlike income contingent loans, mortgaged loans impose repayment burdens in fixed installments over a fixed period (Barr, 1993)
increasingly subsidized by non-government money, including household expenditure, fees, student loans, and voluntary contributions (Tilak, 1993). In 1986, China introduced fees and student loans, while tightening the criteria for securing grants and scholarships (Li & Bray, 1992). Due to their interest-free nature and the fact that certain conditions such as academic merit waived the duty to repay them, the loans functioned as a hidden grant and subsidy and, in a socialist system, resulted in little income difference between college graduates and non-college graduates. While successfully implemented in developed countries, student loans might not be successful in developing countries, due to differences in socio-political climate, lack of necessary economic infrastructure, and the absence of carefully designed programs. Many researchers predict that the poor readiness for systems of cost-sharing and privatization could potentially result in student indebtedness, low repayment rates, and systemic problems in the administration of loans. Additionally, it is difficult to assess the effectiveness of the financial aid policies in developing countries.

In general, most of the previous research focused on the effects of financial aid policy in a single country, and only a few studies conduct an international comparison of the effects of student aid policy on college access. The research shows that increasing tuition has had a negative impact, and that grants have a greater positive effect on college enrollments than student loans do, especially for low-income and minority students. Furthermore, researchers find that in Australia and Sweden income-contingent loans have had a positive impact on low-income students’ access to college.

*Methodology-based Literature Review*

In the U.S., the roles of the federal and the state governments expanded in funding student access over the late 1960s and early 1970s. In 1973, the report of the National
Commission on the Financing of Postsecondary Education (NCFPE) and the following staff report by Carlson et al. (1974) laid out a comprehensive analytical framework with emphasis on using a database and an analytical model. The analytical framework provides an instrument that can estimate the enrollment and financial changes likely to occur as a result of changes in financing policies over the subsequent decades and can significantly improve the quality of policy makers' decisions about the financing of postsecondary education. To a certain degree, these reports have shaped the methodology of ensuing American studies. The interrelatedness between factors in the student decision-making process informs the analytical model and allows the incorporation of mathematical methods, particularly statistical methods (Dresch, 1975; St. John, 2003). In spite of weaknesses, compared to other countries the methodology of American studies has been by far the best at examining and evaluating the effectiveness of financial plans on access. However, comparative scholars have rarely stated this clearly, and the existing methodology of comparative studies relies much on the interpretation of past American studies.

While American researchers often reveal significant relationships between student aid and access, comparative studies have failed to establish such relationships. For example, in the U.S. literature, affordability is found to be positively associated with accessibility (Hansen, 1983; Hossler, et al., 1997; McPherson & Schapiro, 1991; St. John, et. al., 2001; Wallace, 1993). The comparative scholar Vossensteyn (1999) ranks the affordability of higher education systems in nine Western countries (Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the U.K.) without explicitly stating whether higher college participation rates are related to higher levels of affordability. The author concludes higher education is considered the most affordable in Denmark and Finland due to the availability and considerable cost coverage of direct student support for most students, whereas Austria, Belgium, and the U.K. show the
lowest affordability because direct support was available to a relatively small number of students and covered only a small portion of the costs. In a large-scale comparison on the effects of financial aid and ranked student affordability, Usher and Cervenan (2005) attempt to link affordability to accessibility in their comparison of 15 countries (Australia, Austria, Belgium, Britain, Canada, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Sweden, and the U.S.), but find this relationship to be weak or even non-existent. They reveal that Finland and the Netherlands are the most affordable; both countries provide generous grants and reasonable, though limited, loans for a large number of student, achieving high attainment rates. The U.S., Canada and Australia lag behind Europe due to higher college costs despite high provision of student aid, and the U.K. and New Zealand are the least affordable due to high costs. However, in Usher and Cervenan’s study (2005) the links between accessibility and affordability seem unclear, and their affordability ranking is quite different from Vossensteyn’s (1999) largely due to methodological differences.

By comparing the methodology of current comparative studies with the well-developed American research, we find the following limitations in current comparative methodology. First, variables and measurements are poorly-defined. For example, while Vossensteyn (1999) imports the definition of affordability from the U.S. into his comparative research, he modifies its measurements and overlooks many crucial factors in affordability (i.e., family income and social background). Second, the databases in existing comparative research contain inadequate information, and cross-country time-series databases are not available. Missing data, misclassified measurements, non-internationalized or non-equalized variables have affected the comparability of the data and reduced the reliability of the research. Furthermore, most comparative studies use the surveys, statistics and reports of a single country or regional
institutions as their source of information (i.e. Johnstone, 2004; Tight, 1991). Even though some scholars use a set of cross-sectional time-series datasets published by international agencies such as UNESCO (United Nations Educational, Scientific and Cultural Organization), OECD and World Bank, these newly launched datasets span very few years and misclassify some measurements. For example, need-based aid (grants) and merit-based aid (scholarships) in OECD publications are classified into the same category, while many researchers agree that grants exert a greater effect on student access than scholarships, especially for low-income students (Heller, 2001; Vossensteyn, 1999). Third, no analytical models or statistical methods are used in current research. It is important to note that most comparative studies are descriptive, without an analytical model, and only a few studies contain some trend data analysis and simple mathematical techniques. With regard to the effectiveness of financial aid programs, descriptive analysis (e.g., Johnstone, 1998, 2004; Lleras, 2004) is suggestive only, not definitive. Further, simple trend data analysis or mathematical methods can hardly capture the interrelationship of financial aid programs with other factors that affect student decisions on enrollment. For example, the studies of Usher and Cervenan (2005) and Vossensteyn (1999) attach different weights/values to various financial aid programs according to their ability to lower the financial barriers to college access. However, such arbitrarily assigned values, for instance the effect of grant = 2* loan (Vossensteyn, 1999), can rarely reflect the actual influence of these two aid programs across groups of students from different economic levels, much less the changes over time. The use of pooled cross-sectional time-series data for international countries is expected to better capture the variations in the level of higher education enrollment (Stimson, 1985).

Due to these limitations, there are many disagreements and inconsistencies among comparative studies on the relationship of financial aid and college access, for example, the
rankings of student affordability across countries (Usher and Cervenan, 2005; Vossensteyn, 1999). Until the present, it has been argued that the relative affordability of a higher education system can be determined by using objective and quantitatively measurable criteria only (Johnstone, 2004). Therefore, in order to establish a sound relationship between financial programs and access across countries, statistical methods, an analytical model with appropriate control variables, and time series databases are indispensable.

**Theoretical Framework**

Our theoretical framework is built upon the key themes emerging from the current comparative literature and composed of three major theories: privatization theory (St. John, 2006), cost-sharing theory (Johnstone, 1998, 2000, 2003, 2004; Rasmussen, 2006), and human capital theory (Lleras, 2004). They provide an insightful foundation for understanding the rationale, trends, and impacts of international financial aid policies on college access and opportunity.

First, the strategies toward privatization of higher education are characterized by the gradually reduced public financial support for higher education systems (St. John, 2006). The increasing trend toward privatization in higher education is due to increasing resistance from taxpayers which necessitated the shift from public subsidies and low tuition policies to high tuition and student loans. Secondly, cost-sharing theory, which depicts the global trend of shifting an increasing percentage of educational costs from governments and taxpayers to individual students and their families, is influencing higher education financial policy (Rasmussen, 2006). This approach leads to increases in tuition and fees, the freezing or diminution of student support grants, the channeling of more students into a tuition-dependent private sector, and the introduction of student loan programs (Johnstone, 2003). In particular, student loans are gaining
popularity as an effective means of subsidizing higher education, gradually replacing grants and scholarships (Barr, 1993, 2004; Johnstone, 2003; Rasmussen, 2006). Thirdly, the human capital theory focuses on individual payment for one’s own education as an investment in terms of individual returns in the labor market, through increased future income. Specifically, human capital contracts, an income-contingent loan strategy, could reduce the need for government subsidies and promote equal college access (Lleras, 2004). The theory quantifies the social returns for the public and individual gains associated with a college degree, supporting the belief that higher education is a more profitable investment for the individual than for the public.

Analytical Approach

From the methodology-based literature review, it is clear that a well-built database is one of the prerequisites for quality comparative research. The database should provide common grounds for comparisons, using the same structure, the same set of assumptions about important factors, and the same information base about students, institutions, and financing sources. Another prerequisite is a good analytical model with appropriate statistical methods. In order to examine the impact of financial aid policy on college access, this study employs: 1) a cross-sectional (29 countries) time-series (6 years) panel database comprised of internationalized or equalized information; 2) an analytical model widely used by American researchers, including the main financial aid policy variables (grant/scholarship, loans, and institutional expenditure) and appropriate control variables (demographics/population, national economy, and secondary education level); and 3) appropriate statistical methods, that is, fixed and random effect models, to analyze the panel dataset.

Research Questions
This study aims to investigate the relationship between financial aid policies, such as scholarships and grants, student loans, and public expenditures on higher education institutions, and college access in 29 OECD member countries between 1998 and 2003 (Luxembourg is excluded due to too much missing data). The 29 countries are Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden Switzerland, Turkey, the United Kingdom and the United States. Specifically, our research question is:

Are the changes in scholarship and grants, student loans, and public expenditures on institutions of higher education related to tertiary enrollment ratios, after controlling for national economy, educational level, and population characteristics?

Methods

Dataset and Variables

The dataset used in this study is drawn from the online annual data collections of two international organizations, Education at a Glance 2000-2006 from the OECD and World Development Indicators (WDI) from the World Bank. In addition, the published database by the Institute for Statistics of UNESCO is used to examine the consistency of these indicators. From these sources, we selected 10 variables for our study (see Appendix 1, Definitions of the Variables and Data Sources).

This cross-country, time-series (panel) dataset includes data from 29 OECD countries collected from 1998 to 2003. Thus, the number of observations used in our regression models is 174 (29 countries by 6 years) before accounting for missing values.
The dependent variable is tertiary Gross Enrollment Ratio (GER), a combination of tertiary-type A and tertiary-type B education, which is calculated based on the number of young people in the five-year age group following the secondary school leaving age. According to the International Standard Classification of Education (ISCED) defined by UNESCO, Tertiary-type A education programs are largely theory-based and designed to provide sufficient qualifications for entry into advanced research programs and professions with high skill requirements, such as medicine or architecture. Tertiary-type A programs have a minimum cumulative duration of a three-year full-time equivalent at the tertiary level, although typically lasting four or more years. Tertiary-type B programs are typically shorter than those of tertiary-type A and focus on practical, technical or occupational skills for direct entry into the labor market. Their minimum duration is a two-year full-time equivalent at the tertiary level.

The main financial policy variables include scholarships/grants, student loans, and public institutional expenditures, which have been considered in prior research (i.e. Heller, 1996; Reuterberg & Svensson, 1994; Vossensteyn, 1999). The scholarships/grants are defined by OECD as being based on a percentage of total public expenditure on education and GDP. Student loans are reported without subtracting or netting out repayments or interest payments and measured as a percentage of total public expenditure on education and GDP. Based on the findings in the literature, we expect these financial aid programs have effects on tertiary enrollment. We also include the public institutional expenditure percentage relative to the sum of total private and public resources on institutions to examine the effects of cost-sharing on tertiary enrollment (Johnstone, 2003b).

In prior research with single country analyses, the socioeconomic variables (e.g., individual SES), personal demographics (e.g., race, gender, age), and secondary school
performance are often controlled to isolate the influence of student financial aid policy on
college enrollment (Heller, 1996; Reuterberg & Svensson, 1994; St. John & Noell, 1989; St.
John & Paulsen, 2002). Instead of individual SES, we use national Gross Domestic Product
(GDP) per capita for each country (in constant 2000 U.S. dollars) in our analysis to control for
socioeconomic differences among the countries. The substitution of GDP per capita is
appropriate because it roughly reflects the average income of a country’s citizens as well as the
country’s economic strengths and needs. Regarding demographics, although we have not found
an evident relationship between population and college enrollment in educational literature we
expect that the demographics of OECD countries characterized by aging and stagnant population
growth rate have critical effects on human capital growth (Lindh & Malmberg, 1999).
Therefore, we add three demographics variables into our model: population size, annual
population growth rate, and percentage of population 65 years and older. To control for the
possible influence of secondary school factors, we include gross secondary enrollment ratio of
the school-aged student group (12-17 years old) and the percentage of the population 25-34 years
old that has attained at least upper secondary education. It is worthy to note that because the
panel dataset covers six continuous years from 1998-2003, the two secondary education
variables are measured in non-overlapping age groups.

The histograms of the variables suggest that the distributions of total population and GDP
per capita are both positively skewed. To meet model normality assumption, we transformed the
data as appropriate to reduce skewness. The distributions of other variables are about normal.

Statistical Model

The cross-sectional time-series (panel) data design is superior to most previous analyses
that use a single-year cross-sectional dataset or only time-series data within a single country in
that each country has different forms of financial aid policy and the policy in each country has changed over time. Panel data may have group effects, time effects, or both. Two frequently employed models of panel data design include fixed effects models and random effects models. Depending on different assumptions about the systematic part of the equation and/or about the error terms, the choice of an appropriate model is contingent on the results from diagnoses of the error terms (Park, 2005). A fixed effect model (here we use a least square dummy variable (LSDV) estimation method), estimates a separate intercept for each country or time, whereas a random effects model explores differences in error variance. Generally, the functional forms of one-way panel data models are as follows:

One-way fixed group effects model:

\[ y_{it} = (\alpha + \mu_i) + X_{it}'\beta + \nu_{it}, \quad \text{where } \nu_{it} \sim IID(0, \sigma^2_v) \]

One-way random group effects model:

\[ y_{it} = \alpha + X_{it}'\beta + (\mu_i + \nu_{it}), \quad \text{where } \nu_{it} \sim IID(0, \sigma^2_v) \]

Here, \( i \) denotes the group, \( t \) denotes the time. The dummy variable \( \mu_i \) is a group specific constant term and a part of the intercept in the fixed effect model, where \( \alpha \) represents the intercept and \( \nu_{it} \) represents the remainder error terms. In the random effect model, \( \mu_i \) is a part of error terms and it is assumed independent of \( \nu_{it} \) and \( X_{it}' \), which are also independent of each other for all \( i \) and \( t \), \( \mu_i \sim IID(0, \sigma^2_{\mu}) \). \( X_{it}' \) is the observation of \( i \)th group at time \( t \) on regressors. The assumption \( \nu_{it} \sim IID(0, \sigma^2_v) \) indicates that errors are Independent and Identically Distributed (IID).

The treatment of the country effects is crucial in this study because our research interests and their policy inferences are based on the country.
On the one hand, we could estimate a one-way fixed effects model by treating country effects as fixed because an unobservable individual unit effect may exist across cross-sectional units. Such unobservable effects, $\mu_i$, can reflect some time-invariant heterogeneity among countries such as underlying aspects of national culture, educational values that may influence a citizens' access to and spending patterns on higher education, and an historical background that shapes educational institutions and policy systems. The fixed effects model provides inference conditional only on the given sample of 29 OECD countries. We assume heterogeneous intercepts for different countries, but homogenous slopes.

On the other hand, we could also treat country effects as random, with the selected countries regarded as random draws from a larger population or scope of countries which have comparable achievements in economy and education with OECD members, including Luxemburg within OECD and other non-OECD countries (e.g., Lithuania, Latvia, Chile, Russian Federation, etc). It allows some inference on a larger population and provides more efficient estimators if they meet the additional important requirements of being independent of the exogenous variables in the equation. In this paper, the possibilities of both models are examined.

Besides country effects, we recognize that time may potentially influence the dependent variables and correlate with the exogenous variables in the dataset. For example, student loans, GDP per capita, total population and percentages of those 65 years and older, have an apparent tendency to increase annually from 1998-2003. Therefore, including the time effects into fixed or random group effects models can provide a more powerful study with both spatial and temporal dimensions. We use the following equation to estimate the effects of different financial aid policies and other factors on the tertiary enrollment ratios:
\[ y_{it} = \alpha + \sum_{i=1}^{n} \beta_i \mu_i + \beta_T t + \sum_{k=1}^{K} \beta^{(k)} X^{(k)}_{it} + \epsilon_{it} \]

The notations used in this formula are:

- \( n \): the number of countries, where \( i (=1, 2, \ldots, n) \) denotes a country; \( i_0 \) is the country excluded as reference group;

- \( T (=6) \): the total number of time periods, where \( t = 1, 2, \ldots, 6 \), corresponding to 1998, \ldots, 2003, respectively, denotes the year;

- \( K \): the total number of regressors excluding dummy variables, where \( k=1, 2, \ldots, 9 \), denotes the \( k^{th} \) regressor

- \( \beta_T \): the time effect

- \( X^{(k)}_{it} \): the regressors, where \( X^{(1)}_{it} = \) Percentage of 65-year-old in the population, \( X^{(2)}_{it} = \) population annual growth rate, \( X^{(3)}_{it} = \) total population, \( X^{(4)}_{it} = \) GDP per capita,

- \( X^{(5)}_{it} = \) Gross secondary enrollment ratios, \( X^{(6)}_{it} = \) Upper-secondary education attainment rate in the 25- to 34-year-old population, \( X^{(7)}_{it} = \) Scholarship/grants to household, \( X^{(8)}_{it} = \) Student Loans, \( X^{(9)}_{it} = \) Percentage of public tertiary expenditure.

- \( \epsilon_{it} \): the error term with two dimensions, one for the country and one for the time period.

This equation is the general form of our model. By varying the structure of this equation, the following Model 1 through Model 5 can be fitted using the STATA 9.0 software: 1) disregarding the time effect \( \beta_T t \), we estimate a one-way random effects model by placing \( \Sigma \beta_i \mu_i \) as a part of error terms (Model 1) and a one-way fixed group effects model by placing \( \Sigma \beta_i \mu_i \) as a part of intercept (Model 2); 2) we consider the time item \( \beta_T t \) as a continuous variable with increasing numbers of years and add it into Model 1 and Model 2 as an exogenous regressor, then we estimate a new one-way random group effects model (Model 3) and a new one-way fixed group effects model (Model 4); 3) we then treat the time item \( \beta_T t \) as dummy variables and
estimate a two-way fixed group and time effects model (Model 5). We report results for both fixed effects and random effects models, and the results were tested using Hausman test, which hypothesizes that there is no correlation between $\mu_i$ and the exogenous variables. Finally, for Models 3, 4 and 5, we examine whether the estimation is improved after including both time and group effects into the model by checking predicted values and residuals patterns.

Both fixed and random effects models have pros and cons. Fixed effects models may have too many cross-sectional or time-series units of observations that require too many dummy variables (28 country dummies plus 5 time dummies) for their specification. Thus the models use up too many degrees of freedom for powerful statistical tests (Helms, 1985). A model with many dummy variables may have multicollinearity problems, which means several independent variables are highly correlated (Mairesse & Sassenou, 1991). Another big disadvantage of fixed effect models is that the residuals are assumed to be normally distributed and homogeneous, but there could easily be country-specific heteroskedasticity or autocorrelation over time that would plague estimation. If group effects are uncorrelated with the group means of the regressors, it is probably better to employ a more parsimonious parameterization of the panel model. A random effects model is appropriate when dealing with a large number of countries, and it is asymptotically efficient relative to the fixed effects model (Gustafsson & Johanson, 1999). A random effects model has the distinct advantage that it could capture the between-group variation, and if the between-group variation did exist, serial correlation can also be captured. Random effects also allow us to make some unconditional inferences about a larger population.

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3 The Hausman specification test compares the fixed versus random effects under the null hypothesis that the individual effects are uncorrelated with the other regressors in the model (Hausman, 1978). Hausman’s essential result is that the covariance of an efficient estimator with its difference from an inefficient estimator is zero (Greene, 2003). $m = (b_{\text{Robust}} - b_{\text{Efficient}})' \Sigma^{-1} (b_{\text{Robust}} - b_{\text{Efficient}}) \sim \chi^2(k)$, where $\Sigma=Var(b_{\text{Robust}})-Var(b_{\text{Efficient}})$ and $k$ is the number of regressors.
Limitations

This study has a few limitations. First, we select our variables of interest from all available databases published by the two international organizations. However, since some important variables (i.e. tuition) are not available in these databases, they are not taken into consideration in the model. Second, the sample contains considerable missing values for some variables, necessitating the deletion of some cases during the regression analysis. Since the mechanism of the missing values is assumed to be completely at random, we imputed missing values by substituting the data of the previous year or the mean value of the previous year plus the year after, in order to secure enough cases. Finally, the relatively small sample size (n=174) and non-representative country selection (OECD countries) might make it difficult to generalize the results to developing and less developed countries.
Findings

Descriptive Results

Figure 1. The individual and mean profiles of Tertiary Gross Enrollment Ratios (GER) from 1998-2003 (Number of Country =29, N=160)

Figure 1 presents both the individual country profile over time and the overall trend of tertiary enrollment ratios using non-parametric spline smoothing. As we can see, tertiary enrollment ratios increase following an approximately linear trend either at the group level or on average. The large within-group and between-group variations are observed at the baseline year 1998 and the follow-up years. In particular, the magnitude of increase in the enrollment ratios

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4 Spline smoothing provides a natural and flexible approach to curve estimation. The term "spline" is used to refer to a wide class of functions used in applications requiring data interpolation and/or smoothing. Spline functions for interpolation are usually determined as the minimizers of suitable measures of roughness subject to the interpolation constraints. Smoothing splines may be viewed as generalizations of interpolation splines, where the functions are determined to minimize a weighted combination of the average squared approximation error over observed data and the roughness measure. As in almost all non-parametric smoothing methods, there is a smoothing parameter which determines how much the data are smoothed to produce the estimate (Silverman, 1985).
from 2000 to 2002 is obviously larger, while the increase is more stable in the time periods of 1998-2000 and 2002-2003. This pattern may hint that both country and time effects should be included in the model.

Table 1 summarizes the descriptive statistics and trend data on all variables across 29 countries over 1998-2003. The average gross tertiary enrollment ratios in OECD countries are about 53.41 percent over the six years, on average increasing by one to two percent annually. With regard to financial aid policy variables in general, while the scholarships/grants to households and percentage of public tertiary expenditure on institutions are undergoing a slight decline, student loans have undergone a remarkable increase in the six years (see appended Figure 2). More precisely, the average proportion of scholarships/grants account for about 9.92 percent of the total public expenditure on education and GDP, slowly dropping annually. Conversely, the average amount of student loans has increased each year, but exhibited the largest variance among the 29 countries (mean=6.42, SD=8.63). The decline in scholarships/grants and increase in loans seems to be consistent with the previous literature, which indicates the gradual replacement of student loans for grants in developed countries (Barr, 2004; Conlon, 2006; Vossensteyn, 2004). Although the proportion of public tertiary expenditure of the total tertiary expenditure on institutions is relatively high (mean=78.15%), it tends to decrease gradually, indicating that private sources on tertiary education are increasing. The changes in public expenditure seem to be consistent with the global trend of privatization and cost-sharing (Johnstone, 1998, 2000, 2003, 2004).

As for demographic characters of the 29 OECD countries, we find that the older population and the total population steadily increased in the six years. More accurately, while the percentage of the population older than 65 on average increased slightly, the overall annual
Table 1. Descriptive Results of the Variables

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean of All Countries by Year</th>
<th>Total Mean</th>
<th>Standard Deviation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1998</td>
<td>1999</td>
<td>2000</td>
<td>2001</td>
</tr>
<tr>
<td>Gross Tertiary Enrollment Ratio</td>
<td>168</td>
<td>49.08</td>
<td>51.11</td>
<td>52.29</td>
</tr>
<tr>
<td>Percentage of 65-year-older</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Growth Rate</td>
<td>174</td>
<td>1.07</td>
<td>0.52</td>
<td>0.58</td>
</tr>
<tr>
<td>Total Population</td>
<td>174</td>
<td>37091629</td>
<td>37368207</td>
<td>37655026</td>
</tr>
<tr>
<td>Economy</td>
<td>174</td>
<td>18992.18</td>
<td>19585.4</td>
<td>20323.07</td>
</tr>
<tr>
<td>GDP Per Capita</td>
<td></td>
<td>(constant 2000 US dollars)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>166</td>
<td>110.33</td>
<td>110.01</td>
<td>108.92</td>
</tr>
<tr>
<td>Gross Secondary Enrollment Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper-secondary Attainment Rate</td>
<td>180</td>
<td>49.97</td>
<td>50.17</td>
<td>49.90</td>
</tr>
<tr>
<td>Financial Aid Policy</td>
<td>172</td>
<td>11.11</td>
<td>10.93</td>
<td>10.71</td>
</tr>
<tr>
<td>Scholarships/other grants to households</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student loans</td>
<td>174</td>
<td>5.46</td>
<td>4.62</td>
<td>6.52</td>
</tr>
<tr>
<td>Percentage of public tertiary expenditure on institutions</td>
<td>162</td>
<td>77.29</td>
<td>78.42</td>
<td>78.62</td>
</tr>
<tr>
<td>Population</td>
<td>Percentage of 65-year-old</td>
<td>Annual Growth Rate</td>
<td>Total Population</td>
<td>GDP Per Capita</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------</td>
<td>--------------------</td>
<td>------------------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>.303(*<strong>), .050, -.236(</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.059, -.144, .041</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economy</td>
<td>GDP Per Capita (constant 2000 US dollars)</td>
<td>.444(<em><strong>), .426(</strong></em>), .040</td>
<td>.207(**)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Gross Secondary Enrollment Ratio</td>
<td>.500(<em><strong>), .410(</strong></em>), .118, -.265(**)</td>
<td>.353(**<em>), -.173(</em>)</td>
<td>.026</td>
</tr>
<tr>
<td></td>
<td>Upper-secondary Attainment Rate</td>
<td>.048, .272(<em><strong>), -.286(</strong>), -.173(</em>)</td>
<td>.026, -.023</td>
<td></td>
</tr>
<tr>
<td>Financial Aid Policy</td>
<td>Scholarships/other grants to households</td>
<td>.225(<strong>), .246(</strong>*), .001, -.146</td>
<td>.155(<em>), .399(</em>**), .107</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student loans</td>
<td>.353(**), -.088</td>
<td>.171(*)</td>
<td>.049, .349(<em><strong>), .416(</strong></em>), -.026</td>
</tr>
<tr>
<td></td>
<td>Percentage of public tertiary expenditure on institutions</td>
<td>-.238(<strong>), .247(</strong>)</td>
<td>-.142, -.524(***), -.084, .020, .057, .138</td>
<td></td>
</tr>
</tbody>
</table>

Note: * p<.05, **p<.01, ***p<.001
Table 3. Random and Fixed Effects Models of Regressions on Tertiary Enrollment Ratios. \((N=160)\)

<table>
<thead>
<tr>
<th></th>
<th>One-way Group Effect Models Without Time Effect</th>
<th>One-way Group Effect Models with Time as A Regressor</th>
<th>Two-way Fixed Group and Time Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
</tr>
<tr>
<td><strong>Random Effects</strong></td>
<td>Random Effects</td>
<td>Fixed Effects</td>
<td>Random Effects</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>1.885 *</td>
<td>-0.219</td>
<td>-0.818</td>
</tr>
<tr>
<td>Percentage of 65-years-older</td>
<td>0.806(1.018)</td>
<td>0.648(1.063)</td>
<td>0.076(0.199)</td>
</tr>
<tr>
<td>Annual Growth Rate</td>
<td>-0.031(0.267)</td>
<td>0.128(0.199)</td>
<td>0.076(0.199)</td>
</tr>
<tr>
<td>Total Population</td>
<td>0.561(2.381)</td>
<td>-0.48(1.865)</td>
<td>25.945(31.829)</td>
</tr>
<tr>
<td>GDP Per Capita</td>
<td>(4.389)</td>
<td>(8.310)</td>
<td>(3.467)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>-0.011(0.085)</td>
<td>-0.100(0.064)</td>
<td>-0.210**</td>
</tr>
<tr>
<td>Gross Secondary Enrollment Ratio</td>
<td>-0.091(0.080)</td>
<td>0.064(0.077)</td>
<td>(0.077)</td>
</tr>
<tr>
<td>Upper-secondary Attainment Rate</td>
<td>-0.091(0.080)</td>
<td>0.115(0.123)</td>
<td>0.220(0.077)</td>
</tr>
<tr>
<td><strong>Financial Aid Policy</strong></td>
<td>-0.057(0.097)</td>
<td>-0.015(0.072)</td>
<td>0.220(0.077)</td>
</tr>
<tr>
<td>Scholarships/grants</td>
<td>-0.054(0.097)</td>
<td>0.115(0.123)</td>
<td>0.220(0.077)</td>
</tr>
<tr>
<td>Loans</td>
<td>-0.143(0.101)</td>
<td>-0.010(0.077)</td>
<td>0.156(0.111)</td>
</tr>
<tr>
<td>Percentage of public tertiary expenditure on institutions</td>
<td>-0.081(0.100)</td>
<td>-0.010(0.077)</td>
<td>0.156(0.111)</td>
</tr>
<tr>
<td>Year</td>
<td>--</td>
<td>--</td>
<td>2.002***</td>
</tr>
<tr>
<td><strong>Intercept</strong></td>
<td>-169.800 **</td>
<td>-90.132</td>
<td>--</td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.480b</td>
<td>0.956b</td>
<td>0.669b</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: a. Numbers in parentheses are standard errors. b. The R² produced by STATA is not adjusted. c. p<.05, **<.01, ***<.001 (two-tailed tests)
population growth rate slowly decreased, which resembles the aging population trend in most OECD countries. Moreover, the variation of population size between countries is exceptionally large. With regard to the national economy, the annual increase in GDP per capita implies that the national economy of OECD countries shows on average slight growth with a considerable variance (10,393 in constant 2000 US dollars) over the six years. Compared to tertiary enrollment rates, the gross secondary enrollment ratios are much higher (mean=110.95%), while they show a smaller degree of increase than tertiary enrollment ratios. The upper-secondary attainment rate of the population 25-34 years old is on average 49.7 percent over the six years, though slowly decreasing.

The correlation coefficients of the variables in Table 2 can be described briefly. The tertiary enrollment ratios bear strong and positive relationships with GDP per capita ($r=.44$, $p<.001$) and gross secondary enrollment ratios ($r=.50$, $p<.001$), whereas has a significant but moderate association with the percentage of the 65 years and older population ($r=.30$, $p<.001$), scholarships/grants ($r=.23$, $p<.001$) and student loans ($r=.35$, $p<.001$). However, the tertiary enrollment ratios are negatively correlated with public expenditure on institutions ($r=-.238$, $p<.001$).

Results of Fixed and Random Effect Estimation

To answer the research question, we present a step-by-step overview for possible approaches to analyzing panel data and a comparison of the advantages and limitations of five panel data models. This provides a broader perspective than possible using one method alone. First, we find all five models are significant in fitting the data ($p<.001$). Then, we compare the five models as follows:
Model 1 vs. Model 2. As demonstrated in Table 3, without including time effect, Models 1 and 2 produce largely different coefficients in terms of magnitudes and sign, due to different statistic approaches. The one-way fixed group effects model (Model 2) is preferred to the random effects model (Model 1), according to the Hausman test statistic ($\chi^2(9) = 118.29$, $p<.001$). A prerequisite for trusting the results is that their predictions track the observed tertiary enrollment ratios reasonably well. Further examination of the distribution patterns of their residuals and their predicted values of tertiary enrollment ratios are both in favor of the fixed effects model (which ranges 15.03–90.06, SD=15.81 in fixed effects vs. ranges 3.71 ~ 93.60, SD=20.15 in random effects, compared with observed values ranging 18.32–87.53, SD=15.89).

Fixed and random effects results differ in financial aid policy variables. The results of the fixed effects model indicate that scholarships/grants to household, student loans, and the percentage of public tertiary expenditure on institutions do not influence tertiary enrollment. However, the random effects model shows that student loans are significant ($\beta=.296$, $p<.05$), which is consistent with the findings of Rasmussen (2006) who highlights the positive effects of loans on college access. Since the fixed effects model is preferred, we should be very cautious regarding the findings of the random effects model.

Turning to the estimates for the demographic factors, the results of the fixed effects model suggest that a larger population in a country is associated with substantially higher tertiary enrollment ratios. Specifically, a unit (in logarithm) increase in total population in the 29 OECD countries is related to a 71.146 percent unit increase in tertiary enrollment ratio ($p<.05$). Nonetheless, the differences between Models 1 and 2 illustrate the potential dangers of relying on only one estimation method, and we should be cautious about the results derived from this model without further exploration.
Model 3 vs. Model 4 vs. Model 5. After including time effects into Models 1 and 2, Models 3, 4 and 5 exhibit strong consistency in terms of magnitudes and signs for the common predictors, except for the role of gross secondary enrollment ratios. The consistency is even higher in Models 4 and 5. The Hausman test statistic \( \chi^2 \) (10) = 16.08, \( p=0.097 \) indicates that the random effect model (Model 3) is preferred over the fixed effects model (Model 4). We explored residual distribution patterns and predicted values of the tertiary enrollment ratios against observed values for the 29 OECD countries; however, we find the fixed effects Models 4 and 5 track the actual change in enrollment ratio better than the random effects model (see appended Figures 3, 4 and 5). Therefore, the results of the one-way fixed group effects including time variable and the two-way fixed group and time effects model should also be highly valued.

The high consistency of the three models not only reduces the bias of favoring only one model but also strengthens the findings and conclusions. Because similar results are produced from different estimation methods and different specifications, we have confidence that the results are not simply artifacts of a particular estimation procedure. Regardless of model specifications, we conclude safely that scholarship/grants, student loans, and the percentage of public tertiary expenditure on institutions bear no relationship to tertiary enrollment ratios after controlling for population, economy, and secondary education. Since the random effects model is preferable, this conclusion could also be generalized to some non-OECD member countries with similar economies and education levels.

In addition, Models 3, 4 and 5 have common merits and individual strengths and weaknesses. In general, these three models are superior to Models 1 and 2 in that they account for more variance in the tertiary enrollment ratios, which illustrates the necessity of including time effects beyond group effects. This may be because the specifications in Models 3, 4 and 5,
which allow for time effects, remove some systematic changes in the selected countries from the analysis. Moreover, Models 3 and 4 clearly conclude that the average tertiary enrollment ratio increases by about 2 percent annually (p<.001) after adjusting for other factors in the model, which otherwise would not be found with descriptive and correlations analysis. Individually speaking, the greatest merits of Model 3 are that it is statistically preferred over a fixed effects model and permits some unconditional inferences for the population. For Model 4, the newly added time regressor increases the $R^2$ of the one-way fixed effects model by .007 ($F_{(1,121)}=23.72$, p<.001), which means Model 4 (full model) is preferable to Model 2 (reduced model). Treating time as a continuous variable in Model 4 may be more reasonable because: 1) it reflects the increases or changes of tertiary education access on a continuum rather than with discrete points; 2) it secures larger degrees of freedom than Model 5, which treats time as a fixed effect and adds five time dummy variables in the two-way model. Nevertheless, the $R^2$ in Model 5 is slightly higher compared with Model 4. Model 5 is also evidently superior to Model 2 in that the $R^2$ increases by $0.009$ ($F_{(5,117)}=7.00$, p<.001) by including time effects.

The consistent findings across Models 3, 4 and 5 manifest the non-significance of the impacts of population structure, annual growth rate, and size on tertiary enrollment. Including the time effects beyond the group effects model substantially changes the estimated coefficients for all three population variables, suggesting that demographic increase is largely a factor of time.

The consistent findings also support the premise that GDP per capita (in logarithm) is strongly and positively tied to the tertiary enrollment ratio, and it is statistically significant (respectively, $\beta_3=15.248$; $\beta_4=25.945$; $\beta_5=29.962$, p<.001), all else equal. This relationship could apply to both OECD countries and non-OECD countries with similarities in economy and education level, although when applied to other countries the magnitude of the relationship may
decrease. This reflects that the increase in higher education access is strongly fostered by the increase in the national economy.

The findings regarding secondary education are rather counterintuitive. Although the Pearson correlation coefficient between secondary and tertiary enrollment is positive, both one-way fixed effects models and the two-way fixed effects models confirm that gross secondary enrollment ratios have a negative relation to tertiary enrollment ratios. Specifically, a one percentage increase in the secondary enrollment ratios is associated with a 0.227 percent decline in tertiary enrollment (p<.01). However, its non-significance in the random effects model suggests that this is not the case when generalized to secondary education in other countries. The comparison of the three models suggests that this finding may be conditional on OECD countries only and is affected by the inclusion of fixed-time effects. Finally, all models indicate that upper-secondary attainment rates for those 25-34 years old have no influence on tertiary enrollment, holding other variables constant.

Discussion

In this study, our analysis strategy of five random and fixed effects models enables us to provide a more conclusive answer to our research question; that is, scholarship and grants, student loans, and public expenditures on higher education institutions have no impact on gross tertiary enrollment ratios in the 29 OECD countries over 1998-2003, after controlling for national economy, educational level and population characteristics. In addition, the random effects models in this study also allow us to draw inferences, based on these findings, to some other countries with similar educational and economic levels. Overall, the conclusions contradict the existing literature that highlights strong positive effects of need-based grants and scholarships on college enrollment rates (Heller, 1996; Reuterberg & Svensson, 1994; St. John & Noell, 1989;
Usher & Cervenan, 2005; Vossensteyn, 1999). The first one-way random group effects model only partially supports the previous literature on student loans, privatization and human capital theory, which argue that students rely more on themselves and their families to support higher education. Due to the statistical weakness, however, relying on this finding to draw conclusions on student loans may be problematic.

It is not surprising that the consistent findings of our five models support the conclusion that the national economy, reflected mainly by GDP per capita, could strongly foster an increase in higher education access. One of the explanations is that higher GDP per capita may increase individual citizens' ability to afford college and thus reduce the financial obstacles to higher education. On the national level, higher GDP per capita could also reflect the overall wealth of a country in which a well-run higher education system could be grounded and adequately supported both financially and culturally. This relationship is meaningful not only for OECD countries but also for some other countries comparable to OECD countries in educational and economic achievement. This study confirms the fundamental and central role of the national economy as a precondition to promoting higher education access.

Counterintuitively, the secondary enrollment level of a country has a negative effect on higher education access among OECD countries. When lower- and upper-secondary enrollment increases, a larger and more qualified college-aged cohort is prepared for higher education which would reasonably be expected to increase tertiary enrollment levels. A possible explanation for the negative relationship found might be that as the number of prepared students increases, institutions of higher education may be unable to cope. Competitive tax pressures and other spending factors may also reduce the resources of higher education and discourage tertiary enrollment. However, there might be other explanations. As defined by the World Bank's World
Development Indicators (WDI), the Gross Secondary Enrollment Ratio is the ratio of secondary enrollment, including both lower and upper-secondary education levels, to the number of secondary school-aged children (usually children 12-17 years old). In this study, this indicator is on average 110.95 ranging from 69.12~178.51 (SD=22.38) over 1998-2003. As it is often cited on the World Bank and UNECO websites, the ideal Gross Secondary Enrollment Ratio is 100%, but ratios greater than 100 can occur when there is a high number of students who repeat a grade, fail to graduate, or are over- or under-age. On the one hand, overpopulation in secondary schools may demand considerable public resources that would have been allocated to tertiary education so as to decrease college enrollment. On the other hand, the higher the proportion of overaged, probably college-aged, students remaining in secondary schools, and a smaller number of college-age students attending tertiary education. When we examine the dataset, we find evidence that overpopulation in secondary schools exists in many European countries (i.e., UK, Belgium, Australia, Sweden, Denmark, Finland, Netherlands, Norway, etc), while some economically less advantaged OECD countries have lower than 100 gross enrollment ratios. In order to provide a sound interpretation, the secondary education structure, age distribution and labor market of each country may need further exploration.

**Conclusion and Future Research**

In this first international study we conclude that scholarship and grants, student loans, and public expenditures on higher education institutions had no impact on gross tertiary enrollment ratios, after controlling for national economy, secondary educational level and population characteristics. This study has implications for not only OECD countries but also other countries with medium and high educational and economic levels. We also conclude that national economic development, reflected mainly by GDP per capita, drives college access,
possibly due to an increase in the citizens' affordability of college and national financial support of higher education. Finally, we find that secondary enrollment level of a country has a negative effect on higher education college enrollment rates for high school graduates mainly because of the competition for public resources of between secondary and tertiary education levels.

This study also has implications for future research that uses statistics methods to study student aid and college access across countries. This paper employs fixed and random effects models, which assume heterogeneous intercept with homogenous slopes, to analyze the association of financial aid policy with higher education access. This assumption, however, may conflict with the fact that some variables have both heterogeneous slopes and intercepts on tertiary enrollment. Moreover, we find some curvilinear relationship between the dependent variables and regressors. For example, as we examine the scatter plot between GDP per capita and tertiary enrollment ratios, we see that after GDP per capita reaches a certain point, the direction of the relationship with the dependent variable changes and its magnitude slows. The fixed and random effects models can only estimate linear coefficients, which may not capture such curvilinear patterns among variables. Therefore, future research could explore other possible approaches to addressing these problems. Since new data are produced annually by OECD and WDI agencies, we could include more observations and more countries, including some developing and less developed countries, to the current dataset and conduct subsample analysis on whether and how factors differ across broader categories of countries.

Acknowledgement

We would like to thank Nengfeng Zhou, Anna Chung, Lingling Zhang, Rong Chen, Phyllis Stillman, and Professor Stephen DesJardins of the University of Michigan for help with the statistics and suggestions.
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References


Appendix 1. Definition of Variables and Data Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Definitions</th>
</tr>
</thead>
</table>
| **Tertiary Gross Enrollment Ratio** | *Gross enrollment ratio* is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. It can be higher than 100 percent because some students are younger or older than the corresponding age group.  
*Gross tertiary education enrollment ratio* is calculated based on the number of young people in the five-year age group following the secondary school leaving age.  
*Tertiary education*, whether or not leading to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level. It includes *Tertiary-type A education* and *Tertiary-type B education*. See also *International Standard Classification of Education (ISCED)*  
*Tertiary-type A programs* are largely theory-based and are designed to provide sufficient qualifications for entry to advanced research programs and professions with high skill requirements, such as medicine, dentistry or architecture. Tertiary-type A programs have a minimum cumulative theoretical duration (at tertiary level) of three years’ full-time equivalent, although they typically last four or more years. These programs are not exclusively offered at universities. Conversely, not all programs nationally recognized as university programs fulfill the criteria to be classified as tertiary-type A. Tertiary-type A programs include second degree programs like the American Master. First and second programs are sub-classified by the cumulative duration of the programs, i.e., the total study time needed at the tertiary level to complete the degree.  
*Tertiary-type B programs* are typically shorter than those of tertiary-type A and focus on practical, technical or occupational skills for direct entry into the labor market, although some theoretical foundations may be covered in the respective programs. They have a minimum duration of two years full-time equivalent at the tertiary level. |
| **Population**  
Percentage of 65-years-older; Annual Growth Rate; | WDI  
Percentage of 65-years-older in population  
*Population growth rate* means the annual increase in a country's population during a certain period-usually one year- expressed as a percentage of the population when the period began. The population growth rate is the sum of the difference between the birth rate and the death rate- the natural population increase-and the difference between the population entering and leaving the country- the net migration rate. |
<table>
<thead>
<tr>
<th>Population Total</th>
<th>WDI</th>
<th>Total population of the country</th>
</tr>
</thead>
</table>

**Economy**

GDP Per Capita | WDI | GDP per capita is the national Gross domestic product (GDP) divided by its population in constant 2000 US dollars. GDP is the value of all final goods and services produced in a country in one year. GDP can be measured by adding up all of an economy's incomes - wages, interest, profits, and rents - or expenditures - consumption, investment, government purchases, and net exports (exports minus imports). Both results should be the same because one person's expenditure is always another person's income, so the sum of all incomes must equal the sum of all expenditures. |

**Education**

Gross Secondary Enrollment Ratio; Upper-secondary Attainment Rate | WDI/OECD | Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. It can be higher than 100 percent because some students are younger or older than the corresponding age group. Gross Secondary Enrollment Ratio is the ratio of secondary enrollment to the number of secondary school-aged children (usually children 12-17 years old). Upper-secondary attainment rate is the percentage of the population (25-34 years old) that has attained at least upper secondary education. Educational attainment is expressed by the highest completed level of education, defined according to the International Standard Classification of Education (ISCED). |

**Financial Aid Policy**

Scholarships/grants to households | OECD | Scholarships/grants are government scholarships and other government grants to students or households in the unit of percentages of total public expenditure on education and GDP. These include, in addition to scholarships and similar grants (fellowships, awards, bursaries, etc.), the following items: the value of special subsidies provided to students, either in cash or in kind, such as free or reduced-price travel on public transport systems; and family allowances or child allowances that are contingent on student status. Any benefits provided to students or households in the form of tax reductions, tax subsidies, or other special tax provisions are not included. Student loans are in the unit of percentages of total public expenditure on education and GDP. Student loans, which are reported on a gross basis, that is, without subtracting or netting out repayments or interest payments from the borrowers (students or households). This is the percentage of public tertiary expenditure of the sum of private and public expenditures on institutions. Private expenditure: Private expenditure refers to expenditure funded by private sources, i.e., households, and other private entities. “Households” means students and their families. “Other private entities” include private business firms and non-profit organizations, including religious organizations, charitable organizations, and business and labor associations. Private expenditure comprises school fees; materials such
as textbooks and teaching equipment; transport to school (if organized by the school); meals (if provided by the school); boarding fees; and expenditure by employers on initial vocational training. Note that private educational institutions are considered service providers, not funding sources.

Public expenditure: Public expenditure refers to spending of public authorities at all levels. Expenditure that is not directly related to education (e.g., culture, sports, youth activities, etc.) is, in principle, not included unless the activities are provided as ancillary services by educational institutions. Expenditure on education by other ministries or equivalent institutions, for example Health and Agriculture, is included.
Figure 2. Averages of Financial Aid by Year (Number of Country =29)

Figure 3. Predicted Values and Residual Distribution of Model 3 (One-way Random Effects Model with Year as A Regressor) (Number of Country =29, N=160)

Figure 4. Predicted Values and Residual Distribution of Model 4 (One-way Fixed Effects Model with Year as A Regressor) (Number of Country =29, N=160)
Figure 5. Predicted Values and Residual Distribution of Model 5 (Two-way Fixed Group and Time Effects Model) (Number of Country =29, N=160)