Inflation's Role on Tertiary Enrollment: A Global Study

Abstract

Inflation is one of the vital macroeconomic indicators of a country's well-being and of keen interest to politicians and policy makers. When inflation rises, the purchasing power of consumers diminishes, which can accelerate already-present poverty and cause undue stress on families. Students may feel pressured to abandon their ideas of higher education in order to help out their families financially, or conversely may feel more motivated to attend, as currently offered income is insufficient when compared to rising prices. Should the impact of inflation become strong enough to affect worldwide spending habits, changes today could drastically affect the future on a global scale. I address the relationship between inflation and college enrollment on a global scale utilizing a cross-sectional, linear regression model and data from The World Bank and World Population Review of 143 countries for the year 2019. Each country's gross domestic product (GDP), national income per capita (NI, a proxy for median income), unemployment rate, and possibility of free tuition provided by the government are factored into the model as control variables. I find that inflation statistically positively affects enrollment rates. This may be an indication that educational policy makers should take a closer look at inflation rates and adjust financial aid and governmental spending on education accordingly; today's changes in the labor force will have an immediate impact on potential future GDP earnings.

1 Introduction

Inflation is a key macroeconomic indicator of the health of a country; high inflation creates a vicious vortex of hyperinflation, and high deflation suffocates production and increases unemployment. At the height of the Great Depression in the U.S., deflation peaked at -10.3% and unemployment rose to 24.9% (Amadeo, 2022 and FDR Library). The crippling cycle of never-ending hyperinflation in Venezuela reached a staggering 2,959.8% in 2020, destroying purchasing power and savings (Armas, 2022). In times of economic uncertainty, young people have a choice to make: attend college at increasingly high tuitions and forgo a stable income, or lock in income and lose the opportunity for potential higher earnings in the future. Trends of college enrollment can have serious implications for the future workforce; as fewer people attend college, higher-income positions remain unfilled and can cause staff shortages in vital areas such as healthcare, engineering, and education.

This raises the question: how does inflation affect college enrollment within a country? Rising prices pose a threat to those who have trouble affording tuition. Yet as the purchasing power of consumers diminishes, inflation eats away at the nominal interest rate. Borrowers may be more likely to take out a loan when interest rates are low; economic theory predicts investment may increase due to low interest rates. Low interest rates on student loans may incite more to attend college, even at higher prices. Many studies have been done using U.S. data, with very little focusing on the rest of the globe. For instance, past literature suggests that in the U.S. during periods of inflation, females are more likely to attend college while males prefer to forego college in times of growth (Ewing, Beckert, and Ewing 2010, 424-428). In a 2014 study, Long (2014) focused on the effect of recessional economic trends on college enrollment surrounding the American recession of 2008. Using data from 2004-2005 and 2009-2010, Long incorporated three years of observations before and after the start of the recession to fit a time-series model that found enrollment to increase during the period of the recession (aside from the normal increase per year as controlled for).

Recent studies surrounding the topic of inflation's effect on college enrollment focus heavily on U.S. data from the Great Recession of 2009 or now-outdated data throughout the period of stagflation in the 70's and 80's and the period of strong economic growth in the 90's. While these studies utilize different periods of U.S. history to examine a connection between inflation and enrollment, they ignore the rest of the educated world. Many European countries offer free tuition to their citizens, which may hike up enrollment rates among those who are unable to afford college education otherwise. Inflation rates across the U.S. vary heavily during restricted points of time, but for the most part are relatively stable, along with enrollment rates. Enrollment rates have naturally increased since the 1960's due to the Civil Rights movement, but have stabilized since the early 2000's (Statista). This may not be the case in every country, since inflation and enrollment already varies naturally between countries depending on the development stage, type of economy, social customs, and national priorities of the government. Therefore this paper explores the relationship between inflation and enrollment in higher education on a global scale. With data from the World Bank and World Population Review, 143 countries' enrollment rates and inflation rates for the year 2019 are analyzed utilizing a linear regression model.

2 Model

I use a linear regression model to estimate the effects of inflation on enrollment on a per country basis. Previous literature has studied U.S. trends over time, and for that reason time-series models were used (Long, 2014; Hemelt, and Marcotte 2011; Ewing, Beckert, and Ewing 2010). Instead, I utilize cross-sectional data and analyze the effect of inflation on a global scale. I focus on the

Table 1: Variable descriptions and sources

Variables	Description	Source
enrollment	Gross total enrollment in tertiary education measured as a percentage of the total population of the age group including repeaters and late/early enrollment, allowing for a value over 100 percent	World Bank
inf	Annual growth rate of GDP deflator measured as rate of change in price in current local and constant local currency	World Bank
gdp	Gross domestic product measured in U.S. dollars	World Bank
ni.per.capita	Measured as gross national income minus consumption of capital and natural resources divided by the number of people in the area, which is a proxy for median income	World Bank
ue	Ratio of unemployed persons over the active labor force	World Bank
free	Dummy variable where a 1 indicates free tuition is offered by government which is a proxy for cost of tuition	World Population Review

most recent year in which most countries reported statistics for the variables included in the model, which are outlined in Table 1. The predictor variable of interest is inflation. Additional summaries and descriptions of each variable are included in the Appendix.

The model is represented by:

$$enrollment = \beta_0 + \beta_1 inf + \beta_2 log(gdp) + \beta_3 log(ni.per.capita) + \beta_4 ue + \beta_5 free + u$$

where coefficients are estimated using OLS and heteroskedastic robust standard errors are used.

3 Results and Discussion

Table 2 summarizes the results of the model. The ordinary standard errors (column 1) are included here for reference, but heteroskedastic robust inference is used to analyze the model. The statistical significance between the two techniques does not change for any variable. Model assumptions are discussed further in the Appendix. Standard errors are shown in parentheses beside the estimate for each variable.

$\hat{\beta}_1$, or the coefficient for inflation, has an estimate of 1.379. In other words, for each additional percentage point in inflation, enrollment is predicted on average to increase by 1.379 percentage points holding all other variables constant.The R^2 of the model indicates 62.52% of the variation in enrollment is explained by the predictor variables. Of primary interest, inflation has a statistically significant positive effect on enrollment, with a p-value of 0.0000638. Like Ewing, Beckert, and Ewing (2010), my study found inflation to be statistically significant. These authors found inflation to be jointly significant with economic growth at the 5% level of significance at the U.S. level while I found inflation to be significant by itself on a global scale.

Economic theory does not have a concrete prediction of inflation's effect on education. It may be worth pursuing as Ewing, Beckert, and Ewing's results along with mine support the notion that inflation affects college enrollment. Theory dictates that as unemployment decreases, inflation

Table 2: Model Summary

	Dependent variable:	
	enrollment	
	Ordinary Standard Errors	Heteroskedastic Robust Standard Errors
	(1)	(2)
inf	1.379*** (0.335)	1.379*** (0.491)
log(gdp)	0.805 (0.713)	0.805 (0.594)
log(ni_per_capita)	16.716*** (1.484)	16.716*** (1.394)
ue	0.378 (0.363)	0.378 (0.469)
free	5.561 (4.912)	5.561 (5.726)
Constant	−126.897*** (19.052)	−126.897*** (14.723)
Observations	130	130
R^2	0.625	0.625
Adjusted R^2	0.610	0.610
Note:		*p<0.1; **p<0.05; ***p<0.01

increases, which was supported by Long (2014) in her study of effect of the Housing Crisis on college enrollment. If inflation can drive unemployment up or down, it is worth looking into its effect on college enrollment for policy makers to consider. My results indicating that inflation has a positive effect on college enrollment well below the 1% LOS is not a surprising effect; it would seem that rising prices provide motivation to earn a degree to combat said prices rather than a deterrent to earn money now and avoid higher tuitions. It is intuitive, as tuition changes are not instantaneous. An increase in inflation from the previous year would cause admission boards to consider raising next year's tuition today, creating at least a two-year lag in the increase in tuition (if the board agrees immediately, which is often not the case).

Despite these results, my work is limited. Important control variables were omitted as they couldn't be quantified, and not all countries reported data. An important variable I am omitting is the social custom of a country. Many countries in the Middle East and Africa do not encourage women to attend higher education, which will obviously drive down enrollment rates compared to countries that encourage both. Some countries do not value higher education at all. I have no way numerically to include this aside from the GDP of a country, which does little for the female enrollment issue. The dummy variable free may also prove to cause some issues, as countries that don't offer free tuition can vary drastically from one another. Due to lack of recent data, I am unable to incorporate the amount of governmental spending spent on tertiary education (a proxy for financial aid), which is another potential omitted variable. The dummy variable *free* had to contain data from 2022 instead of 2019 for sake of availability, which is justified in the Appendix. A cross-sectional analysis was chosen over the better-fit time-series due to lack of available data. Further research should be conducted on a time-series basis to see if inflation affects enrollment on a global scale over time. It could be that inflation affects enrollment on a year-by-year basis, but evens out over time. Lagged variables such as changes in tuition and official announcements of planned free tuition programs would be especially helpful for accounting for the cost of education.

References

Amadeo, Kimberly. 2022. "US Inflation Rate by Year From 1929 to 2023." *The Balance,* March 28, 2022. https://www.thebalance.com/u-s-inflation-rate-history-by-year-and-forecast-3306093.

Armas, Mayela. 2022. "Venezeula's inflation hit 686.4% in 2021-central bank." *Reuters,* January 8, 2022. https://www.reuters.com/world/americas/venezuelas-inflation-hit-6864-2021-central-bank-2022-01-08/.

Ewing, Kris M., Kim A. Beckert, and Bradley T. Ewing. 2010. "The Response of U.S. College Enrollment to Unexpected Changes in Macroeconomic Activity." *Education Economics* 18, no. 4: 423-434. https://doi.org/10.1080/09645290903465739.

Franklin D. Roosevelt Library. "Great Depression Facts." *FDR Presidential Library and Museum.* https://www.fdrlibrary.org/great-depression-facts.

Hemelt, Steven W., and Dave E. Marcotte. 2011. "The Impact of Tuition Increases on Enrollment at Public Colleges and Universities." *Educational Evaluation and Policy Analysis* 33, no. 4 (December 2011): 435-457. https://doi.org/10.3102/0162373711415261.

Long, Bridget Terry. 2014. "The Financial Crisis and College Enrollment: How Have Students and Their Families Responded?" In *How the Financial Crisis and Great Recession Affected Higher Education* (1): 209-233.

National Center for Education Statistics. 2021. "Undergraduate Enrollment." In *Condition of Education, Postsecondary Education,* May 2021. https://nces.ed.gov/programs/coe/indicator/cha.

Statista. 2021. "College enrollment in the United States from 1965 to 2019 and projections up to 2029 for public and private colleges." January 2021. https://www.statista.com/statistics/183995/us-college-enrollment-and-projections-in-public-and-private-institutions/.

The World Bank Group. 2022. World Bank Open Data. data.worldbank.org/. Data provided for each country for the following variables: enrollment, gdp, ni_per_capita, and unemployment.

World Population Review. "Countries With Free College 2022." 2022. worldpopulationreview.com/country-rankings/countries-with-free-college.

Appendix

CLM Assumptions

The assumptions of the Classical Linear Model are all either upheld or are violated in a way that does not affect the consistency or unbiasedness of the estimators significantly.

My model relies on data collected by the World Bank and World Population Review. These organizations themselves must rely on the reportings by each country. If the reason certain countries fail to report their macroeconomic indicators is dependent on the predictor variables itself, then the data are missing at random (e.g. poorer countries do not have the ability to measure and report GDP and inflation). This caused me to exclude countries based on the availability of inflation data for the year 2019, which could qualify as exogenous sample selection and violate the random sample assumption. Despite this, missing at random does not cause bias or inconsistency in the OLS estimators.

The data does not exhibit perfect collinearity, and it is reasonable to assume that GDP and NI per capita are highly related to one another. They both rely on the gross domestic production of income of a country, with national income including income made abroad. This relationship does not violate perfect collinearity since they do not use the same exact measure of income. Multicollinearity shouldn't be an issue as the Variance Inflation Factor (VIF) is relatively small for each predictor variable (shown in Table 3).

Table 3: Variance Inflation Factors of Model

inf	log(gdp)	log(ni_per_capita)	ue	free
1.137	1.145	1.341	1.031	1.236

I recognize I am omitting at least one important control variable (social customs), which, if correlated with any of the predictor variables, would bias their coefficient estimates. Despite this, I believe that the variables that are left out are not numerous and are reflected enough through the GDP and NI per capita of a country. GDP and NI per capita are highly related to the development stage of a country, which is probably the main contributor to how a society views its people. Poorer societies tend to be located in third or second world countries where women are not seen equal to men, and due to this education is not high on the list of priorities. Despite the high possibility of omitted variables, I believe the violation of the zero conditional mean assumption will not cause a large bias in the estimators due to the the GDP and NI per capita variables.

Figure 1 shows the fitted values compared to the residuals in the model. Since there is different variation for low and high fitted values, homoskedasticity is violated. Despite this, the heteroskedasticity present does not seem to be large. Heteroskedastic robust standard errors using the White method were used to preform a t-test on each coefficient. When compared to the normal coefficients without heteroskedastic robust inference, the increase in standard error is quite small. The largest increase is about 0.814 (for *free*). The statistical significance for each coefficient is also exactly the same, indicating heteroskedasticity was not a big issue. It doesn't hurt to use heteroskedastic robust standard errors if homoskedasticity is present, so robust inference is utilized in the analysis to be on the safe side.

As seen from Figure 2, residuals exhibit slight non-normality in the tails. Since I have a moderately large sample size for such a small number of predictor variables, I can rely on asymptotic normality

to still use t-tests.

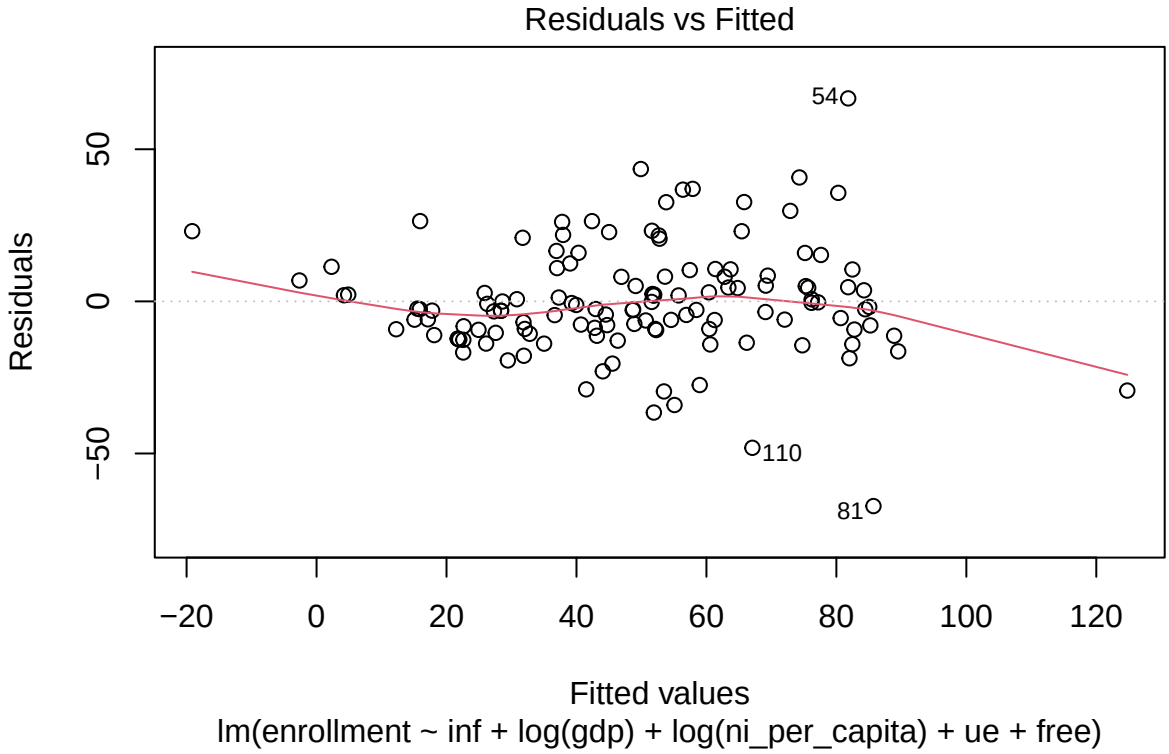


Figure 1: Fitted Values Compared to Residuals

Data Description and Summary Statistics

Table 4 provides a five number summary for each variable included in the model. The variable *gdptril* represents the GDP in trillions of current U.S. dollars. *log(gdp)* is the variable used in the model. *ni_per_capita* is in current U.S. dollars.

Table 4: Data Summary

Statistic	N	Mean	St. Dev.	Min	Max
enrollment	143	49.639	29.153	3.092	148.531
inf	143	3.420	5.892	−4.456	50.921
ni_per_capita	131	13,749.690	15,768.220	199.888	65,600.050
ue	140	6.602	4.768	0.100	28.470
free	143	0.154	0.362	0	1
gdptril	143	2.345	6.736	0.0002	53.983

College enrollment is gauged as the gross total enrollment in tertiary education for 2019 measured as a percentage of the total population of that age group. Tertiary education is a higher form of education after high school and includes universities, colleges, and trade schools. As a gross indicator, this can reach over 100% when factoring in those not in the designated five year age group entering and continuing college chosen by the government such as repeaters, and late and early

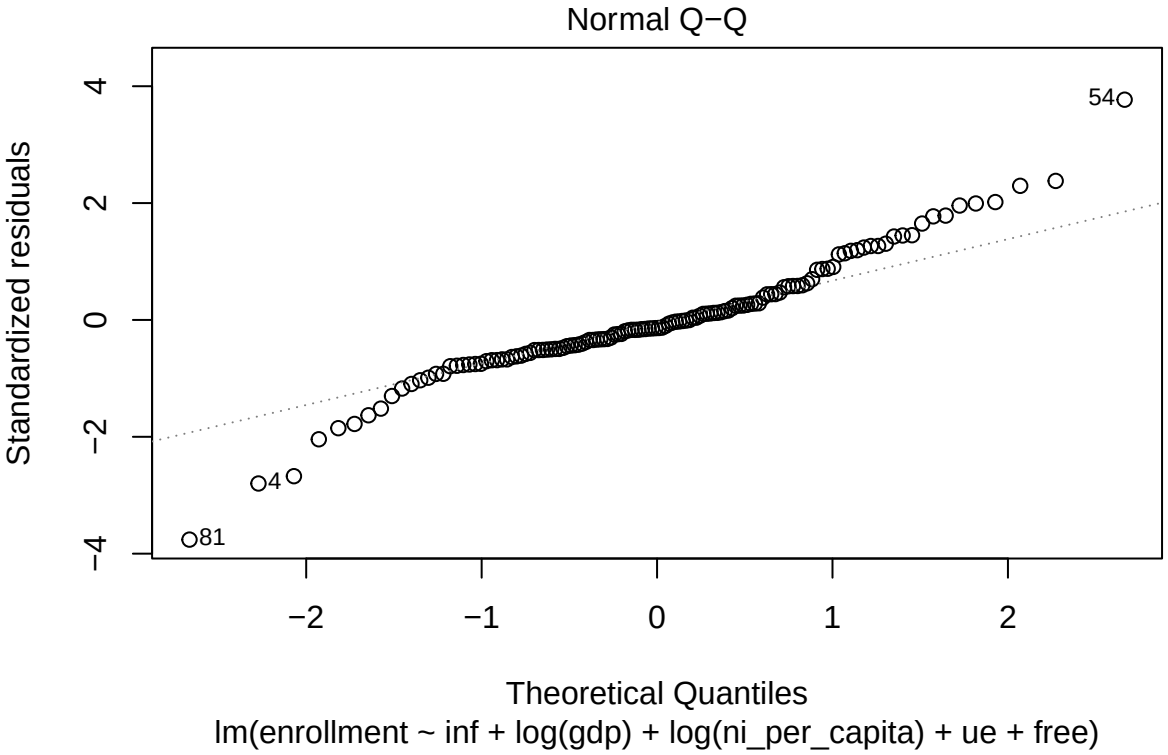


Figure 2: Standardized Residuals Against Theoretical Quantiles, Q-Q Plot

enrollment. These data were collected by The World Bank. Out of 143 observations, enrollment ranges from 3.09% to 148.53% with a mean of 49.64%. The standard deviation of enrollment is quite high at 29.153. The histogram of Gross Enrollment shows the distribution of the data.

Inflation is measured as the annual growth rate of the GDP deflator, which shows the rate of price change in that country based on the GDP in current local and constant local currency. GDP deflator was chosen as opposed to CPI, a more common form of inflation measure in the U.S., due to its advantage of incorporating all prices, rather than just consumer spending as in CPI. Data were gathered by The World Bank and are for the year 2019. Out of 143 observations, inflation ranges from -4.46%, indicating deflation, to 50.92%, with a mean of 3.42%. Most countries seem to fall in the 0-10% range with some outliers. Inflation's distribution has a large right skew, as seen in the histogram below.

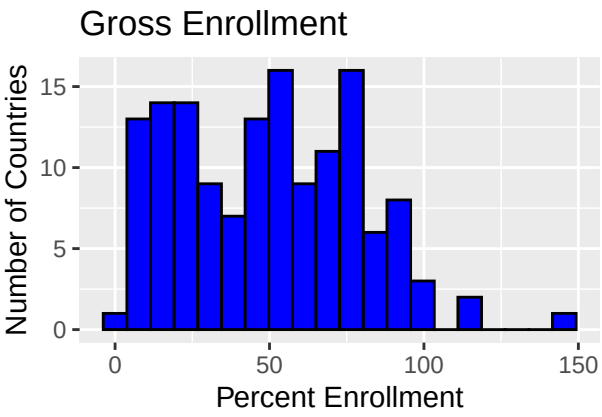
GDP for each country is measured in U.S. dollars for the year 2019. The data were collected by the World Bank. Out of 143 observations, GDP varies from .0002 trillion to 53.983 trillion with a mean of 2.345 trillion dollars. GDP is an important factor in the development stage of a country, as wealthier societies tend to value and are able to fund education more than their poorer counterparts. Most countries fall into the 0-20 trillion range. Controlling for this variable will help close in on the true effect (if any) of inflation on enrollment.

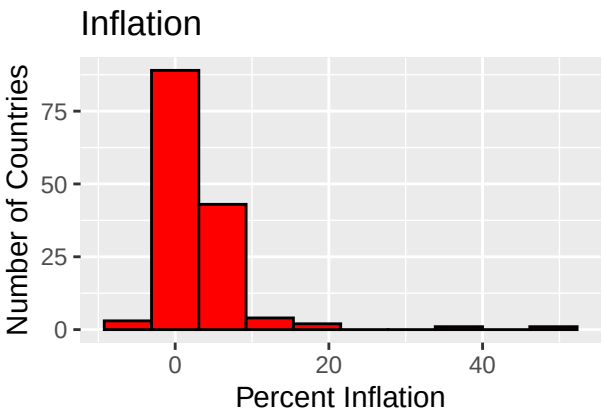
National income per capita is a measure of the average income per person in a country; adjusted national income per capita is gross national income minus consumption of capital and natural resources, divided by the number of people in that area. It stands as a proxy for the median income of a country, and helps distinguish the standard of living in that particular country. As a result, it serves as a measure of a person's ability to pay for higher education; once controlled for, we can

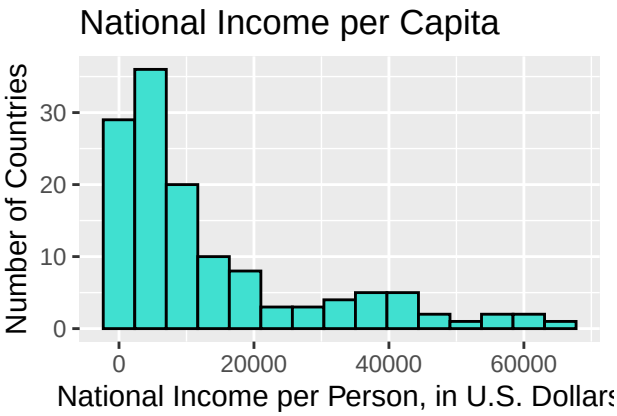
partial out the effect of affordability and expense of school from inflation. The data were collected by World Bank and is in terms of current U.S. dollars for the year of 2019. The data set is missing 12 values for this variable, amounting to 131 observations. This can potentially cause bias in the OLS estimators, but since the missing data are such a miniscule amount the model shouldn't be too impacted. Out of these 131 observations, the mean is $13,739.69, with a minimum of 199.89 and a maximum of 65,600.05. The histogram shows the distribution of the data.

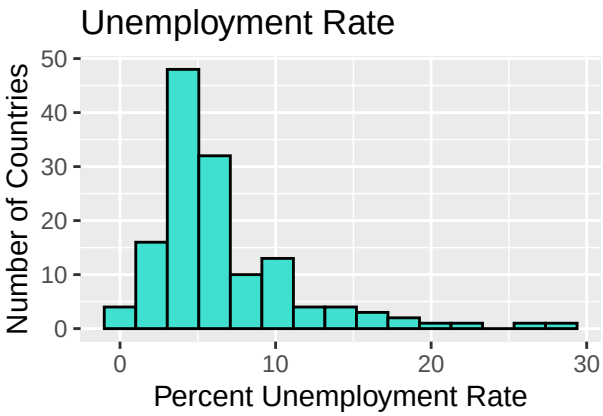
Unemployment rate is the ratio of unemployed persons over the active labor force in a given country. As previous literature has suggested, in times of inflation females tend to attend college more heavily while males prefer to forgo college in times of growth (Ewing, Beckert, and Ewing 2010, 424-428). Capturing the amount of those forgoing college and looking for a job and keeping it constant among countries is a vital piece in measuring the actual effect of inflation; if unemployment is high, people may decide to return to school in hopes of becoming a more attractive candidate. The unemployment data used were collected by the World Bank for the year 2019. Three values are missing, for a total of 140. Unemployment ranges from .1% to 28.470%, with a mean of 6.602%. Three values missing for a control variable (out of 143) should not impact the model that heavily. The distribution of the data has a large right skew, as seen in the histogram below.

The dummy variable *free* contains data from the World Population Review for the year 2022, unlike the other variables which have data from 2019. Data were not available for 2019, so the closest year in data (2022) was chosen. For each country, data for the variable *free* were used in conjunction with the other 2019 variables as if it were from the year 2019. After considering the implications, this was decided acceptable. Data for free tuition were published in January 2022, implying at the beginning of the calendar year these countries had a program to pay its citizens' tuition. Enrollment data for 2019 implies a traditional start date in the fall, with the other variables encompassing a 12 month average for 2019. Between fall 2019 and January 2022 there is an approximate 16-17 month lag time. Free tuition programs, once signed into law, are not instantaneous. If a country pays for its citizens' tuition, then its governmental program supporting that payment has to have been approved and up-and-running for some time. A lag of a little over a year is not enough time for a country to design, legislate, pass, and implement a functional free tuition program. Therefore, I conclude there cannot be a significant difference in the data from 2019 to 2022 and am able to utilize 2022 data in place of 2019. The mean of the the variable *free* is 0.154, indicating 15.4% of the countries in the data set offer free tuition to citizens. The standard deviation is quite large at 0.362.


Gross Enrollment
Number of Countries
0
5
10
15
0
50
100
150
Percent Enrollment


Inflation
Number of Countries
0
25
50
75
0
20
40
Percent Inflation


National Income per Capita
Number of Countries
0
10
20
30
0
20000
40000
60000
National Income per Person, in U.S. Dollars


Unemployment Rate
Number of Countries
0
10
20
30
40
50
0
10
20
30
Percent Unemployment Rate