Article

Education as a Determinant of Tolerance

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Abstract: This study empirically examines the relationship between education and tolerance for sexual minorities. The empirical results provide support for the positive effect of education on tolerance towards sexual minorities, with this effect being particularly pronounced in high-income countries. This study makes a contribution to the literature by employing robust methodologies. This empirical analysis utilizes country-level panel data and the concept of institutionalized tolerance, and employs various panel regression and machine learning techniques.

Keywords: education; tolerance; panel data; sexual minorities; rainbow index

1. Introduction

Does education have a role in promoting social tolerance? In order to answer this question, this study analyzes panel data by using robust methods including various econometric and machine learning models. While the majority of studies on social tolerance have focused on individual-level survey data, this study employs country-level data. That is, this study contributes to the literature on education and tolerance by conducting a country-level panel data analysis utilizing both econometric and machine learning methodologies. This study uses the Rainbow index, which ranks European countries based on their legal and policy practices concerning LGBTI, as a metric for institutionalized tolerance, and the level of education, quantified by expected years of schooling, as an explanatory variable.

This study specifically concentrates on examining social tolerance towards sexual minorities (for an extensive review, see Badgett et al. 2024; Hässler et al. 2024; Lewis and Reynolds 2021). During the early 1970s, there was a notable shift in how homosexuality was no longer viewed primarily as a pathology or mental disorder. Weinberg (1972) challenged the view of homosexuality as a disease, and the American Psychiatric Association removed homosexuality from its list of mental disorders (the Diagnostic and Statistical Manual of Mental Disorders) in 1973. Since then, tolerance for homosexuality has been increased over the past decades (Mondak and Sanders 2003; Sullivan 2004). However, homophobia and discrimination based on sexual orientation are still prevalent (Herek 2015, pp. s31–s32). Pew Research Center (2013) reports that 42 percent of adults in the U.S. oppose same-sex marriage. State repression against sexual minorities (Tschantret 2019) and homophobic public policy (Smith 2019) are still observed. Homophobia exists even in the medical field (Rose 1994). It is widely reported that there exists discrimination against sexual minority people across various areas. Researchers have found an income disparity between sexual minorities and heterosexual individuals (for a review, see Croteau 1996; Ozeren 2014; Ward 2003). Wage differentials between them are observed by many studies (Ahmed and Hammarstedt 2010; Allegretto and Arthur 2001; Arabsheibani et al. 2005; Badgett 1995; Drydakis 2012; Elmslie and Tebaldi 2007; Laurent and Mihoubi 2012). Some studies show that discriminatory practices occur in labor markets and workplaces (Ahmed et al. 2013; Drydakis 2009; Frank 2006; Weichselbaumer 2003). According to a field experiment on the rental housing market in Sweden, gay men receive fewer invitations (Ahmed and Hammarstedt 2009).

Given the presence of homophobia and discrimination based on sexual orientation, it is crucial to identify the determining factors that influence tolerance towards sexual minorities. It is widely recognized that economic development is one of the most significant factors influencing attitudes towards tolerance of sexual minorities. Economic development encourages people to transition their focus from basic survival needs to "post-materialist" concerns (Inglehart 1981, 1990, 1997, 2008), which leads to respect for minority rights. Empirical research supports the idea that economic development plays a positive role in fostering tolerance. Persell et al. (2001) found that individuals with higher incomes or greater job security are more likely to demonstrate tolerance toward homosexual people. Similarly, Adamczyk and Pitt (2009) indicated that tolerance tends to increase in societies as they undergo industrialization. Corneo and Jeanne (2009) and Štulhofer and Rimac (2009) provided evidence of a positive relationship between GDP and tolerance. Halkitis et al. (2018) reported that LGBTI individuals faced increased homophobia during the recent economic recession in Greece. Lee (2021) examined country-level panel data to confirm the mutual positive effects between social tolerance and economic development. Education represents another crucial aspect in research on tolerance, which is discussed in the next section.

2. Previous Studies

Understanding attitudes towards minorities involves a complex process. Herek (1984) conducted a comprehensive review of empirical research and identified three distinct types of attitudes: experiential, defensive, and symbolic. Researchers point to various mechanisms through which education influences tolerance, which can be summarized as follows. First, education exposes people to a variety of lifestyles and cultures, fostering comfort and familiarity with diverse others (Stouffer 1955). Interpersonal interactions within educational environments have the potential to diminish animosity towards minority groups (Cigler and Joslyn 2002; Dixon and Rosenbaum 2004; Erickson and Nosanchuk 1998; Huckfeldt et al. 1995; Sigelman et al. 1996). Second, schools impart liberal values that uphold and advocate for the rights of minority groups (Finney 1974; Gibson and Tedin 1988; Lawrence 1976; Nunn 1973; Selvin and Hagstrom 1960; Van de Meerendonk and Scheepers 2004; Williams et al. 1976). Third, education facilitates greater understanding and acceptance of minority groups, fostering tolerance among individuals (Côté and Erickson 2009; Kingston et al. 2003; Schuman et al. 1997). Fourth, education encourages increased cognitive sophistication and flexibility (Jackman and Muha 1984; Nunn et al. 1978), which can contribute to higher tolerance levels as these capabilities enable people to better comprehend complex concepts and critically evaluate new information.

Since education is acknowledged to influence individuals' beliefs and attitudes towards others (Astin 1977; Bettinger and Slonim 2006; Chickering 1970; Feldman and Newcomb 1969; Offe and Fuchs 2002) and interpersonal trust (Hooghe et al. 2009; Kunovich 2004; Maykovich 1975; Quillian 1995), it is considered an important instrument for promoting tolerance of minorities (Andersen and Fetner 2008; Borgonovi 2012; Gaasholt and Togeby 1995; Jaspers 2008; Jenssen and Engesbak 1994; Kelley 2001; Lerner 1958; Lottes and Kuriloff 1994; McCutcheon 1985; Persell et al. 2001; Steffens and Wagner 2004; Vogt 1997). It is widely assumed that education enriches individuals' general knowledge and critical thinking abilities, consequently fostering greater tolerance towards minority groups.

Empirical research has investigated the impact of education on different forms of tolerance. Stouffer (1955) provided a pioneering study of tolerance, utilizing survey data to examine public attitudes, and highlighted education as a pivotal factor for fostering political tolerance. Davis (1975) compared Stouffer's 1954 survey with the 1972–1973 General Social Survey (GSS) and demonstrated a 23% increase in tolerance during that period. Additionally, the study indicated that education accounts for 4% of the overall change in tolerance. Using the 2005 World Values Survey data, Bangwayo-Skeete and Zikhali (2013) examined five dimensions of social tolerance, such as tolerance for racial and religious dissimilarity, homosexual people, AIDS victims, and immigrants. The study found that

education positively influences all five dimensions of tolerance in Latin America and the Caribbean. Mestvirishvili et al. (2017) analyzed survey data from 2013 of residents in Tbilisi, Georgia, regarding their attitudes following the 17 May 2013 attack on LGBT activists. The study revealed that higher levels of education are associated with lower levels of homophobia.

Empirical studies have also explored the mechanisms that link education and tolerance, as mentioned above. Bobo and Licari (1989) investigated the 1984 General Social Survey (GSS) data and demonstrated a positive relationship between education and tolerance. They further suggested that this effect is mediated by cognitive sophistication. Ohlander et al. (2005) analyzed General Social Survey (GSS) data from 1988 to 1994 and discovered a positive relationship between education and tolerance of homosexuality. They suggested that education fosters greater support for civil liberties and enhances cognitive sophistication, contributing to this positive association. Côté and Erickson (2009) discovered that tolerance tends to be higher among individuals with higher levels of education. They claim that this effect of schooling may be attributed to lifelong learning, which helps individuals develop the ability to critically process information.

While numerous empirical studies have confirmed the influence of education on tolerance towards minorities, there are concerns regarding the nature of this effect. The relationship between tolerance and education may depend on various factors, such as the specific target groups being considered and the level of analysis being conducted. Bangwayo-Skeete and Zikhali (2011) investigated tolerance towards six groups/practices, including linguistic differences, racial distinction, religious dissimilarity, homosexuality, AIDS victims, and immigrants. They found that education increases tolerance for all groups except homosexual people. Two studies utilizing data from the European Social Survey examined tolerance of minorities both at the individual and country level, yielding mixed results. Borgonovi (2012) demonstrated that while the positive effect of education on tolerance towards immigrants is evident at the individual level, it is not consistently observed at the country level. This discrepancy is attributed to variations in the context of intergroup relations, which differ significantly across countries. Similarly, Van den Akker et al. (2013) found that highly educated individuals exhibit greater tolerance towards homosexuality. However, they found that the effect of higher national educational levels is insignificant.

Considering these complicated characteristics of the relationship between education and tolerance, this study empirically examines education and tolerance of sexual minorities by using country level panel data and various robust empirical techniques. The empirical methods used in this study and the findings are discussed below.

3. Methods

3.1. Basic Model and Data

This study empirically examines how education influences social tolerance towards sexual minorities. The dataset and the methodology used in the empirical analysis are discussed in this section. This study uses panel data of 49 countries in Europe over 2012–2022, provided by ILGA-Europe (European Region of the International Lesbian, Gay, Bisexual, Trans and Intersex Association) and World Bank. ILGA-Europe ranks European countries according to their laws and policies affecting the rights of sexual minorities. The 2022 ranking reveals Malta, Denmark, Belgium, Sweden, and Norway as the top five countries, while Belarus, Russia, Armenia, Turkey, and Azerbaijan are listed as the bottom five.

The basic regression model to be estimated is as follows:

$$rainbow_{i,t} = \alpha_i + \beta_1 eys_{i,t} + \beta_2 ln(gdp)_{i,t} + \beta_3 ineq_{i,t} + \epsilon_{i,t} \tag{1}$$

where rainbow refers to the rainbow index, eys to expected years of schooling, ln(gdp) to the natural log of GDP per capita, ineq to the level of inequality, *i* to the country, *t* to time period, α and β to parameters, and ϵ to the classical error term. Pooled regressions are performed and analyzed using different combinations of variables to check multicollinearity.

In addition to the linear model, a quadratic model is also used to examine a possible nonlinear relationship.

The rainbow index, obtained from the Rainbow Europe (https://rainbow-europe.org/, accessed on 18 April 2024) of ILGA-Europe, is employed as a proxy for institutionalized tolerance towards sexual minorities. It assesses the laws and policies pertaining to the rights of LGBTI individuals in each country across 24 categories. Individuals' perceptions can be reflected by institutions, and the latter can also shape the former (Freitag and Bühlmann 2009; Herreros and Criado 2008; Rothstein and Stolle 2008; Rothstein and Uslaner 2005). Kirchner et al. (2011) utilized data from the World Values Survey (2005–2008) and national statistics from 28 countries to propose an institutional theory of tolerance. They found that political–institutional configurations influence individuals' perceptions of threat from other groups, thereby shaping social tolerance.

Most studies on tolerance have relied on individual-level survey data for their analysis, and there are, indeed, some concerns regarding methodological issues in existing studies on tolerance. Indeed, bias in respondents' answers to survey questions can lead to a lack of reliable measures, thereby affecting the validity of the findings (Morgan and Sonquist 1963). Less-educated respondents may tend to agree with simplistically worded statements, leading to an acquiescent response bias. This bias can create a spurious relationship between education and tolerance (Jackman 1973). More-educated respondents are often inclined to support abstract principles of tolerance. However, the disparity between more- and less-educated groups tends to diminish when concrete questions are introduced (Jackman 1978; Jackman and Muha 1984). In light of this methodological concern, this study incorporates an indicator for institutionalized tolerance, which can complement existing research utilizing individual-level survey data. Indeed, the two types of studies serve as complements rather than substitutes for each other (Fuchs et al. 2014).

The level of education is measured by the expected years of schooling, which comes from the Human Development Report (HDR) of United Nations Development Programme (UNDP). The natural log of GDP per capita, obtained from World Bank database, is a proxy for economic development, and the level of inequality in income from HDR is also included as a control variable. These economic factors are confirmed to affect tolerance by empirical studies (for example, see Andersen and Fetner 2008; Lee 2021).

In addition to analyzing the full sample, split samples are utilized in the empirical analysis. Two split-samples of the data are created by dividing them into two income groups: low income and high income. The countries in the sample are sorted based on GDP levels and divided into two equal-sized groups: low-income countries with GDP levels below the median and high-income countries with GDP levels above the median. This split-sample approach can help mitigate potential endogeneity bias (Lee 2015, p. 1900). The relationship between education and tolerance is not expected to differ between different income levels. Thus, while endogeneity may introduce biased estimates, these biases are anticipated to be consistent across all split samples. If differences are observed between the samples, the estimated difference between the groups should be unbiased for the true difference, reflecting the pure effect of one variable on another. In this case, if disparities arise between the subsamples, it suggests that the true effect is more significant for one group than the other (Hoshi et al. 1991, p. 36).

Table 1 reports the summary statistics for the sample. It is evident from the summary statistics that the rainbow index is significantly higher in high-income countries compared to low-income ones. Similarly, expected years of schooling are also higher in high-income countries compared to low-income ones.

Table 1. Summary statistics.

Variable	Full			Low Income			High Income		
	Median	**Mean**	**s.d.**	**Median**	**Mean**	**s.d.**	**Median**	**Mean**	**s.d.**
rainbow	32.00	37.49	21.98	22.50	24.82	14.15	54.50	50.57	20.96
eys	15.81	15.99	1.84	14.95	15.07	1.31	16.98	16.99	1.82
ln(gdp)	9.83	9.80	1.04	8.86	8.92	0.60	10.67	10.68	0.52
ineq	14.48	15.53	4.73	17.43	16.88	5.36	13.46	14.07	3.40

Notes: The table shows the summary statistics of the variables used in the study. rainbow refers to the rainbow index, eys to expected years of schooling, ln(gdp) to the natural log of GDP per capita, and ineq to the level of inequality.

3.2. Panel Regression and Machine Learning

This study implements panel regression analysis using the regression equation as follows:

$$rainbow_{i,t} = \alpha_i + \beta_1 eys_{i,t-1} + \beta_2 ln(gdp)_{i,t-1} + \beta_3 ineq_{i,t-1} + \epsilon_{i,t}, \tag{2}$$

in which using lagged independent variables is a common strategy employed to address potential issues of causality. The White estimator (Arellano 1987; White 1980) is also applied to address heteroskedasticity, which can be a significant issue, particularly due to variations in the sizes of countries in the dataset. The sample data exhibit a short time series, diminishing the significance of panel stationarity problems. This assertion is supported by the results of several unit root tests (Choi et al. 2001; Im et al. 2003; Maddala and Wu 1999).

In addition to the pooled OLS regression as a reference, two commonly used panel regressions—fixed effects and random effects—are conducted. Panel tests, including the F test, LM test, and Hausman test (Hausman 1978), are performed. The results indicate that the random effects model is appropriate for Equation (2).

Demeaned mean group (MG) and generalized feasible generalized least squares (FGLS) estimators are also employed in the analysis of panel data. MG estimators are particularly useful for addressing cross-sectional dependence, which can be significant when neighboring countries are interconnected due to unobserved common factors. In MG estimation, the data are cross-sectionally demeaned, effectively reducing the influence of common factors (Coakley et al. 2006; Pesaran 2006; Pesaran and Smith 1995). FGLS estimation is utilized to address intragroup heteroskedasticity and serial correlation, as the assumption of regressors' exogeneity may be untenable in this context (Im et al. 1999).

In sum, the panel data are analyzed by using estimators such as fixed effects, random effects, demeaned MG, and generalized FGLS. Panel regression analysis is valuable for assessing the relationship between abstract constructs like tolerance and education because it allows for the control of unobservable individual characteristics (Hausman and Taylor 1981). The concept of tolerance encompasses various factors unique to each country, including political, cultural, and legal systems, making it inherently complex and not self-evident. This complexity gives rise to an endogeneity issue, as these individual-specific features are likely to simultaneously influence both tolerance and education. In this context, panel data analysis plays a crucial role in enhancing our understanding of the relationship between fluid concepts such as tolerance and education by offering reliable estimates that account for these complexities.

In addition to panel regression methods, feature selection models based on machine learning techniques are employed to aid in identifying the determinants of tolerance. The two algorithms for feature selection of R (a programming language for statistical computing and graphics)—Boruta (Kursa and Rudnicki 2010) and regsubsets (Lumley and Miller 2009)—are used in this study. The Boruta algorithm is a feature selection technique that utilizes random forests. It adopts a top-down search strategy by iteratively comparing original attributes with random attributes based on their importance. It progressively eliminates irrelevant features to identify all the features relevant to the decision variable. Another model selection function, regsubsets, evaluates all possible combinations of inde-

pendent variables and returns the best models of different sizes based on certain statistical criteria. Here, this study uses subset selection using an exhaustive search approach.

4. Results

In order to examine the relationship between tolerance and education, this study conducts panel data regression analysis and feature selection in machine learning. The empirical findings observed by these methods are discussed in this section.

As a preliminary step, the scatter plots of tolerance and independent variables (education, GDP, and inequality) are shown in Figure 1. As expected, the positive relationship between tolerance and education/GDP, and the negative relationship between tolerance and inequality are observed from the figure.
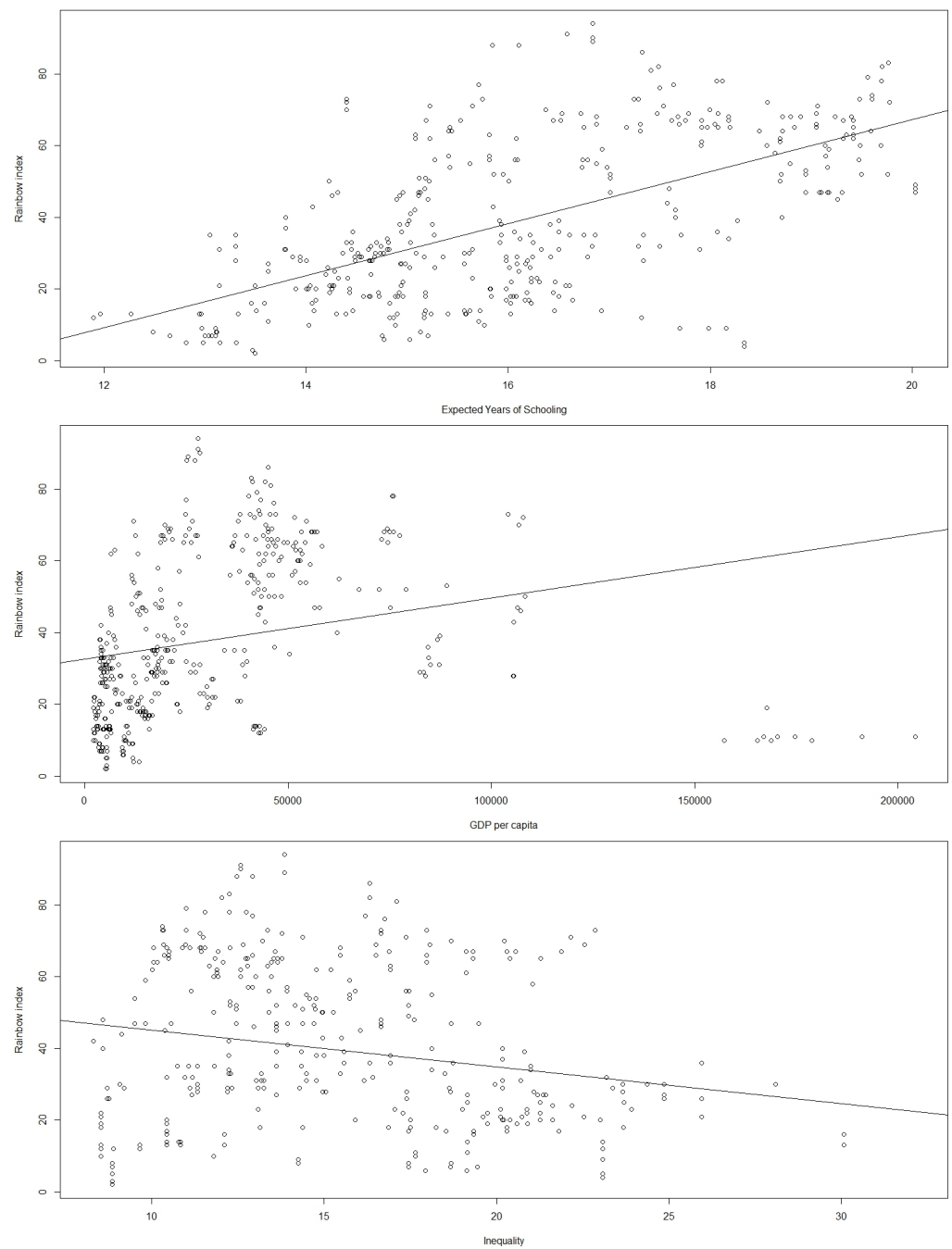

Figure 1. Rainbow index vs. education, GDP, and inequality.

The pooled regression results are reported in Table 2. With the full sample, linear regression analysis indicates a positive effect of education on tolerance. However, the quadratic regression does not produce a significant result. For the control variables, the positive effect of GDP is observed by the regressions, while the inequality level seems to be insignificant. The split-sample regressions reveal intriguing findings. In the low-income group, a positive effect of education is evident in the simple regression, but it disappears in the multiple regression, likely due to the correlation between education and GDP. Conversely, in the high-income group, the positive relationship between education and tolerance remains robust, while the effects of control variables are not statistically significant. These results suggest that the positive effect of education on tolerance is pronounced for high-income countries.

Table 2. Pooled regression results.

	Full Sample				Split Samples			
	Linear		Quadratic		Low Income		High Income	
eys_t	7.25 ***	3.48 ***	12.06	5.54	2.49 ***	0.65	5.39 ***	4.80 ***
	(15.91)	(5.76)	(1.65)	(0.70)	(3.38)	(0.71)	(8.72)	(5.76)
eys_t^2			−0.14	−0.06				
			(−0.66)	(−0.26)				
$\ln(\text{gdp})_t$		10.29 ***		10.24 ***		6.71 **		3.44
		(9.34)		(9.12)		(3.30)		(1.33)
ineq_t		−0.24		−0.24		−0.03		0.37
		(−1.36)		(−1.38)		(−0.20)		(0.98)
R^2	0.37	0.48	0.37	0.48	0.05	0.10	0.27	0.17

Notes: The table shows the results of pooled regressions in which rainbow_t is used as a dependent variable. Figures are regression coefficient estimates, and t values are shown in parentheses below coefficient estimates. ***, and **, respectively, indicate significance levels at 0.1%, and 1% levels.

The empirical results of the panel data regressions with fixed effects and random effects are summarized in Table 3. The split-sample regressions are performed using random effects. In the full-sample regression, both fixed-effects and random-effects models indicate the expected positive effect of education on tolerance. In the split-sample regression, while the positive effect is evident in both income groups, it is notably stronger in terms of magnitude and significance in high-income countries compared to low-income countries, consistent with the pooled regression results.

Table 3. Fixed/random-effects regression results.

	Full Sample				Split Samples			
	Fixed Effects		Random Effects		Low Income		High Income	
eys_{t-1}	3.45 ***	3.55 ***	4.36 ***	3.52 ***	1.95 *	2.04 *	5.43 ***	4.83 ***
	(4.78)	(4.63)	(6.85)	(4.97)	(2.15)	(2.15)	(5.43)	(4.11)
$\ln(\text{gdp})_{t-1}$		2.66		8.69 ***		−1.93		15.80 *
		(0.62)		(3.90)		(−0.55)		(2.54)
ineq_{t-1}		0.25		0.25		−0.01		1.32 **
		(1.22)		(1.34)		(−0.05)		(3.05)
R^2	0.05	0.05	0.08	0.12	0.07	0.08	0.09	0.15

Notes: The table shows the results of fixed/random-effects regressions in which rainbow_t is used as a dependent variable. Figures are regression coefficient estimates, and t values are shown in parentheses below coefficient estimates. ***, **, and *, respectively, indicate significance levels at 0.1%, 1%, and 5% levels. The random-effects approach is employed for the split-sample regressions.

Table 4 provides an overview of the results obtained from the demeaned mean groups (MG) and the generalized FGLS regressions. The split-sample regressions are conducted using FGLS. In both the MG and FGLS regressions, statistically significant estimates are

observed, indicating a positive association between education and tolerance. The split-sample regressions yield results similar to those obtained in the regressions above. In the low-income group, while the simple regression suggests a positive effect of education, the multiple regression does not confirm this effect. Conversely, in the high-income group, both regressions capture the positive effect adequately. Therefore, the finding that the positive effect is more pronounced in high-income countries is also observed in the FGLS regressions.

Table 4. MG and FGLS results.

	Full Sample				Split Samples			
	Mean Groups		FGLS		Low Income		High Income	
eys_{t-1}	5.99 *	6.60 **	4.74 ***	1.58 **	2.14 *	0.39	4.12 ***	3.07 **
	(2.05)	(2.75)	(6.69)	(2.77)	(2.30)	(0.38)	(4.83)	(2.98)
$\ln(\text{gdp})_{t-1}$		1.65		14.17 ***		6.27 *		5.55
		(0.11)		(9.54)		(2.21)		(1.80)
ineq_{t-1}		0.50		−0.02		0.03		0.36
		(1.11)		(−0.34)		(0.28)		(1.61)
R^2	0.95	0.98	0.31	0.45	0.04	0.08	0.23	0.13

Notes: The table shows the results of demeaned mean groups and generalized FGLS regressions in which rainbow$_t$ is used as a dependent variable. Figures are regression coefficient estimates, and t values are shown in parentheses below coefficient estimates. ***, **, and *, respectively, indicate significance levels at 0.1%, 1%, and 5% levels.

Table 5 reports the results of the feature selection methods–Boruta and regsubsets, and Figure 2 presents the Boruta boxplot. According to the Boruta analysis, all independent variables are confirmed to influence the tolerance variable, while the most influential variable is GDP, which is observed also by the regsubsets method that shows the best set of variables for each model size.
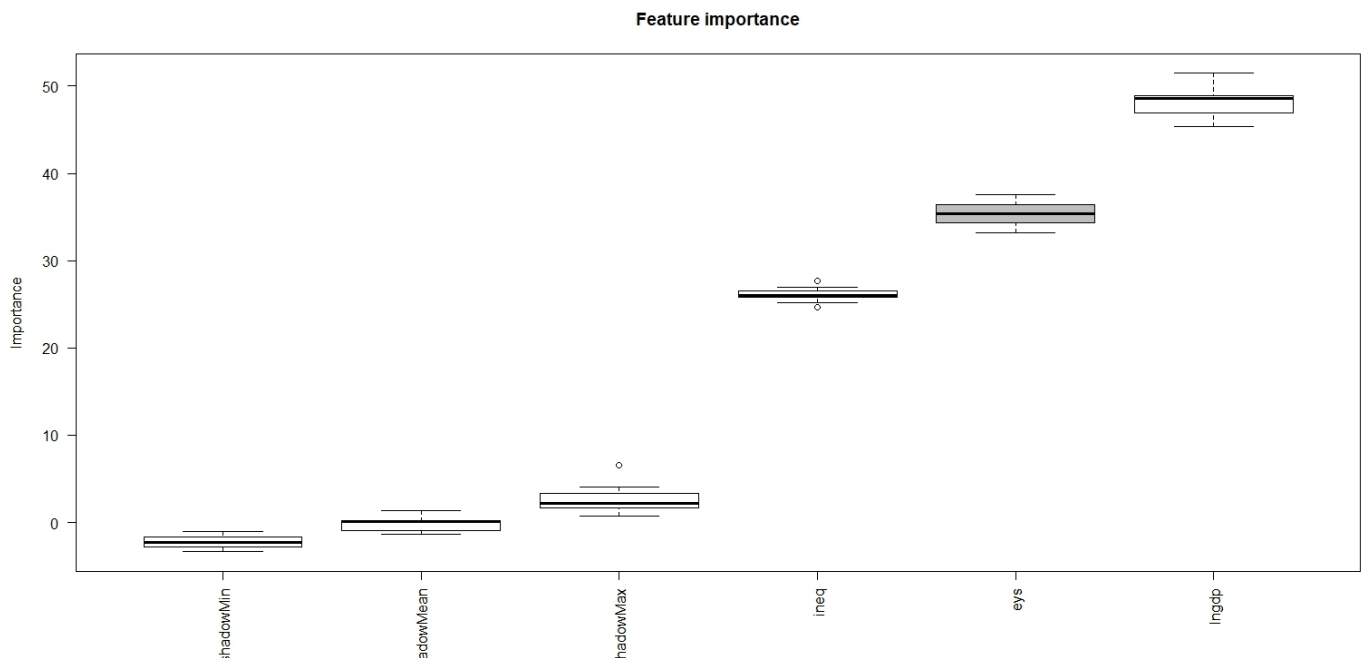

Figure 2. Boruta boxplot.

Table 5. Machine learning feature selection results.

	Boruta					Regsubsets			
	Mean	Median	Min.	Max.	Decision	1	2	3	Coef.
eys	35.33	35.33	33.20	37.51	confirmed		*	*	3.48
ln(gdp)	48.05	48.63	45.32	51.46	confirmed	*	*	*	10.29
ineq	26.09	26.05	24.68	27.63	confirmed			*	−0.24
R^2								0.48	

Notes: The table shows the results of machine learning feature selection methods of Boruta and regsubsets in which rainbow is used as a dependent variable.

5. Conclusions

This study empirically explores the association between education and tolerance towards sexual minorities by analyzing country-level panel data. In light of the persistence of homophobia and discrimination based on sexual orientation, it is essential to identify the factors that shape tolerance towards sexual minorities. In addition to economic development, education stands out as another vital factor in understanding tolerance. Education is recognized as a crucial factor influencing individuals' beliefs, attitudes towards others, and interpersonal trust. Education enhances individuals' general knowledge and critical thinking abilities, thereby fostering greater tolerance towards minority groups.

This study utilizes panel data from 49 European countries spanning the period 2012 to 2022. The panel data are analyzed using various estimators, including fixed effects, random effects, demeaned mean group (MG), and generalized feasible generalized least squares (FGLS) estimators. Furthermore, machine-learning-based feature selection models are utilized to assist in identifying the determinants of tolerance. The empirical findings indeed support the positive impact of education on tolerance towards sexual minorities, with this effect being especially prominent in high-income countries.

Education plays a crucial role in promoting social tolerance toward sexual minorities, especially in high-income countries, where educational systems often emphasize diversity, inclusivity, and critical thinking. These educational frameworks can help shape more accepting attitudes by fostering awareness and understanding of different sexual orientations and identities, thereby contributing to a more tolerant society.

Education increases awareness of sexual diversity and the broader social, cultural, and historical contexts surrounding sexual minorities. Exposure to various sexual identities and orientations in educational settings encourages individuals to understand diverse perspectives, which can reduce prejudice and foster empathy. Inclusive educational curricula that incorporate issues like gender, sexual orientation, and human rights can break down misconceptions and foster greater acceptance by presenting sexual minorities in a positive, normalized light, helping students see LGBTQIA+ individuals as integral members of society. Higher levels of education tend to improve critical thinking skills, allowing individuals to question stereotypes, challenge biases, and think beyond traditional societal norms.

The positive relationship between education and tolerance toward sexual minorities has important policy implications, especially for promoting inclusive societies and reducing discrimination. Policymakers can use this understanding to develop targeted strategies that leverage education systems as tools for fostering tolerance. Educational policies could mandate the inclusion of LGBTQIA+ history, rights, and issues in school curricula to promote understanding and empathy. This might involve teaching students about diverse family structures, gender identities, and sexual orientations. Policies could require training programs to prepare teachers to handle discussions around sexual minorities sensitively and informatively. By equipping educators with the necessary tools, they can address these topics without bias or discomfort, helping students understand and accept diversity. Schools can adopt robust antibullying policies specifically addressing discrimination based on sexual orientation or gender identity. Such policies would provide clear protocols for preventing and addressing incidents of discrimination, creating a safer, more supportive environment for LGBTQIA+ students and promoting a culture of tolerance.

This study makes a significant contribution to the literature on education and tolerance by employing robust methodologies. Specifically, we utilize country-level panel data, incorporate the concept of institutionalized tolerance, employ various panel regression techniques, and integrate machine learning techniques into the empirical analysis.

This study has some limitations that should be acknowledged. First, this study uses expected years of schooling as a measure of education, but it focuses on quantity rather than quality of education. Expected years of schooling does not account for differences in curricula or nonformal education. Second, while religion is a significant factor in studies on tolerance toward homosexuals, it is not included in this panel data analysis due to data limitations. Additionally, the endogeneity issue is a known challenge in this area of research. Although panel data analysis is employed here to help reduce endogeneity concerns, it does not entirely resolve them. Using instrumental variables is one approach to addressing endogeneity, but finding suitable instruments is often challenging. These issues are suggested for exploration in future research.

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