Multilevel project: How freedom of expression is influenced over years by the rule of law

Benedetta Lava, r1056608

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Abstact

This study examines the relationship between freedom of expression and the rule of law, measured by executive respect for the constitution, across 20 European countries from 1960 to 2010. Using panel data from the V-Dem dataset, the Penn World Table, and supplementary sources, I employed multilevel modeling techniques, including fixed effects, random effects, within-between, and Mundlak models, to disentangle within-country temporal effects from cross-country differences. My findings reveal a robust positive association between constitutional respect and freedom of expression, with within-country improvements in the rule of law showing stronger effects than between-country disparities. Notably, corruption levels and regime type further moderate this relationship. The analysis underscores the importance of institutional checks on executive power in safeguarding expressive freedoms. Methodologically, the study demonstrates the advantages of within-between decomposition over conventional panel models in isolating temporal dynamics from structural differences.

1 Introduction

The primary aim of this study is to analyze how freedom of expression is influenced by respect of the rule of law, measured through the extent to which the executive respects the constitution, using panel data from some European countries from 1960 to 2010.

Before going into the quantitative analysis, it is necessary to provide general definitions of the rule of law and freedom of expression.

According to the United Nations, the rule of law is defined as follows:

> The rule of law is a principle of governance in which all persons, institutions and entities, public and private, including the State itself, are accountable to laws that are publicly promulgated, equally enforced and independently adjudicated, and which are consistent with international human rights norms and standards. It requires, as well, measures to ensure adherence to the principles of supremacy of the law, equality before the law, accountability to the law, fairness in the application of the law, separation of powers, participation in decision-making, legal certainty, avoidance of arbitrariness and procedural and legal transparency.
> — *Source:*United Nations, *What is the Rule of Law?*, available at: `https://www.un.org/ruleoflaw/what-is-the-rule-of-law/`

It is primarily concerned with how power is exercised, rather than who exercises it. In contrast, democracy is centered on political participation and popular sovereignty, typically expressed through free and fair elections.

In essence, the rule of law limits the arbitrariness of power, ensuring that public authority is exercised in accordance with pre-existing and known laws, rather than based on individual will.

Obviously, in this analysis, the quantification of how much a state's executive power respects the constitution ($v2exrescon$ variable) was used as a proxy for the rule of law .

As previously acknowledged in the literature, the variable `v2exrescon` from the V-Dem dataset has been used as a proxy for the rule of law. For instance, Gutmann, Metelska-Szaniawska, and Voigt 2024 explicitly refer to it as an indicator of constitutional compliance, a fundamental component of the rule of law.

Indeed for a general definition of freedom of expression we can look to the clear definition of freedom of expression given by the European Convention on Human Rights (ECHR),in particular the Article 10 states:

> *Everyone has the right to freedom of expression. This right shall include freedom to hold opinions and to receive and impart information and ideas without interference by public authority and regardless of frontiers. This Article shall not prevent States from requiring the licensing of broadcasting, television or cinema enterprises.*
> — *Source:* Council of Europe, European Convention on Human Rights. Available at: https://fra.europa.eu/en/law-reference/european-convention-human-rights-article-10

If we focus on quantifying the relationship between freedom of expression and, more generally, the extent to which executive power respects the constitution, we can examine the following table extracted from the annual report by World Justice Project 2024 which reports two components of the Rule of Law Index:

Country	**Factor 1: Constraints on Government Powers**	**Factor 4.4: Freedom of Expression**
Norway	0.92	0.94
Finland	0.92	0.88
Sweden	0.86	0.86
Germany	0.86	0.83
Belgium	0.81	0.79
Greece	0.76	0.55
Spain	0.70	0.69
Italy	0.70	0.67
Albania	0.43	0.50
Turkey	0.29	0.36
Serbia	0.34	0.43
Morocco	0.46	0.45

Table 1: WJP 2024 Scores: Constraints on Executive Power and Freedom of Expression in Selected Countries

In particular in Table 1 Factor 1, *Constraints on Government Powers*, measures the extent to which those who govern are bound by law and in this case it can be considered as a proxy of rule of law. This factor includes checks and balances from the judiciary, legislature, and independent auditing institutions, as well as the presence of a free press and civil society oversight while Sub-factor 4.4, *Freedom of Opinion and Expression*, assesses whether individuals, civil society organizations, political parties, and the media are free to express opinions and report on government policies without fear of retaliation.

The data show a general trend: countries scoring higher on Factor 1 also tend to score higher on Sub-factor 4.4. This suggests a positive correlation between institutional checks on executive power and the protection of freedom of expression.

The plot below, which visualizes our data at the country level, further supports the idea of a positive association between these two variables.

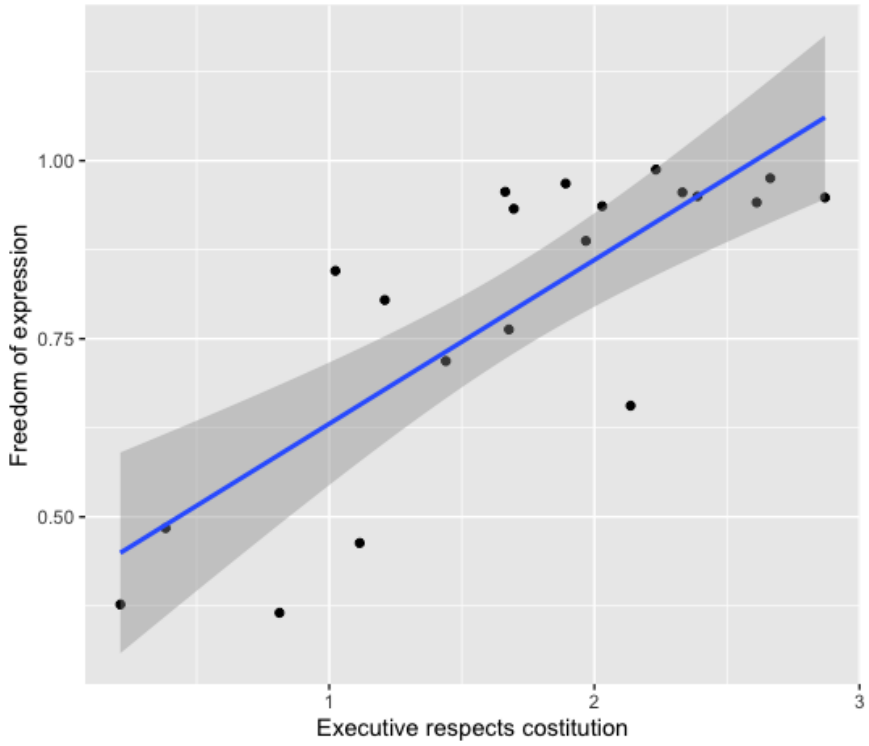

Figure 1: Relationship between Executive power respects constitution and Freedom of expression at country-level.

So generally trying to quantify these topics is pretty complex, but thanks to the V-democracy dataset, one of the most comprehensive global datasets on political regimes, democracy, and governance (Coppedge et al. 2025), it is possible to lead an analysis focusing on the changes over time of these several variables about democracy.

Therefore with this data we can try to answer different questions, for example "Is the increase in constitutional respect over time (within-country variation) associated with greater freedom of expression?" or "Do countries with higher average levels of constitutional respect (between-country variation) exhibit greater freedom of expression?" or "Do national characteristics such as the income group or the level of corruption explain why the respect of freedom of expression is stronger in certain countries?"

In the following section, using multilevel models which handle the hierarchical structure of our data, such as fixed and random effects models and within-between and Mundlak specification, I tried to answer these questions.

2 Description of Data

As mentioned above, the dataset used in this analysis is structured as panel data, including multiple variables recorded annually for a selection of European countries over the period from 1960 to 2010. The final dataset was created by merging three different sources: the V-Dem dataset, which contains a wide range of indicators measuring various dimensions of democracy; the Penn World Table (PWT), which provides information on income levels, output, inputs, and productivity across 183 countries from 1950 to 2019 Feenstra, Inklaar, and Timmer 2015; and an additional dataset used in the study by O'Reilly 2021.

The following variables, used in this analysis, are drawn from the V-Dem dataset (each variable is constructed using rigorous methodological procedures, often involving Bayesian factor analysis or deterministic coding) and from PWT database and from the dataset used in the paper of O'Reilly 2021:

- $v2x\_freexp\_altinf$ (Freedom of Expression and Alternative Sources of Information Index): This index

captures the extent to which citizens are free to express political opinions and access alternative sources of information. It includes variables related to media censorship, journalists' harassment, media bias, self-censorship, presence of critical media, freedom of discussion (both for men and women), and academic and cultural expression. The resulting index ranges from 0 to 1, with higher values indicating greater freedom.

- $v2x\_regime$ (Regimes of the World Classification): This variable categorizes political regimes into four types: closed autocracy (0), electoral autocracy (1), electoral democracy (2), and liberal democracy (3)
- $v2regdur$ (Regime Duration): This variable measures the number of consecutive years a regime has been in power.
- $v2exrescon$ (Executive Respects the Constitution): This variable assesses the degree to which the executive branch adheres to the constitution in practice. Higher values of this variable indicate greater respect for constitutional rules so an higher rule of law.
- $v2ex\_hogw$ (Relative Power of the Head of Government): This variable captures the relative power of the Head of Government (HOG) compared to the Head of State (HOS) specifically over the appointment and dismissal of cabinet ministers. It is defined as the inverse of the HOS's power on the same matter, and thus reflects the balance of executive authority between the two roles. A score of 0 indicates that the HOG has no power and the HOS holds full authority. A score of 0.5 denotes equal power shared between the HOG and HOS. A score of 1 suggests that the HOG has full power over cabinet decisions.
- $v2x\_corr$ (Corruption Index): This index captures the general level of corruption in the executive, legislative, judicial and public sectors of a country. The index ranges from 0 (low corruption) to 1 (high corruption), and serves as a comprehensive measure of public sector integrity.
- $IncomeGroup$ which represents the income group of a country.

3 Descriptive Analysis

The countries considered in this study are: Austria, Belgium, Bulgaria, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Spain, and Sweden.

The dataset is balanced, as each country has observations for 51 consecutive years. Moreover, the variables used are expressed as indices, and therefore do not require further rescaling.

Figure 2 illustrates the evolution of freedom of expression over time across several European countries. We observe that in some countries, such as Denmark, Finland, and Austria, freedom of expression remains consistently high throughout the period. In contrast, other countries, such as Bulgaria, Spain, Romania, and Poland, exhibit lower levels of freedom of expression in the early years, with noticeable improvements starting in the 1970s.

These trends suggest that the evolution of freedom of expression varies substantially within countries. While some nations, particularly in Northern Europe, display stable trajectories, others show more dynamic patterns of change over time.

Given this variation, an important question arises: to what extent are these changes in freedom of expression linked to changes in the rule of law over time?

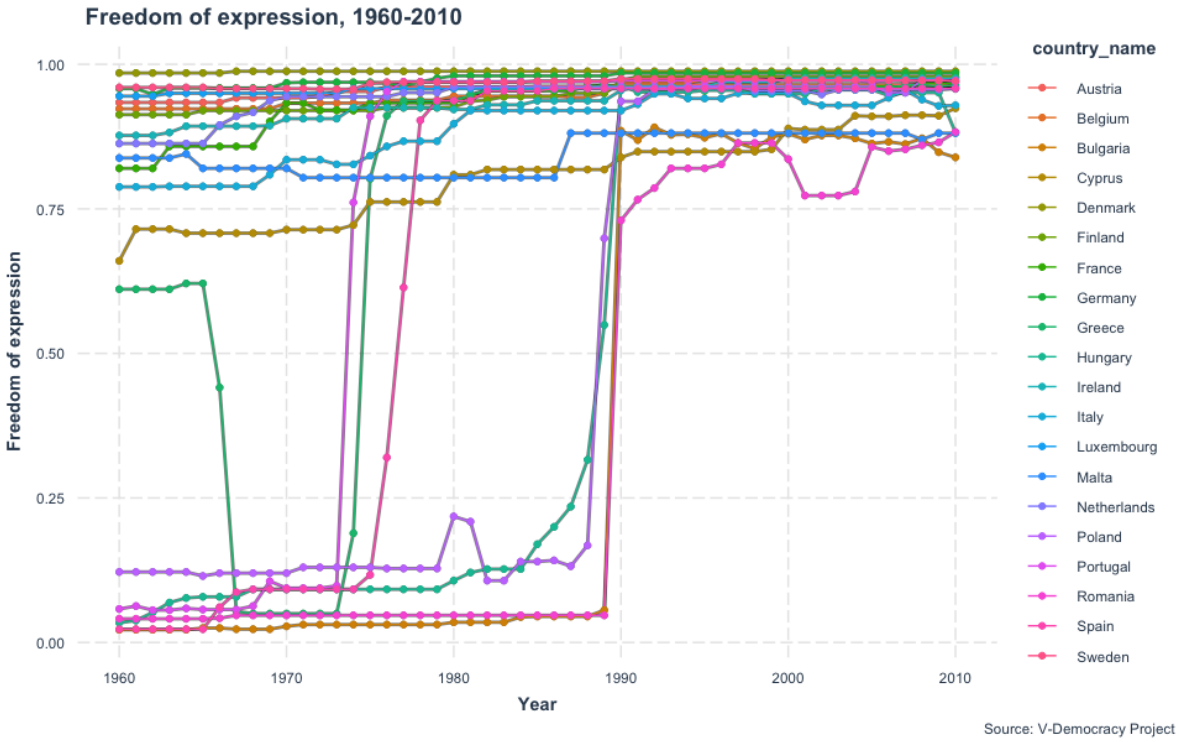

Figure 2: Freedom of expression over the years.

Since we can see from the plot above that freedom of expression has changed over the years, the first question we might ask is if this change is due to a change in the rule of law over the years.

4 Modelling

Standard regression model

To answer the previous questions, the first step is to fit a linear regression model to see how freedom of expression is affected by the rule of law, in this context quantified by the executive power's respect for the constitution and other variables that previously I have described.

The results of the standard regression model that I had fitted are the following (Table 2):

Table 2: OLS Regression Coefficients

Coefficient	Estimate	Std. Error	t value	$Pr(>\|t\|)$
(Intercept)	0.10960	0.01031	10.629	$< 2e-16^{***}$
v2x_corr	-0.07221	0.02195	-3.290	0.00104^{**}
v2exrescon	0.01871	0.00415	4.515	$7.1e-06^{***}$
v2x_regime1	0.47990	0.01365	35.161	$< 2e-16^{***}$
v2x_regime2	0.72430	0.00902	80.299	$< 2e-16^{***}$
v2x_regime3	0.78340	0.01101	71.161	$< 2e-16^{***}$
v2regdur	0.00000	0.00000	3.032	0.00249^{**}
v2ex_hogw0.5	-0.00849	0.01026	-0.828	0.40809
v2ex_hogw1	0.01415	0.00686	2.063	0.03934^{*}
IncomegroupUpper middle income	-0.03074	0.00885	-3.473	0.00054^{***}

We note that almost all of the coefficients are statistically significant, except for those associated with certain levels of the variable capturing the relative power of the Head of Government.

The variables that exhibit the strongest positive influence on freedom of expression include the political regime (with all levels of this categorical variable being statistically significant), selected levels of the Head of Government's relative power and the degree to which the executive respects the constitution.

In this model government corruption shows a negative coefficient, indicating that higher levels of corruption are associated with lower levels of freedom of expression.

In particular, the positive coefficient for the rule of law variable confirms the descriptive findings presented in Table 1, reinforcing the idea that countries with stronger rule of law tend to exhibit greater levels of freedom of expression.

It is important to note that standard linear regression models assume independence across observational units. However, in my case, where I analyzed repeated observations for the same countries over time, it is essential to account for the inherent dependency structure in the data.

Using a standard linear model in the presence of such dependency leads to biased standard errors, typically underestimated, which increases the risk of Type I error. Furthermore, biased standard errors can result in incorrect confidence intervals and hypothesis tests, ultimately affecting the assessment of statistical significance.

To address this issue, I employed multilevel models, which explicitly account for the nested structure of our data. These models yield more accurate standard errors and allow for a more reliable interpretation of the relationships under investigation.

Dependence

Before introducing models that account for the dependency structure of panel data, it is useful to present the concept of the Intra-class Correlation Coefficient (ICC), also known as the Variance Partition Coefficient (VPC). The ICC is an index that measures the proportion of total variance attributable to differences between clusters, in our case the clusters are the different countries.

Given the panel structure of the dataset, I expect a relatively high ICC, as repeated observations over time within the same country are likely to be more similar to each other than to observations from different countries. This dependency is clearly visible in correlation plot in Figure 3.

In particular, as shown in Figure 3, the correlation between successive years is very strong, and even the correlation between distant years (e.g., 1960 and 2010) remains around 50%.

To obtain the ICC index that I have mentioned before, I fitted an empty multilevel model, which decomposes the variance into within and between variation, considering only the country as a random intercept.

The formula for the empty random intercept model, where the response variable is freedom of expression and the random intercepts are for countries observed from 1960 to 2010, can be written as:

$$\text{Freedom of Expression}_{it} = \beta_0 + u_i + \epsilon_{it}$$

Where:

- $\text{Freedom of Expression}_{it}$ represents the level of freedom of expression for country i at time t.
- β_0 is the overall intercept, representing the average level of freedom of expression across all countries and time points. This is a fixed effect.
- u_i is the random intercept for country i. It represents the deviation of country i's average level of freedom of expression from the overall average (β_0). We assume that $u_i \sim \mathcal{N}(0, \sigma_u^2)$, where σ_u^2 is the variance of the random intercepts across countries.
- ϵ_{it} is the error term at the individual level (for country i at time t). It represents the within-country variation in freedom of expression over time. We assume that $\epsilon_{it} \sim \mathcal{N}(0, \sigma_e^2)$, where σ_e^2 is the residual variance.
- Notation: Indices ordered from lowest (i) to highest (j) level

Assumptions about the error term:

- Both error terms are IID (independent and identically distributed):

$$u_j \sim N(0, \sigma_u^2) \quad \text{(variance per group)}$$
$$e_{ij} \sim N(0, \sigma_e^2) \quad \text{(variance per observation within group)}$$

- Both error terms are independent of each other:

$$\text{Cov}(u_j, e_{ij}) = 0$$

In the context of an empty random intercept model, the ICC directly represents the average correlation of the dependent variable (freedom of expression) measured at different time points within the same country. So, with our data, we obtain an ICC equal to 44.03% which means, following the rule of thumb of 10%, there is a great dependency on the data due to the clustering in level-2 units and this higher value of the ICC indicates that freedom of expression within the same country is more similar over time compared to freedom of expression in different countries, a result we expected because the dependency in the observations will often much stronger in panel data that in other kinds of multilevel data.

While the intra-class correlation coefficient (ICC) already shows that there is meaningful variation between countries in the outcome variable (freedom of expression), I wanted to reinforce this conclusion with a more robust statistical test.

For this reason, I performed an ANOVA-based comparison between a standard linear regression model (OLS) with only an intercept and an empty multilevel model that includes only a random intercept for countries. This is done using a likelihood ratio test (LRT), which allows us to test whether adding random effects significantly improves model fit.

The results of the comparison are shown below:

Model	npar	AIC	BIC	logLik	Deviance	**Chisq**	p-value
mod0 (OLS)	2	532.32	542.17	-264.160	528.32	—	—
mod2 (Multilevel)	3	38.78	53.57	-16.392	32.78	495.54	$< 2.2e\text{-}16$ ***

As we can see, the likelihood ratio test yields a chi-squared statistic of 495.54, and a p-value lower than < 0.05, so this test provides strong statistical evidence that incorporating random intercepts for countries is necessary. So this finding reinforces the conclusions drawn from the ICC and justifies the use of hierarchical models in the subsequent analysis.

Fixed Effect model

In light of these results, it seems obvious to take this dependency structure into account using appropriate models such as the fixed effects model.

As mentioned above, my goal is to examine whether within-country improvements in constitutional respect are associated with higher levels of freedom of expression, and to explore the dynamic development of expressive freedoms across time.

Before speaking of a fixed effects model, let us recall that in the language of 'panel people' if we consider the following model,

$$y_{it} = \beta_0 + \beta_1 x_{1it} + \gamma_1 z_{1t} + u_i + \epsilon_{it}$$

,

this model assumes that the dependencies between observations from the same unit are due to unit-specific characteristics, u_i(often called unobserved heterogeneity).

So if u_i is correlated with the variables in the model, estimates will be biased.

A solution for control the unobserved heterogeneity is using the so called Least Square Dummy Variables (LSVD) approach, a special version of the standard linear regression model in which we add a set of unit-specific dummy variables:

$$\text{Freedom of Expression}_{it} = \beta_0 + \beta_1 \text{v2exrescon}_{it} + \sum_{i=1}^{n-1} \delta_i d_i + \epsilon_{it}$$

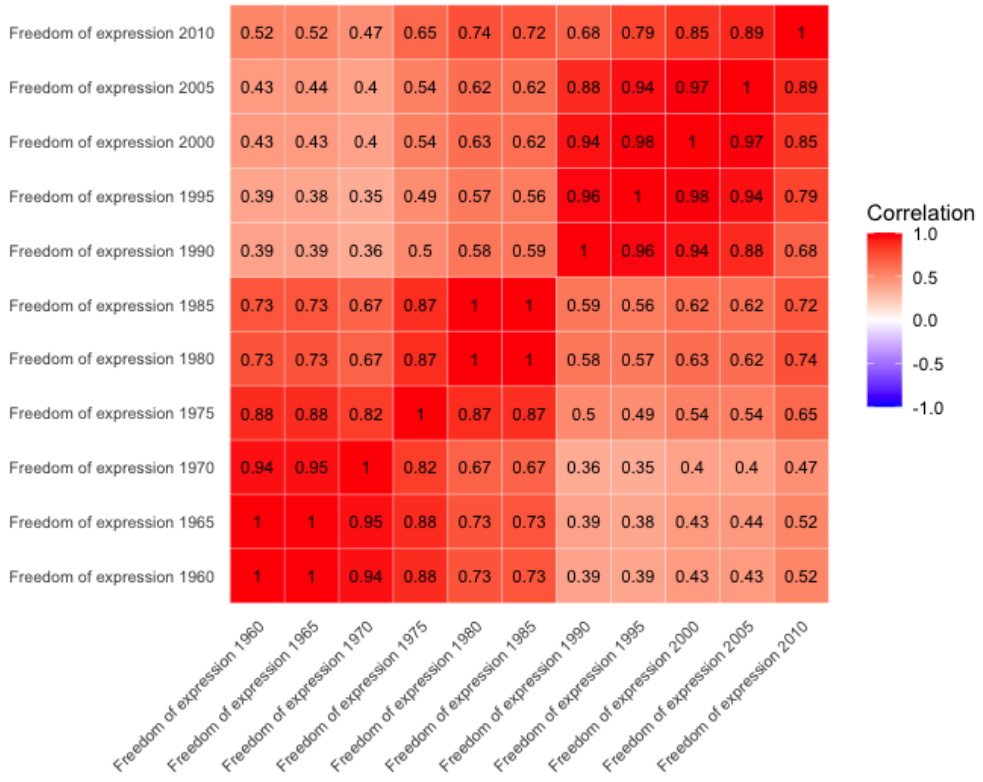

Figure 3: Correlation plot of Freedom of Expression over years.

In our context I fitted this type of model using 20-1 different dummy variables for the 20 countries we are considering and considering only the "executive respects the constitution" as covariates, the results of this model are in Table 3:

Table 3: LSVD Regression Coefficients

Coefficient	Estimate	Std. Error	t value	$Pr(>\|t\|)$
(Intercept)	0.407277	0.024809	16.416	$< 2e-16^{***}$
v2exrescon	0.330051	0.008275	39.886	$< 2e-16^{***}$
factor(country_name)Belgium	-0.245646	0.029800	-8.243	$5.23e-16^{***}$
factor(country_name)Bulgaria	-0.100306	0.031563	-3.178	0.001529^{**}
factor(country_name)Cyprus	-0.001987	0.029430	-0.068	0.946173
factor(country_name)Denmark	-0.156363	0.029566	-5.289	$1.51e-07^{***}$
factor(country_name)Finland	-0.406087	0.030848	-13.164	$< 2e-16^{***}$
factor(country_name)France	-0.034573	0.029191	-1.184	0.236538
factor(country_name)Germany	-0.310758	0.030339	-10.243	$< 2e-16^{***}$
factor(country_name)Greece	-0.197850	0.029190	-6.778	$2.08e-11^{***}$
factor(country_name)Hungary	-0.311919	0.029540	-10.559	$< 2e-16^{***}$
factor(country_name)Ireland	-0.140930	0.029346	-4.802	$1.81e-06^{***}$
factor(country_name)Italy	-0.169328	0.029298	-5.780	$1.00e-08^{***}$
factor(country_name)Luxembourg	-0.221446	0.029709	-7.454	$1.96e-13^{***}$
factor(country_name)Malta	0.100395	0.029666	3.384	0.000742^{***}
factor(country_name)Netherlands	-0.327978	0.030226	-10.851	$< 2e-16^{***}$
factor(country_name)Poland	-0.049387	0.031054	-1.590	0.112068
factor(country_name)Portugal	-0.163702	0.029248	-5.597	$2.82e-08^{***}$
factor(country_name)Romania	-0.310036	0.030027	-10.325	$< 2e-16^{***}$
factor(country_name)Spain	-0.456349	0.029451	-15.495	$< 2e-16^{***}$
factor(country_name)Sweden	-0.063591	0.029250	-2.174	0.029936^{*}

Remember that any time-invariant variable must be removed to avoid perfect collinearity with the set of country dummy variables. In this case, the reference category for the set of dummy variables is the country *Austria* and the unobserved effects are modeled as Fixed Effects.

We can observe that, also in this model, the coefficient associated with the rule of law ($v2exrescon$) is positive and statistically significant, as already seen in the previous regression model.

Now, instead of partialing out the variance between units of analysis using dummy variables, we can apply the so-called Fixed Effects (FE) model (referred to as the "within" model in the `plm` package) which focuses on within-unit variation by removing between-unit variation.

The FE model is constructed by averaging each unit over time and then subtracting this average (the between model) from the observed values, effectively eliminating time-invariant unobserved heterogeneity.

In this context, I avoided performing this transformation manually, as it would lead to incorrect standard errors due to an improper calculation of the degrees of freedom. Instead, I relied on the implementation provided by the `plm` package, which handles this correctly.

For the LSVD model, the FE model, and the models that follow, I initially considered only the rule of law as the independent variable. This choice is made for clarity in presenting the results and for a better understanding of the differences and strengths of each model.

The table above presents the results obtained from the LSVD and FE models:

As we expected, the LSDV model gives us the same estimate of the effect of rule of law on freedom of expression as the FE model.

We also note that the standard error of this coefficient in both models is about twice as large (0.0083) as that calculated using the standard regression model (0.004) considering all variables. This result confirms that if we do not consider models that take into account the dependency structure of our data, we incur in interpretation errors.

In particular, as we have seen before, the index of freedom of expression increases by 0.33 when the rule of law increases by one unit, confirming the idea that the increase in constitutional respect over time is associated with greater freedom of expression.

Furthermore, compared to the standard regression model, it can be seen that the estimated coefficient

relating to the rule of law is greater, highlight the fact that if the dependency structure is not taken into account, the effects of the variables may also be distorted.

Table 4: Regression Coefficients

	Model	
Coefficient	LSVD	FE
(Intercept)	0.4073***	
	(0.0248)	
v2exrescon	0.3301***	0.3301***
	(0.0083)	(0.0083)
factor(country_name)Belgium	-0.2456***	
	(0.0298)	
factor(country_name)Bulgaria	-0.1003**	
	(0.0316)	
factor(country_name)Cyprus	-0.0020	
	(0.0294)	
factor(country_name)Denmark	-0.1564***	
	(0.0296)	
factor(country_name)Finland	-0.4061***	
	(0.0308)	
factor(country_name)France	-0.0346	
	(0.0292)	
factor(country_name)Germany	-0.3108***	
	(0.0303)	
factor(country_name)Greece	-0.1978***	
	(0.0292)	
factor(country_name)Hungary	-0.3119***	
	(0.0295)	
factor(country_name)Ireland	-0.1409***	
	(0.0293)	
factor(country_name)Italy	-0.1693***	
	(0.0293)	
factor(country_name)Luxembourg	-0.2214***	
	(0.0297)	
factor(country_name)Malta	0.1004***	
	(0.0297)	
factor(country_name)Netherlands	-0.3280***	
	(0.0302)	
factor(country_name)Poland	-0.0494	
	(0.0311)	
factor(country_name)Portugal	-0.1637***	
	(0.0292)	
factor(country_name)Romania	-0.3100***	
	(0.0300)	
factor(country_name)Spain	-0.4563***	
	(0.0295)	
factor(country_name)Sweden	-0.0636*	
	(0.0293)	
R^2	0.7835	0.6143
Adj. R^2	0.7792	0.6065
Num. obs.	1020	1020

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Random Effect Model and Mundlak model

The positive aspect of the fixed-effects model is that it controls for all unit-specific time constant characteristics that could influence the dependent variable, eliminating u_i from the model i.e. unobserved heterogeneity.

On the other hand, using what panel people call the Random Effect (RE) model,

$$y_{it} = \beta_0 + \beta_1 x_{1it} + \gamma_1 z_{1t} + u_i + \epsilon_{it}$$

instead of eliminating u_i from the data, we could estimate it, assuming that this unobserved heterogeneity is uncorrelated with the model's independent variables, including time-constant variables such as *Incomegroup* in our data.

The Table 5 presents the results of FE model and RE model.

Previously, we conducted the Breush-Pagan test, which, given the rejection of the null hypothesis ($chisq = 3208.2, df = 1, p - value < 2.2e - 16$), confirmed that there is a serious correlation in our data, so it makes sense to estimate an RE model.

Table 5: Regression Results FE vs RE

	Model	
Coefficient	FE	RE
v2exrescon	0.3301***	0.3247***
	(0.0083)	(0.0082)
(Intercept)		0.2418***
		(0.0317)
IncomegroupUpper middle income		-0.0369
		(0.0889)
R^2	0.6143	0.6124
Adj. R^2	0.6065	0.6116
Num. obs.	1020	1020
s_idios		0.1474
s_id		0.1159

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

We note that the estimated effect of our variable of interest, $v2exrescon$, is slightly smaller in the Random Effects (RE) model but remains positive. This difference arises because, unlike the Fixed Effects (FE) model, which removes all between-unit variation, the RE model incorporates both within-unit and between-unit variation to estimate the parameters.

We also observe that the estimated standard errors are very similar across both models.

However, it is important to recall that the RE model is valid only under the assumption that the unobserved unit-specific effects are uncorrelated with the explanatory variables in order to not have biased coefficients.

If this assumption is violated, the RE model yields biased estimates, and the FE model should be preferred.

To test whether this assumption holds, we performed a Hausman test comparing the FE and RE estimates. In our case, we reject the null hypothesis of no correlation ($\chi^2 = 17.299$, $df = 1$, p-value = 3.194e-05), indicating that the FE model is more appropriate for our analysis.

The within-between model

In the context of panel data analysis, the Between-Within (BW) model offers an alternative methodological approach to Fixed Effects (FE) and Random Effects (RE) models, particularly when one aims to explicitly distinguish the impact of explanatory variables both within units over time (within effects) and between units (between effects).

The FE model focuses exclusively on within-unit variation, removing any time-invariant component for each unit. In contrast, the RE model incorporates both within and between unit variation but relies on the assumption that the effect of the variables is the same across both dimensions and, crucially, that unobserved heterogeneity is uncorrelated with the explanatory variables.

The BW model overcomes these limitations by explicitly decomposing each explanatory variable into two components: a between-unit component and a within-unit component, offering a more flexible solution compared to FE or RE model. This type of models allows for a estimation of the effects operating at different levels of variation.

The formulation for between-within model is the following:

$$\text{Freedom of Expression}_{it} = \beta_0 + \beta_{WE}(\text{v2exrescon}_{1it} - \bar{\text{v2exrescon}}_i) + \beta_{BE}\bar{\text{v2exrescon}}_i + \gamma_1 \text{Incomegroup}_i + u_i + e_{it}$$

- $\beta_{WE}(\text{v2exrescon}_{it} - \bar{\text{v2exrescon}}_i)$ provides the within-effect of $v2exrescon$
- $\beta_{BE}\bar{\text{v2exrescon}}_i$ provides the between-effect of $v2exrescon$
- This is the effect of $v2exrescon$ decomposed into its within- and between-component.
- The FE estimator (Bell, Fairbrother, and Jones 2019) is equivalent to the β_{WE} estimator.

Futhermore we can introduce a particular form of the BW model, namely the Mundlak model, which allows us to directly evaluate the difference between within and between effects, so this model provides a direct test of the equivalence of within-between effects.

The formulation of Mundlak model is the following:

$$\text{Freedom of Expression}_{it} = \beta_0 + \beta_{WE}\text{v2exrescon}_{it} + \beta_{BWD}\bar{\text{v2exrescon}}_i + \gamma_1 \text{Incomegroup}_i + u_i + e_{it}$$

- So if β_{BWD} is significance, this means within and between effects are different.

The following table presents the results from four panel data models, Fixed Effects (FE), Random Effects (RE), Within-Between (WB), and Mundlak, to estimate the relationship between freedom of expression and executive respect for the constitution ($v2exrescon$).

Table 6: Comparing Regression Models (*_m* in the BW model stands for between estimate while for Mundlak model stands for difference between-within estimate, *_dm* in BW model stands for within estimate)

	FE	RE	WB	Mundlak
v2exrescon	0.33***	0.32***		0.33***
	(0.01)	(0.01)		(0.01)
(Intercept)		0.24***	0.52***	0.52***
		(0.03)	(0.09)	(0.09)
IncomegroupUpper middle income		-0.04	-0.24*	-0.24*
		(0.09)	(0.11)	(0.11)
v2exrescon_dm			0.33***	
			(0.01)	
v2exrescon_m			0.18***	-0.15***
			(0.04)	(0.04)
R^2	0.61	0.61	0.62	0.62
Adj. R^2	0.61	0.61	0.62	0.62
Num. obs.	1020	1020	1020	1020
s_idios		0.15	0.15	0.15
s_id		0.12	0.12	0.12

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

We observe that the effect of $v2exrescon$ is highly significant ($p < 0.001$) across all four models.

So an increase in executive respect for the constitution is positively and strongly associated with higher levels of freedom of expression. This finding is robust and consistent across all specifications.

When focusing on the Within-Between model, I observed that the within-country effect of rule of law on freedom of expression over time (0.33), is stronger than the between-country effect (0.18).

This suggests that temporal improvements in the rule of law within a country are more strongly associated with increases in freedom of expression than the structural differences in rule of law between countries.

In the Mundlak model, the coefficient $v2exrescon\_m$ (–0.15***), captures the difference between within and between-country effect of the average level of rule of law and represents the context effect.

In particular, this value in the Mundlak model is equal to 0.18 ($between\ coefficient$) minus 0.33 ($within\ coefficient$) in within-between model.

This value reflects the context effect, meaning the difference between the between-country and within-country effects. A negative value suggests that countries with a high average level of constitutional respect may not see as much improvement in freedom of expression from further increases in respect for the constitution, compared to countries starting from a lower baseline.

Regarding the effect of the income classification, the coefficient is significant and equal to -0.24 in both the BW model and the Mundlak model.

This therefore suggests that upper middle-income countries tend to have less freedom of expression than high-income countries.

This implies that, despite higher economic development, upper-middle-income countries may face political or institutional constraints on freedom of expression.

The intercept is estimated only in the random effects (RE), "WB", and Mundlak models, as the fixed effects (FE) model absorbs the country-specific effects. In the RE and Mundlak specifications, the intercept is 0.24 and 0.52 respectively, both statistically significant. These intercepts represent the expected level of freedom of expression for the reference category (i.e., Upper middle income countries) when all other predictors are held at zero.

Notably, the intercept in the Within-Between and Mundlak models (0.52) is substantially higher than in the RE model (0.24). This difference suggests that, once we account for the country-level mean of the key independent variable ($v2exrescon\_m$), as done in the Mundlak specification, the baseline level of freedom of expression increases. This shift implies that part of the variation previously captured by the random intercept in the RE model actually reflects systematic between-country differences in the explanatory variable.

Furthermore, the R^2 and $adjustedR^2$ are nearly identical across models (0.61–0.62), suggesting similar explanatory power.

5 Cross level Interaction and random slope

To investigate how the effect of executive respect for the constitution ($v2exrescon$) on freedom of expression varies across income groups, I estimated two multilevel linear models with random intercepts and random slopes. Specifically, we decomposed $v2exrescon$ into its within-country ($v2exrescon\_dm$ and between-country ($v2exrescon\_m$) components, following the within-between model specification. Additionally, I interacted the within component with a level-2 categorical variable ($Incomegroup$) to capture cross-level moderation.

The second model employs the Mundlak specification, which includes both the level-1 variable and its group mean as separate predictors.

In both cases, a random slope for the within-country component was included to allow the effect of $v2exrescon$ to vary by country. This approach allows us to disentangle how institutional behavior impacts rights differently within and across contexts, and whether this effect depends on macro-economic development.

Table 7: Multilevel models with cross-level interaction between executive constitutional respect and income group

	WB Model	Mundlak Model
Intercept	0.58***	0.58***
	(0.07)	(0.07)
v2exrescon_dm	0.22	
	(0.14)	
v2exrescon		0.22
		(0.14)
v2exrescon_m	0.14***	-0.08
	(0.04)	(0.14)
Incomegroup: Upper middle income	-0.08	-0.08
	(0.16)	(0.16)
v2exrescon_dm × Upper middle income	-0.24	
	(0.40)	
v2exrescon × Upper middle income		-0.24
		(0.40)
v2exrescon_m × Upper middle income	-0.40	-0.16
	(0.21)	(0.45)
AIC	-1631.58	-1631.58
BIC	-1582.31	-1582.31
Log Likelihood	825.79	825.79
Num. observations	1020	1020
Num. groups (countries)	20	20
Var: Intercept (country)	0.01	0.01
Var: Slope (*v2exrescon_dm*)	0.28	0.28
Cov: Intercept–Slope	-0.04	-0.04
Residual variance	0.01	0.01

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 7 presents the results. In the within-between model, the within-country effect of *v2exrescon* (*v2exrescon_dm*) is positive but not statistically significant.

The between-country effect (*v2exrescon_m*) is positive and statistically significant , indicating that countries with a higher average respect for the constitution tend to have better freedom of expression outcomes.

The cross-level interaction between the within component and the *Uppermiddleincome* group is negative but not significant, implying that the effect of rule of law does not differ substantially across income groups.

In the Mundlak model, results are broadly consistent. The effect of *v2exrescon* is positive and the cross-level interaction remains non-significant. The between-country effect is negative but not significant.

In both models, the inclusion of a random slope for the within component is supported by substantial variance (Var = 0.28), indicating that the impact of constitutional respect on freedom of expression differs across countries. This justifies the use of a random slope specification to avoid biased fixed effect estimates due to unmodeled heterogeneity in slopes.

The comparison between the previous models (FE, RE, WB, Mundlak) and the extended models with cross-level interactions and random slopes reveals important differences. While the effect of *v2exrescon* is consistently strong and significant, it becomes weaker and statistically insignificant once cross-level interactions and random slopes are included.

Interestingly, the negative effect of being an upper middle income country statistically significant in the standard WB and Mundlak models loses significance in the interaction models.

The between effect of constitutional respect remains positive and significant in the WB model, but becomes unstable or negative in the Mundlak formulation, particularly when interaction terms are included.

Given the lack of statistical significance in the cross-level interaction terms and the minimal improvement in model fit, I preferred the more parsimonious models without interaction effects. These simpler specifications offer clearer interpretability while still capturing the substantial within- and between-country variation in the effect of executive respect for the constitution on freedom of expression.

In light of the previous results, and given the lack of significant interaction effects and the limited added value of modeling random slopes, the following analyses focus on models with random intercepts only and without cross-level interactions.

6 General results

After having conducted the analysis focusing only on the relationship between freedom of expression and rule of law across the years for different European countries and investigating the different assumptions of the models I have considered, in this section I looked at how the other variables under study influence our response variable.

To assess the robustness and interpretability of the relationship between executive respect for the constitution ($v2exrescon$) and freedom of expression, I compared four panel data models: Fixed Effects (FE), Random Effects (RE), Within-Between (WB), and Mundlak.

The results are in Table 8

In the fixed and random models, the coefficient for $v2exrescon$ is positive and highly significant ($p < 0.001$), confirming a strong positive association between the rule of law and freedom of expression.

In particular for this coefficient RE slightly underestimates the effect due to its assumption of no correlation between unobserved country-specific effects and regressors, and as we have seen before with the Hausman test this assumption is less realistic.

Another consequence that if this assumption fails, this can lead to biased results, is the lower coefficient for $v2x\_corr$ (0.03, non-significant), instead high significance in the other models.

If we consider the WB model, this allows us to distinguish the within and between effects and in particular the within effect of rule of law is equal to 0.07 *** while the between effect is not significance.

This result suggests that year-to-year increases in respect for the constitution within countries are positively associated with freedom of expression, while cross-country differences in respect for the constitution are not significant in this specification.

The Mundlak model augments RE by including group means of time-varying covariates ($\_m$), relaxing the RE assumption.

The significant and negative coefficient for $v2exrescon\_m$ (-0.07 ***) suggests that countries with higher average respect for the constitution may experience lower marginal increases in freedom of expression, potentially due to saturation or other institutional factors.

Regarding the other variables, we observe the following:

- $v2x\_corr$ (corruption perception) shows a strong within effect in FE and WB (0.14 ***), while its between effect in WB ($v2x\_corr\_m$) is negative and significant (-0.20 ** in WB), indicating that countries with higher average corruption scores tend to have lower levels of freedom of expression.
- Regime type dummies ($v2x\_regime$) are consistently positive and significant across all models, showing expected gradients from autocracy to democracy, and their decomposition in the Mundlak model confirms both within and between regime effects.

In conclusion all models demonstrate high explanatory power, with:

- R^2 values ranging from 0.94 (FE/RE) to 0.95 (WB and Mundlak), while the *adjusted* R^2 reaching 0.95, confirming excellent model performance and suggesting that most of the variation in freedom of expression is well captured by the predictors.

Comparing the initial models, which included only the rule of law proxy, with the final models incorporating all structural variables, we observe that:

- The initial fixed effects (FE) and random effects (RE) models showed a strong positive association between executive constitutional compliance ($v2exrescon$) and freedom of expression (FE: $\beta = 0.33$, $p < 0.001$).
- The within-between (WB) decomposition revealed that within-country improvements in rule of law had a stronger effect ($\beta = 0.33$, $p < 0.001$) than cross-country differences ($\beta = 0.18$, $p < 0.001$).
- The Mundlak model confirmed this distinction, with a significant negative between-effect ($\beta = –0.15$, $p < 0.001$), suggesting diminishing returns in high-compliance nations.

- When including additional predictors (Table 8) such as corruption, regime type, duration, income group, the within-effect of rule of law remained significant but smaller ($\beta = 0.07$, $p < 0.001$), indicating partial mediation by other institutional factors.
- Corruption ($v2x\_corr$) exhibited a positive within-effect ($\beta = 0.14$, $p < 0.001$) but a negative between-effect ($\beta = –0.20$, $p < 0.01$), implying that while short-term reductions in corruption boost free expression, structurally clean governments may face other constraints.
- Among all predictors, regime type had the largest marginal impact: transitioning to more democratic regimes increased freedom of expression by 0.47–0.75 points ($p < 0.001$) if we consider the FE model.

Regarding model performance, we observe the following: the R^2 improved from 0.62 (simple WB/Mundlak models) to 0.95 (full WB/Mundlak models), indicating that institutional context accounts for most of the variation.

The Hausman test confirmed FE's superiority over RE, rejecting the assumption of uncorrelated random effects even for the models with all regressors.

Confidence Interval Analysis

This section analyzes the confidence intervals across different panel model specifications, accounting for the limited temporal variability in some variables (e.g., countries such as Finland or Norway showing little variation in rule of law or freedom of expression over time).

The results of confidence interval are in Table 9.

If we consider the Fixed Effects Model (FE), we observe that the coefficient $v2exrescon$ shows significant positive effect (0.0581, 0.0832), the coefficient $v2x\_corr$ shows wide but entirely positive interval (0.0727, 0.2072). If we consider the variables of political regimes, all show positive and significant effects with narrow interval while $v2regdur$ and $v2ex\_hogw$ show non-significant effects because the intervals include zero.

If we consider the Random Effects Model (RE), we observe that: $v2exrescon$ shows a positive but weaker effect than FE (0.0316, 0.0526), $v2x\_corr$ shows an interval that includes zero (-0.0290, 0.0826), indicating uncertain effect, such as income group while regimes type shows similar interval to FE but with slightly different intervals.

If we consider the Within-Between Model (WB), this model reveals important within-between differences: $v2exrescon$ shows non-significant between-effect and the coefficients for the type of regimes show that within-effects (w_) are more precise than between-effects (m_)

Finally in the Mundlak Model results are similar to WB specification: $v2exrescon$ shows a positive effect with negative between-component, $v2x\_corr$ shows the same pattern as WB model and the interval confirms non-significance of $v2regdur$

The width of the confidence intervals observed in Table 9 reflects the degree of within-country variability of the predictors. Variables that exhibit limited temporal variation within countries,such as $v2regdur$ or $v2ex\_hogw$, tend to produce narrower confidence intervals, but often with limited precision or statistical power due to a lack of variation. In contrast, variables with greater within-country variability, such as

$v2x\_corr$ or $v2exrescon$, yield wider confidence intervals, especially in the within and Mundlak specifications, indicating more informative estimation of their effects over time.

Table 9: Confidence intervals (95%) for our models (be = between estimate, bwd = difference between-within estimate and we = within estimate)

Coefficient	Within Effect	Random Effects	Within-Between (WB)	Mundlak
(Intercept)		0.0317 – 0.0810	0.0844 – 0.2465	0.0844 – 0.2465
v2exrescon	0.0581 – 0.0832	0.0316 – 0.0526	-0.0298 – 0.0249 (be)	-0.1032 -0.0429 (bwd)
			0.0581 – 0.0832 (we)	0.0581 – 0.0832 (we)
v2x_corr	0.0727 – 0.2072	-0.0290 – 0.0826	-0.3270 – -0.0748 (be)	-0.4837 – -0.1980 (bwd)
			0.0727 – 0.2072 (we)	0.0727 – 0.2072 (we)
v2x_regime1	0.4366 – 0.4938	0.4471 – 0.5024	0.2713 – 0.7939 (be)	-0.1955 – 0.3302 (bwd)
			0.4366 – 0.4938 (we)	0.4366 – 0.4938 (we)
v2x_regime2	0.6278 – 0.6803	0.6746 – 0.7187	0.6702 – 0.8131 (be)	0.0115 – 0.1637 (bwd)
			0.6278 – 0.6803 (we)	0.6278 – 0.6803 (we)
v2x_regime3	0.7256 – 0.7743	0.7470 – 0.7935	0.6788 – 0.9169 (be)	-0.0737 0.1694 (bwd)
			0.7256 – 0.7743 (we)	0.7256 – 0.7743 (we)
v2regdur	0.0000 – 0.0000	0.0000 – 0.0000	0.0000 – 0.0000 (be)	0.0000 – 0.0000 (bwd)
			0.0000 – 0.0000 (we)	0.0000 – 0.0000 (we)
v2ex_hogw0.5	-0.0474 – 0.0136	-0.0364 – 0.0143	-0.1105 – 0.0990 (be)	-0.0979 – 0.1203 (bwd)
			-0.0474 – 0.0136 (we)	-0.0474 – 0.0136 (we)
v2ex_hogw1	-0.0009 – 0.0419	-0.0019 – 0.0323	-0.0564 – 0.0964 (be)	-0.0799 – 0.0788 (bwd)
			-0.0009 – 0.0419 (we)	-0.0009 – 0.0419 (we)
IncomegroupUpper middle income		-0.0551 – 0.0026	-0.0734 – 0.0342	-0.0734 – 0.0342

7 Conclusion

This analysis of the relationship between executive respect for constitutional principles and freedom of expression across 20 European countries from 1960 to 2010 provides several relevant findings with important theoretical and policy implications.

The results show a strong positive link between compliance with rule of law principles and the protection of freedom of expression, although this relationship varies between changes within countries over time and differences between countries.

To ensure model parsimony, I estimated reduced versions of the models by excluding variables that were not statistically significant such as the Income Group and Relative Power of the Head of Government. The results remained robust, confirming the relevance of the key predictors as it is showed in Table 10

The main finding is that improvements in constitutional respect within individual countries are more strongly linked to gains in freedom of expression than are differences between countries. This can suggests that domestic institutional reforms may play a more important role in promoting expressive freedoms.

Other variables also provide valuable insights. If we look at the result in Table 10, the within estimates (from the FE, WB, and Mundlak-dm models) suggest a positive and statistically significant relationship between corruption and the dependent variable. This result may seem counterintuitive, especially if higher values of $v2xcorr$ indicate greater corruption. However, it can be interpreted in several ways.

First, in countries undergoing democratic transitions, it is possible to observe an increase in political openness or freedom of expression before corruption levels start to decline. In such cases, both variables may rise together over time.

Second, as media freedom improves, corruption may become more visible and more frequently reported, which could lead to an apparent positive association between the two.

Importantly, the between-effects (from the Mundlak and Wuthin-Between models) show a negative and significant relationship between average levels of corruption and the outcome. This aligns with conventional expectations: countries with higher long-term corruption tend to perform worse on democratic or institutional indicators.

Regarding regime type, the within components of regime categories remain strongly positive and significant, especially for more democratic regimes. This implies that when a country shifts toward a more democratic regime type over time, there is a corresponding improvement in the outcome variable. These results highlight the positive contribution of both formal institutional design and democratic regime change to political development.

The confidence interval analysis reveals two key patterns: consistently significant within-country effects for institutional variables (particularly constitutional respect and corruption control), and wider intervals for between-country estimates. This suggests the models may be limited by insufficient temporal variation in institutional variables among the sampled countries.

An alternative approach to obtain tighter intervals would expand the analysis to include nations that experienced more radical institutional changes (e.g., post-authoritarian transitions or democratic backsliding cases), where key variables like rule of law and freedom of expression show greater variability. This could improve estimate precision while maintaining the panel data advantages demonstrated in our preferred within-between specifications.

Furthermore, the previous findings suggest several directions for future research.

First, including cultural and social variables could help explain how institutions shape freedom of expression.

Second, studying whether there are threshold effects in the rule of law and freedom of expression link could help identify turning points in democratic progress.

Third, extending the time period to include recent cases of democratic decline could test whether these results still hold today.

From a policy point of view, the findings suggest that constitutional reforms should be part of broader strategies to strengthen democracy, rather than treated as stand-alone measures. The results also indicate that upper-middle-income democracies may need targeted institutional support to move beyond current limits in rights protection.

On the methodological side, the study shows the importance of separating effects that occur within countries over time from those that reflect differences between countries. The better performance of the within-between and Mundlak models highlights the value of this approach in comparative institutional research.

Since the interaction terms and random slopes were not statistically significant in the earlier models, and because their inclusion reduced the precision and interpretability of key coefficients, they were excluded from the final analysis. This follows the principle of parsimony and avoids overfitting, especially given the limited number of level-2 units (countries).

In summary, while this study confirms a clear link between executive respect for the constitution and freedom of expression, it also shows the complexity of this relationship. The protection of expressive freedoms depends not only on the presence of formal constitutional rules, but also on their consistent enforcement and their interaction with broader democratic institutions.

These results show that protecting freedom of expression is not just about having laws, but also about applying them consistently over time. The study makes clear that democracy grows through ongoing changes within countries, not just through fixed constitutional rules.

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Table 8: Comparing Regression Models including all variables (*_m* or *m_* in the BW model stands for between estimate while for Mundlak model stands for difference between-within estimate, *_dm* or *_w* in BW model stands for within estimate)

	FE	RE	WB	Mundlak
v2exrescon	0.07***	0.04***		0.07***
	(0.01)	(0.01)		(0.01)
v2x_corr	0.14***	0.03		0.14***
	(0.03)	(0.03)		(0.03)
v2x_regime1	0.47***	0.47***		0.47***
	(0.01)	(0.01)		(0.01)
v2x_regime2	0.65***	0.70***		0.65***
	(0.01)	(0.01)		(0.01)
v2x_regime3	0.75***	0.77***		0.75***
	(0.01)	(0.01)		(0.01)
v2regdur	0.00***	0.00***		0.00***
	(0.00)	(0.00)		(0.00)
v2ex_hogw0.5	-0.02	-0.01		-0.02
	(0.02)	(0.01)		(0.02)
v2ex_hogw1	0.02	0.02		0.02
	(0.01)	(0.01)		(0.01)
(Intercept)		0.06***	0.17***	0.17***
		(0.01)	(0.04)	(0.04)
IncomegroupUpper middle income		-0.03	-0.02	-0.02
		(0.01)	(0.03)	(0.03)
v2exrescon_m			-0.00	-0.07***
			(0.01)	(0.02)
v2exrescon_dm			0.07***	
			(0.01)	
v2x_corr_m			-0.20**	-0.34***
			(0.06)	(0.07)
v2x_corr_dm			0.14***	
			(0.03)	
v2regdur_m			-0.00	-0.00*
			(0.00)	(0.00)
v2regdur_dm			0.00***	
			(0.00)	
m_regime_1			0.53***	0.07
			(0.13)	(0.13)
w_regime_1			0.47***	
			(0.01)	
m_regime_2			0.74***	0.09*
			(0.04)	(0.04)
w_regime_2			0.65***	
			(0.01)	
m_regime_3			0.80***	0.05
			(0.06)	(0.06)
w_regime_3			0.75***	
			(0.01)	
m_hogw_0.5			-0.01	0.01
			(0.05)	(0.06)
w_hogw_0.5			-0.02	
			(0.02)	
m_hogw_1			0.02	-0.00
			(0.04)	(0.04)
w_hogw_1			0.02	
			(0.01)	
R^2	0.94	0.94	0.95	0.95
Adj. R^2	0.93	0.94	0.95	0.95
Num. obs.	1020	1020	1020	1020
s_idios		0.06	0.06	0.06
s_id		0.01	0.01	0.01

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table 10: Final regression results: FE, RE, WB and Mundlak Models (*_m* or *m_* in the BW model stands for between estimate while for Mundlak model stands for difference between-within estimate, *_dm* or *_w* in BW model stands for within estimate)

	FE	RE	WB	Mundlak
v2exrescon	0.07***	0.05***		0.07***
	(0.01)	(0.01)		(0.01)
v2x_corr	0.15***	0.03		0.15***
	(0.03)	(0.03)		(0.03)
v2x_regime1	0.47***	0.48***		0.47***
	(0.01)	(0.01)		(0.01)
v2x_regime2	0.66***	0.70***		0.66***
	(0.01)	(0.01)		(0.01)
v2x_regime3	0.76***	0.77***		0.76***
	(0.01)	(0.01)		(0.01)
v2regdur	0.00***	0.00***		0.00***
	(0.00)	(0.00)		(0.00)
(Intercept)		0.05***	0.17***	0.17***
		(0.01)	(0.03)	(0.03)
v2exrescon_m			-0.00	-0.08***
			(0.01)	(0.01)
v2exrescon_dm			0.07***	
			(0.01)	
v2x_corr_m			-0.21***	-0.36***
			(0.06)	(0.07)
v2x_corr_dm			0.15***	
			(0.03)	
v2regdur_m			-0.00	-0.00**
			(0.00)	(0.00)
v2regdur_dm			0.00***	
			(0.00)	
m_regime_1			0.53***	0.06
			(0.07)	(0.07)
w_regime_1			0.47***	
			(0.01)	
m_regime_2			0.74***	0.08*
			(0.04)	(0.04)
w_regime_2			0.66***	
			(0.01)	
m_regime_3			0.81***	0.06
			(0.05)	(0.05)
w_regime_3			0.76***	
			(0.01)	
R^2	0.94	0.94	0.94	0.94
Adjusted R^2	0.93	0.94	0.94	0.94
Num. obs.	1020	1020	1020	1020
s_idios		0.06	0.06	0.06
s_id		0.02	0.02	0.02

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$