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# Improving models of democracy: The example of lagged effects of economic development, education, and gender equality



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## ABSTRACT

The author examines how time delayed effects of economic development, education, and gender equality influence political democracy. Literature review shows inadequate understanding of lagged effects, which raises methodological and theoretical issues with the current quantitative studies of democracy. Using country-years as a unit of analysis, the author estimates a series of OLS PCSE models for each predictor with a systematic analysis of the distributions of the lagged effects. The second set of multiple OLS PCSE regressions are estimated including all three independent variables. The results show that economic development, education, and gender have three unique trajectories of the time-delayed effects: Economic development has long-term effects, education produces continuous effects regardless of the timing, and gender equality has the most prominent immediate and short term effects. The results call for the reassessment of model specifications and theoretical setups in the quantitative studies of democracy.

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## 1. Introduction

It is a long-standing tradition in quantitative research on democratization, as well as other quantitative studies in general, to include a broad range of control variables in the baseline model. One reason this tradition exists is to eliminate or reduce omitted variable bias and to avoid spurious correlations. The second reason is theoretical – to account for alternative explanations and theories. Yet, little attention has been paid to the operationalization of the control variables in quantitative models of democracy. Specifically, there is often inadequate explanation or no discussion of the reasons why certain control variables are employed with immediate effects on the dependent variable, while other control variables are incorporated in a lagged form, that is, when delayed effects are supposed to take place. Consequently, this leads to the current state of research with insufficient investigations of the lags of the main independent and control variables in statistical models of democracy. The limited discussion of using immediate versus lagged effects raises larger theoretical issues regarding the extent to which social processes and phenomena can instantaneously influence each other. Empirically, inadequate analysis of lags leads to poor model specifications where the effects of the independent variables, such as GDP, are often contradictory in different studies. [Table 1](#) summarizes a sample of the studies that analyzed political democracy and used economic development as one of the independent variables. Surprisingly, no studies in this table explicitly discuss the operationalization of the concepts in terms of lagged effects. Most papers simply state that the authors chose a certain lag of GDP without an explanation, while some papers never even mention that the author/s chose a certain lag. Using a systematic analysis of lags

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**Table 1**  
Effects of GDP and education on democracy: Literature review.

Studies	GDP	Education	Notes
Bollen (1979)	+		
Bollen (1983)	+		
Bollen and Jackman (1985)	+		
Gonick and Rosh (1988)	+	+	% literacy is used for Education
Burkhart and Lewis-Beck (1994)	+		
Bollen and Jackman (1995)	+		10th GDP lag
Crenshaw (1995)	+	+	15th lag for GDP and Education
Muller (1995a,b)	+		10th GDP lag and democracy change
Muller (1995b)	+, -, n/s		10th GDP lag
Londregan and Poole (1996)	+		
Barro (1999)	+	+	Education is measured by years of primary schooling
Feng and Zak (1999)	+, n/s	+, n/s	GDP and education are n/s if present jointly in the models; 3rd GDP lag and 1- to 5-year education lag
Dailami (2000)	+		
Przeworski et al. (2000)	n/s		1st lag and lagged moving average
Paxton (2002)	n/s		
Li and Reuveny (2003)	+, -, n/s	+, n/s	
Kurzman and Leahey (2004)	n/s		
Rudra (2005)	+, -, n/s		
Atkinson (2006)	+, n/s		n/s effect of GDP in authoritarian and positive effect in transitional states
Epstein et al. (2006)	+		
Gleditsch and Ward (2006)	n/s		Unspecified lag
Welzel and Inglehart (2006)	+, -, n/s		7th, 8th, or 9th lags
Gans-Morse and Nichter (2008)	+, n/s		1st lag
Schimmelfennig and Scholtz (2008)	+, n/s		4th lag
Balaev (2009)	n/s, marg.+		1st lag
Houle (2009)	n/s, marg.+		Unspecified GDP lag
Torfason and Ingram (2010)	n/s	+	Education is shown in online supplement
Qi and Shin (2011)	+, -, n/s		

Note: “+” is significant positive effect, “-” is significant negative effect, “marg.” is marginally significant effect, “n/s” is non-significant effect; different effects in the same study indicate effects in different models.

can potentially reduce this level of disagreement about the effects of economic development and other independent variables on democracy.

Table 1 shows that currently there is no standard operationalization of economic development – the measurement of economic development is from immediate effects to the 15th lag. Perhaps the main culprit here is the lack of theoretical conceptualization regarding how economic development affects democracy.

While it is not the purpose of this paper to develop a standard for the application of lagged variables, I outline the need for a more detailed exploration of the lagged effects of the independent variables in statistical models of democracy. As such, this analysis is intended to be neither a methodological paper nor a stand-alone empirical investigation of the relationships between economic development, education, gender equality, and democracy. Rather, this paper raises the issue of a disconnect between theory and methodology, and shows how lagged specification can improve the models of democracy both empirically and theoretically.

I demonstrate how the lagged effects are different from the non-lagged effects in some variables. I show that while there may not be an apparent immediate effect of a predictor on democracy, significant lagged effects may be present. Furthermore, I illustrate that in many cases, lagged variables can improve the overall fit of the model by increasing the values of the coefficients and the significance of other independent variables. Therefore, lagged effects are particularly important for joint significance of the explanatory variables in multiple models.

The paper is organized as follows: I first provide a literature review with a theoretical outline of the relevance of economic development, education, and gender equality in the analysis of democracy. I then provide a series of empirical examples of bivariate and multivariate models with systematic analyses of lags. Finally, I draw several conclusions advocating the necessity for a more detailed exploration of lagged effects from methodological and theoretical standpoints. Due to the lack of theory and contradictory empirical evidence, this paper follows a general exploratory format. Instead of deriving hypotheses based on a strong theory and formally testing these hypotheses, I use existing theories as a rough guidance and provide empirical evidence that could be used for further theory development.

## 2. Economic development and democracy

One of the longest-established hypotheses in democratization literature addresses the relationship between economy and democracy. Early research emphasized a positive relationship between economic development and democracy (Bollen, 1979; Cutright, 1963; Jackman, 1973; Lerner, 1958; Lipset, 1959). Some authors questioned and critiqued this

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