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# Democracy and growth: Evidence from a machine learning indicator

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## ABSTRACT

We present a novel approach for measuring democracy based on Support Vector Machines, a mathematical algorithm for pattern recognition. The Support Vector Machines Democracy Index (SVM DI) is continuous on the [0,1] interval and enables very detailed and sensitive measurement of democracy for 185 countries in the period between 1981 and 2011. Application of the SVM DI yields results which highlight a robust positive relationship between democracy and economic growth. We argue that the ambiguity in recent studies mainly originates from the lack of sensitivity of traditional democracy indicators. Analyzing transmission channels through which democracy exerts its influence on growth, we conclude that democratic countries feature better educated populations, higher investment shares, and lower fertility rates, but not necessarily higher levels of redistribution.

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## 1. Introduction

Today, the belief in democracy and its positive effects on freedom, liberty, and wealth is widespread among citizens of different countries. Covering preferences of the vast majority of the world's citizens, the *World Value Survey (2014)* finds that 79% of the global population wish to live in a country that is governed democratically.<sup>1</sup> This preference is not only prevalent in countries with a long democratic tradition (United States: 78.7%, Sweden: 91.9), but can also be found in Islamic states (Pakistan: 78.3, Malaysia: 86.6), African nations (Rwanda: 74.1, Zimbabwe: 86.1), South America (Chile: 83.4, Ecuador: 84.2), and Asia (China: 80.6, South Korea: 86.0). Beginning in December 2010, the unfulfilled desire for democracy in the Arab World (Egypt: 93.6, Yemen: 76.3) culminated in a wave of protests, riots, and demonstrations that spread throughout the nations of the

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<sup>1</sup> See question V140 of the World Value Survey's 6th Wave, conducted between 2010 and 2014: "How important is it for you to live in a country that is governed democratically? On this scale where 1 means it is not at all important and 10 means absolutely important what position would you choose?" The above numbers refer to all respondents that respond to the question with a value of 7 or higher.

Arab League and the surrounding area. Driven by a fatigue with authoritarian rule, the desire for the improvement in economic opportunities was one major trigger for the uprisings (see [Campante and Chor, 2012](#)).

While the majority of the citizens around the world seem to be quite confident that democracy brings with it an improvement in living standards, academics in the fields of political science and economics could not disagree more about the effect of democratization on economic growth. [Gerring et al. \(2005\)](#) summarize the related literature by concluding that “*the net effect of democracy on growth over the last five decades is negative or null*”. More recently, some studies point to a positive effect of democracy on the income level (e.g. [Acemoglu et al., 2014](#) and [Madsen et al., 2015](#)), whereas other studies still find no positive contribution (e.g. [Murtin and Wacziarg, 2014](#)).

In this paper, we provide evidence for a robust positive influence of democracy on economic growth. We argue that the ambiguity in the recent literature can first and foremost be traced back to the composition of existing democracy indicators. Available indices suffer from substantial methodological weaknesses, particularly with regard to the strategy employed to aggregate the underlying secondary data. As a result, existing indicators do not react with sufficient sensitivity to political events and regime changes.

This problem is amplified by the specification of the applied estimation techniques. A large number of recent studies eliminate unobserved heterogeneity via Within-Group estimations or difference GMM. However, while the first method yields a considerable dynamic panel bias ([Nickell, 1981](#)), the latter is accompanied by dramatic efficiency losses if additional orthogonality restrictions can be exploited (see [Blundell and Bond, 1998](#)). Even more crucial, when estimating empirical models using transformations that remove the information in the equation in levels, it is particularly necessary to utilize democracy indicators that react very sensitively to political events and regime changes. Otherwise, relying on the limited within-country information in the panel is likely to yield ambiguous results concerning the growth effect of democratization.

This paper addresses both challenges. In the first step, we introduce a novel approach to measure democracy which is based on machine learning algorithms for pattern recognition. The advantage gained via application of these algorithms is that they give computers the ability to learn without being explicitly programmed. Whereas the machine learning toolbox provides numerous promising instruments, Support Vector Machines (SVM) in particular have recently produced striking results in various branches of science, e.g. for categorization of cancer cells ([Guyon et al., 2002](#)) and identification of biomarkers of neurological and psychiatric disease ([Orrù et al., 2012](#)). We transfer the SVM approach to the problem of democracy measurement, obtaining an index which we refer to as the *Support Vector Machines Democracy Indicator* (SVMDI). The indicator is continuous on the interval from 0 to 1, thereby considerably enhancing the level of detail. The most important improvement, however, is that the aggregation of the underlying secondary variables is not arbitrary, as our SVM algorithm puts the problem of learning—i.e. the evaluation of country-years—into the context of an optimization problem. The SVMDI is available for 185 countries in the period from 1981 to 2011, covering countries representative of over 99% of the global population.

In the second step, we analyze the effect of the SVMDI on economic growth in a system GMM framework which addresses the econometric challenges described above. Our findings indicate a robust positive relationship between the SVMDI measure and economic growth. This result remains stable when changing the estimation technique to some recently applied strategies from the literature. In particular, accounting for waves of democratization via instrumental variable regressions using regional and cultural democratization trends as external instruments strongly supports the baseline outcomes.

We also provide an extensive comparative analysis of the results obtained by SVMDI and alternative democracy indicators. Given the inability of hitherto existing democracy indicators to react with sufficient sensitivity to political developments, the SVMDI is the only indicator that suggests a positive effect on growth in models that rely on the within variation of countries. This implies that even small steps in the transition process towards democracy are beneficial for increases in living standards. However, when using the system GMM framework of our baseline estimations, the positive association between democracy and growth emerges as a clear empirical pattern, even when relying on rough measures of democratization.

Finally, we investigate the transmission channels through which democracy effects income increases. We observe that democracy exerts its influence via better education, higher investment shares, and lower fertility rates. Meanwhile, we find little evidence for a redistribution-enhancing effect that would consequently contribute to an overall non-linear effect of democracy (see [Barro, 1996](#)). Hence, our results imply that higher degrees of democratization are always beneficial to growth.

The paper proceeds as follows: [Section 2](#) discusses the ambiguity in terms of the effect of democracy on growth in recent studies. [Section 3](#) critically analyzes the most commonly used traditional democracy indicators. In [Section 4](#), we introduce the ideas behind Support Vector Machines and the SVMDI algorithm. This section additionally provides an overview of the democracy level and its historical trends in the world, and compares the SVMDI to alternative indicators. [Section 5](#) is concerned with the estimation strategy and the presentation of the empirical results. In [Section 6](#), we examine the transmission channels of democracy. We conclude in [Section 7](#).

## 2. The ambiguous effect of democracy in recent studies

The effect of democracy on growth is strongly ambiguous in recent studies, both theoretically and empirically. On the theoretical side, it has been argued that democratization may benefit growth, most importantly via better provision of public goods and education ([Saint-Paul and Verdier, 1993](#), [Benabou, 1996](#), and [Lizzeri and Persico, 2004](#)) or by imposing constraints on kleptocratic dictators and preventing political groups from monopolizing lucrative economic opportunities ([Acemoglu et al., 2008](#) and [Acemoglu and Robinson, 2012](#)). In addition, [Alesina et al. \(1996\)](#) emphasize that increased political stability enhances national

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