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Democracy and Growth: Evidence from SVMMDI indices

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Abstract

Evidence from a novel measure of democracy (SVMMDI) based on Support Vector Machines highlights a robust positive relationship between democracy and economic growth. We argue that the ambiguity in recent studies can be traced back to the neglect of the information in the equation in levels and the lack of sufficient sensitivity of traditional democracy indicators. We further analyze the transmission channels through which democracy exerts its influence on growth, concluding that democratic countries have better educated populations, higher investment shares, lower fertility rates, but not necessarily higher levels of redistribution. The latter explains why we find only little indication of a nonlinear effect of democracy on growth.

Keywords: Democracy, Economic Growth, Support Vector Machines

JEL No.: O11, O47, P16, H11, C43

1 Introduction

Skepticism about the effect of democracy on wealth is as old as democracy itself. Whereas Socrates compares the democracy to a “*charming form of government, full of variety and disorder, and dispensing a sort of equality to equals and unequaled alike*”, Plato designated it as the second worst regime type after tyranny. Today, roughly 2,500 years after the fierce debates of the great philosophers in Classical Greek, academics in political science and economics could not disagree more about the effect of democratization on economic growth. [Gerring et al. \(2005\)](#) summarize the recent academic literature, concluding that “*the net effect of democracy on growth over the last five decades is negative or null*”.

In this paper, we provide evidence of a robust positive effect of democracy on growth. We argue that the the ambiguity in the recent literature can be traced back to two main issues: first and most important, available democracy indices are often subject to substantial measurement errors and do not react with sufficient sensitivity to political events and regime changes. In particular, as (non-)democratic countries differ in numerous historical, cultural, political, and institutional aspects, a dichotomous index may not be detailed enough to capture the effect of democratization on growth. Second, in light of the diversity of the countries, it is crucial to accurately model unobserved heterogeneity. A large number of recent studies eliminate country-fixed effects by using Within-Group estimations or difference GMM. However, whereas the first method yields a considerable dynamic panel bias ([Nickell, 1981](#)), the latter is accompanied by dramatic efficiency losses if additional orthogonality restrictions, which maintain some of the information in levels, can be exploited (see [Blundell and Bond, 1998](#)). Additional concerns with regard to some of the earlier studies include the failure to address possible problems caused by endogeneity and the disregard of period fixed effects. Moreover, Within-Group estimations typically amplify measurement errors and remove large parts of the information in the equation in levels, which is also the case when utilizing first-difference GMM. If the democracy indicator does not react sensitively to political events that occur in the countries included in the sample, then neglect of the full cross-sectional information in the panel is likely to yield ambiguous results concerning the growth effect of democratization.

The present paper addresses both challenges. We apply the democracy index proposed by [Gründler and Krieger \(2015\)](#), which employs a novel approach based on Support Vector Machines to classify the degree of democratization on the $(0, 1)$ interval. The Support Vector Machines Democracy Index (SVMDI) yields a very detailed and flexible method for classifying democracies and reacts very sensitively to different political events. Additionally, we provide a system GMM framework which circumvents the econometrical issues described above. Our findings indicate a robust positive relationship between the SVMDI measure of democracy and growth. This result remains stable when altering the estimation technique and can be confirmed on the basis of recently applied techniques such as difference GMM and Within-Group regressions. We also find some indication for a non-linear relationship in

models using a reduced specification. This nonlinearity vanishes if additional controls are introduced. We further provide an extensive comparative analysis of the results obtained by SVMDI and alternative democracy indicators. The findings underline the high sensitivity of SVMDI to political events and regime changes, indicating a significantly positive effect of democracy on growth, even when exploiting only the limited within variation of the indicator. With the exception of a slightly significant effect of the [Vanhanen \(2000\)](#) index, the alternative measures provide no indication for a positive relationship of democracy and growth when conducting this exercise. However, when estimating the effect of democracy on the basis of traditional indices using the system GMM framework of our baseline estimations, the positive association between democracy and growth emerges as a clear empirical pattern.

Finally, we investigate the transmission channels through which democracy affects income increases. We observe that democracy exerts its influence via better education, higher investment shares, and lower fertility rates. In contrast, we find no evidence for a redistribution-enhancing effect of democratization. As recent studies often argue that an increase in political rights may hinder growth at high levels of democratization due to higher redistributive activity (see, e.g. [Barro, 1996](#)), the latter explains why we cannot detect nonlinear effects of democracy in comprehensive model specifications.

The paper proceeds as follows. Section 2 discusses the ambiguity in the effect of democracy on growth in recent theoretical and empirical studies. Section 3 describes some of the traditional democracy indicators and briefly explains the ideas behind the SVMDI measure. Subsequently, we illustrate the relationship between SVMDI and the traditional indicators and provide an overview of the status quo of democracy in the world and historical developments using SVMDI data. Section 4 is concerned with the estimation strategy and the presentation of the empirical results. In Section 5, we investigate the transmission channels of democracy. We conclude in Section 6.

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 constraining 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 better political stability enhances national and foreign investment, thereby contributing to income increases. [Feng \(1997\)](#) illustrates that democracy reduces the probability of regime changes, which indirectly benefits growth. However, a large body of literature emphasizes the possible negative effects of democratization, mainly as a result of a higher level of redistribution, which is assumed to reduce growth (see, for

instance, [Alesina and Rodrik, 1994](#) and [Persson and Tabellini, 1994](#)). In addition, [Olson \(1982\)](#) emphasizes that sufficient organization of interest groups can lead to stagnation in democracies.

Empirically, cross-sectional analyses conducted by [Barro \(1996\)](#) and [Tavares and Wacziarg \(2001\)](#) suggest a (slightly) negative effect of democracy on growth. The investigation of [Barro \(1996\)](#) also provides evidence for a nonlinear relationship between the variables, where an increase in political rights at low levels of democratization benefits growth, but triggers a negative effect if a critical threshold of democratization is exceeded. [Barro \(2003\)](#) confirms the nonlinear effect using panel data, where other panel data analyses yield quite ambiguous results. [Rodrik and Wacziarg \(2005\)](#) find no significant effect of democratic transition on growth in the long-run, but emphasize short-run benefits and a decline in economic volatility. [Burkhart and Lewis-Beck \(1994\)](#) and [Giavazzi and Tabellini \(2005\)](#) also find no robust indication of a positive relationship between democracy and growth. Using semi-parametric methods, [Persson and Tabellini \(2008\)](#) report an average negative effect of departure from democracy on growth. [Persson and Tabellini \(2009\)](#) analyze the effect of democratic capital, measured by a nation’s historical experience with democracy and by the incidence of democracy in its neighborhood. Whereas the results imply that democratic capital stimulates growth, [Acemoglu et al. \(2014\)](#) argue that the formidable challenge in this case is the difficulty of disentangling the impact of unobserved heterogeneity and the effect of democratic capital. [Gerring et al. \(2005\)](#) apply a similar approach, concluding that democratization facilitates income increases. Providing an alternative dichotomous index of democracy and estimating first-difference GMM models, [Acemoglu et al. \(2014\)](#) conclude that the degree of democracy is positively correlated with future GDP per capita.

A different branch of literature is concerned with the reverse effect, i.e. the causal relationship of economic growth to democracy. This literature goes back to [Lipset \(1959\)](#), who finds a strong and positive correlation between the level of income per capita and the likelihood of transition to democracy. More recent investigations provide little indication of any effect of growth to democracy (see [Acemoglu et al., 2008, 2009](#)). However, we do not focus on this question in the present paper.

3 Democracy variables

3.1 Recent indicators

The traditional way to create a democracy indicator follows three steps: first, it is required to choose a definition of democracy. Second, a number of instruments need to be designed that are able to describe the properties of the theoretical concept. Finally, it is necessary to find a suitable manner to combine the selected variables to compile the democracy index. In practical applications, however, a number of problems occur in each of these steps. One major issue concerns the definition of democracy, as there exists no broadly accepted defi-

nition to describe the concept of democracy, neither in political science nor in the field of economics. The interpretations range from minimal approaches, which focus primarily on the election process (Dahl, 1971) to concepts building on human rights and social inequality (Rawls, 1971). As a result of the variety of definitions, the indicators considerably deviate in their underlying instruments. The popular index of Vanhanen (2000) applies only two dimensions—participation and competition of elections—to characterize a democracy (we refer to this index as VANHANEN). Similarly, Boix et al. (2013) rely on three conditions for contestation and participation (BOIX). Such minimal concepts are also used in the Polity-index (POLITY) proposed by Marshall et al. (2014). More extensive approaches are employed in Freedom House (2014), where countries are classified by the assessment of experts considering a number of aspects of political rights and civil liberty (FREEDOM HOUSE). Advantages and disadvantages of the various approaches are extensively discussed in the literature (e.g. in Munck and Verkuilen, 2002 and Cheibub et al., 2010). Points of criticism often brought forward include the low level of detail, the utilization of unfounded scaling, the combination of the variables, and the selection of the instruments.

An alternative way to create a democracy indicator is to combine the information of existing indices. Such a method is conducted by Acemoglu et al. (2014) who link the Freedom House rating and the Polity score with the indicators of Cheibub et al. (2010) and Boix et al. (2013), subsequently referred to as ACEMOGLU. While these indexes may provide a more precise measure of democracy, the applied heuristic is quite facile and only allows for a binary classification, which may be not sufficiently detailed to capture the various characteristics distinguishing the countries. A similar, more detailed index is provided by the UDS index of Pemstein et al. (2010), which is based on a Bayesian latent variable approach and merges ten traditional indicators.

3.2 Measuring democracy using Support Vector Machines - the SVM DI approach

In a recent paper, Gründler and Krieger (2015) propose a novel approach based on a mathematical algorithm, which is able to solve the problems encountered by recent indicators. This method is very adaptive and allows for both a traditional indicator based on certain properties and a combination of an optimal number of established indices. The approach applies Support Vector Machines (SMVs), a mathematical algorithm for pattern recognition. This algorithm has been very beneficial in various branches of science, e.g. in medicine to categorize cancer cells (Guyon et al., 2002) and in geophysics to classify hyperspectral data (Gualtieri, 2009). SMVs use a nonlinear generalization of the Generalized Portrait algorithm developed by Vapnik and Lerner (1963) and Vapnik and Chervonenkis (1964). The algorithm is described in detail in Gründler and Krieger (2015), while an illustrative introduction of Support Vector regressions is given by Smola and Schölkopf (2004). The general idea of SMV is as follows: given a data set $(X_1, y_1), \dots, (X_n, y_n)$, where $X_i \in \mathbb{R}^m$ and $y_i \in \{-1, +1\}$,

we want to find a function $C : \mathbb{R}^m \rightarrow \mathbb{R}$ with the property $C(X_i) = y_i \forall i = 1, \dots, n$. SVMs seek to find a hyperplane $H(a, \gamma) = \{x \in \mathbb{R}^m | a'x = \gamma\}$ separating the observations according to their labels y_i . Assuming that such a hyperplane can be found, the function $C(X_i) = \text{sign}(a'X_i + \gamma)$ classifies the observations according to the specified property. In practical applications, however, it is often impossible to find such a solution in \mathbb{R}^m . In this event, SVMs relocate the search to a space with higher dimension (the *feature space*). Using a transformation function $\Phi(\cdot)$ to shift the information X_i into the feature space, the optimal hyperplane is evaluated by solving the optimization problem

$$\min_{a, \gamma} \frac{1}{2} \|a\|_2^2 \text{ s.t. } y_i (\Phi(X_i)'a + \gamma) \geq 1 \quad \forall i = 1, \dots, n,$$

which enables us to obtain a nonlinear classification function satisfying the specified property by transforming the estimated hyperplane back to \mathbb{R}^m . As the transformation function is generally unknown, [Gründler and Krieger \(2015\)](#) use the Gaussian RBF kernel, which is commonly applied in machine learning.

To obtain a measure of democracy, [Gründler and Krieger \(2015\)](#) propose an algorithm that consists of ten steps, yielding a continuous indicator in the $(0, 1)$ interval, entitled “Support Vector Machines Democracy Indicator” (SVMDI). To give a brief overview, SVMDI first chooses a set of eight variables to characterize a democracy.¹ In the next step, the algorithm chooses country-years that can unambiguously be labeled as (non-)democracies, referring to the Polity index.² Based on these, $d_1(d_0)$ of the labeled observations are chosen and consolidated in the *R-Set* (step 3). Using the previously sketched SVM classification tool, initial consistency of the *R-Set* is checked. If the SVMs confirm the selection, the algorithm proceeds to the next step, where a random generator picks $t_1(t_0)$ of the $d_1(d_0)$ country-years. These $t = t_0 + t_1$ observations constitute the *T-Set*. In the subsequent step, the *T-Set* is used to conduct Support Vector regressions, which yields a non-linear function $f(\cdot)$ to classify all country-years. The procedure of random picking and SV regression is repeated $x \in \mathbb{N}$ times. Out of these classifications, a democracy indicator is calculated as the mean of the x estimations. Finally, the whole algorithm beginning with step 3 is repeated $y \in \mathbb{N}$ times. The SVMDI is the mean of the y estimations. [Gründler and Krieger \(2015\)](#) provide an intense discussion of the mechanism as well as an extensive robustness check, which confirms a high level of internal and external robustness.

Figure [A1](#) in the appendix illustrates the relationship between the different democracy indicators using all available observations in the sample. As a benchmark, we choose six commonly used indicators, POLITY, VANHANEN, ACEMOGLU, FREEDOM HOUSE,

¹These are the ratings of political rights, civil liberty, and freedom of the press of [Freedom House \(2014\)](#), the rate of participation and competition of [Vanhanen \(2000\)](#), the rating of independence of justice of [Cingranelli et al. \(2014\)](#) and the average over the remaining CRIC indicators (freedom of foreign and domestic movement, freedom of assembly and association, freedom of speech and freedom of religion), as well as the political terror scale of [Gibney et al. \(2013\)](#).

²[Gründler and Krieger \(2015\)](#) classify country-years as democracy if they have a Polity-Score of 10. Likewise, observations are labeled non-democratic if the Polity-Score is -7 or below.

BOIX, and UDS, all of which are described in Section 3.1. Whenever the available indices lack observations of recent periods (e.g. VANHANEN) or are not made available yet (e.g. ACEMOGLU), we calculate missing values according to the algorithms reported in the original documentations. Figure A1 shows that the SVMDI is positively related to the alternative measures, although we observe strong deviations for some of the relationships. These deviations are particularly pronounced when comparing the SVMDI score to less informative indices that can only assume a limited and predefined number of values, where SVMDI provides a more detailed classification of the degree of democracy. Note that due to the generation of 5-year averages, dichotomous indices d with $d \in (0, 1)$ are transformed to $d \in \mathbb{Q}$.

3.3 Democracy in the world

How strong are democratic tendencies in the world? Figure 1 maps the SVMDI data in the post-2010 period. This yields a very heterogeneous picture: while countries in Europe, Oceania, North America, and—to a large extent—in South America possess high SVMDI scores, a substantial part of the nations in Africa and Asia is considerably less democratic. An interesting pattern revealed by Figure 1 is that the degree of democratization shows clear tendencies toward regional concentration. In other words, if a country is (non-)democratic, we observe a high probability that the same applies to its neighboring country. There are three remarkable exceptions to that general rule: landlocked by countries with very low SVMDI scores, Mongolia (SVMDI: 0.8068), Ghana (0.9302), and—to a lesser extent—Benin (0.6413) succeeded in establishing democratic structures. Overall, the figure suggests a strong polarization of the extent of democratization.

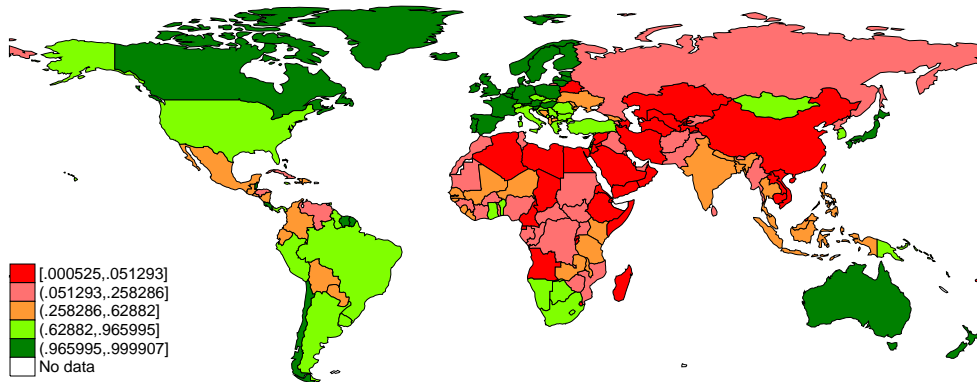


Figure 1 Democracy in the world (SVMDI), post-2010 period.

This polarization becomes particularly apparent when we consider the distribution of the SVMDI measure, which is illustrated in Figure 2. The data suggests a bimodal distribution, where the first mode is located at a very low level of democracy, and a second mode lies at a substantially higher degree of democracy that is very close to a SVMDI value of

one. This pattern is typical when examining the degree of democracy across countries and occurs quite similarly when analyzing alternate measures. The reason is that there exists a substantial number of countries with an SVMDI index close to zero. These countries include nations where (military) dictatorships and civil wars are prevalent, or where different government forms are enshrined in national constitutions. Such examples include Cameroon (0.0049), Swaziland (0.0069), Rwanda (0.0071), Qatar (0.0305), and Syria (0.0337). On the other hand, there are numerous countries where strong democratic institutions have been established, particularly in Europe, North America, Oceania and in some parts of Latin America.

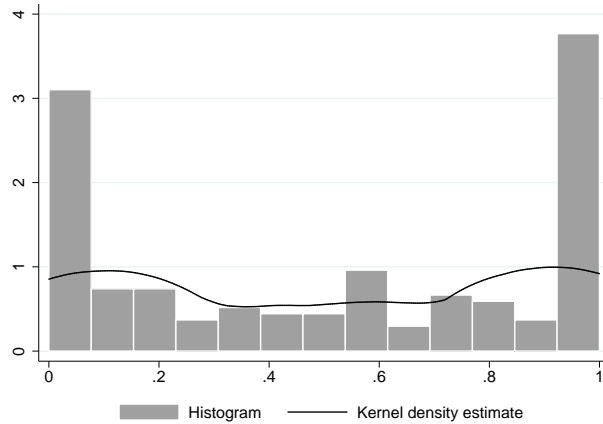


Figure 2 Distribution of democracy, SVMDI data, post-2010 period. Kernel is Epanechnikov.

Although there are still a considerable number of non-democratic countries, democratization emerges as a clear empirical pattern in the SVMDI data. Figure 3 illustrates the distribution of democracy in 1980 and 2010. These periods refer to the first and the last 5-year interval available in the SVMDI dataset. Whereas the relative fraction of non-democratic nations was extraordinarily high in the 1980-1984 period, the data approximates a uniform distribution in the post-2010 period, where we observe a substantially higher amount of democratic countries and a lower number of countries with a poor SVMDI score.

Figure 4 highlights the relationship between democracy and the development level. There is a tendency for wealthier countries to be more democratic; however, we can also observe major deviations from that general rule. The most extreme example is Qatar: in the post-2010 period, the country possesses the highest average real per capita income of all economies in the sample (108,065 USD). In contrast, there are few countries in the world where democratic structures are less pronounced (SVMDI is 0.0305). Other such examples include Brunei Darussalam (GDP per capita: 52,052 USD; SVMDI: 0.0259), Equatorial Guinea (27,722 USD; 0.00064), Oman (27,635 USD; 0.0322), Kuwait (57,526 USD; 0.03222), and Saudi Arabia (22,765 USD; 0.02716).

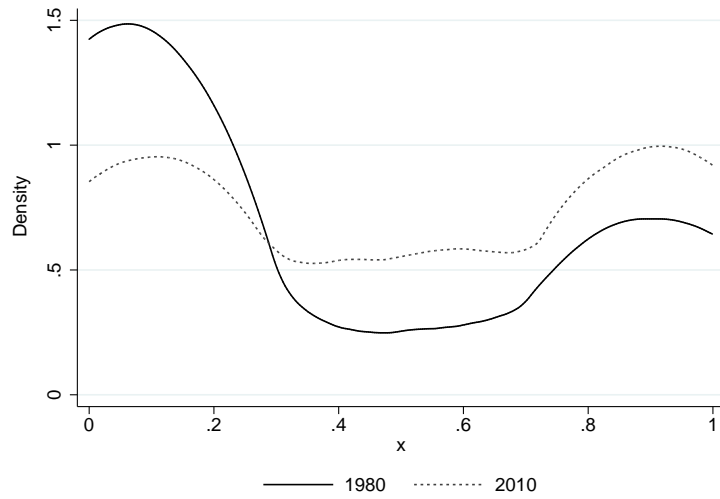


Figure 3 Democracy in the World, SVMDI data, kernel density estimates 1980—2010. Kernel is Epanechnikov.



Figure 4 Democracy and development level, SVMDI data, post-2010 period. R squared is 21.76 percent.

4 The empirical effect of democracy on growth

4.1 Estimation strategy

We use a standard framework of empirical growth regressions to estimate the effect of democracy on growth, using 5-year averages of all variables. Averaging the data is necessary due to the long-term perspective of growth theory, the need to disentangle short-term fluctuations and long-term effects, and the occurrence of gaps in the data concerning some of the covariates. Considering additive linkage of the variables, our basic dynamic panel specification is

$$y_{it} = \theta y_{it-1} + \lambda h_{it} + \beta \mathbf{X}_{it} + \gamma d_{it} + \eta_i + \xi_t + v_{it} \quad (1)$$

where y_{it} is the log of initial per capita GDP in i at 5-year period t , h_{it} is human capital endowment, and \mathbf{X}_{it} includes the covariates of the regression. The selection of the covariates is based on the standard framework of Barro (2003, 2013), which has been proven to capture the empirical determinants of economic growth quite accurately in a number of studies. These variables include the logarithmic value of real per capita GDP in $(t - 1)$ to account for conditional convergence, denoted by $\log(\text{GDP}_{pc})$; the investment share (INVS); government consumption (GOVC); the inflation rate (INFL); the degree of openness (OPEN); and the log of the fertility rate, $\log(\text{FERT})$. Human capital enters in the equation using average years of schooling (SCHOOLY) and $\log(\text{LIFEEX})$, the log of life expectancy at birth to proxy education and health.³ We do not include measures of physical capital, as their calculation relies on arbitrary assumptions regarding depreciation and the initial value. Rather, we follow Barro (2003, 2013) in assuming that higher levels of $\log(\text{GDP}_{pc})$ and h_{it} reflect higher levels of capital endowment.

Equation (1) also captures country-specific effects η_i and time effects of period t , denoted by ξ_t , in order to account for the various institutional aspects of the countries. The term $v_{it} \equiv u_{it} - \xi_t - \eta_i$ denotes the idiosyncratic error of the model. Neglecting unobservable heterogeneity and period-specific effects, the error term simplifies to u_{it} , where we would expect inconsistency and endogeneity. The marginal effect of democracy d_{it} is captured in γ .

A common and widely-used approach to account for both unobserved heterogeneity and endogeneity is the estimator proposed by Arellano and Bond (1991). Define for reasons of lucidity $\nabla k \equiv (k_{it} - k_{it-1})$ and $\nabla_2 k \equiv (k_{it-1} - k_{it-2})$, the basic idea of this approach is to adjust (1) to

$$\nabla y = \theta \nabla_2 y + \lambda \nabla h + \gamma \nabla d + \beta \nabla \mathbf{X} + \nabla \xi + \nabla v \quad (2)$$

³The data used in the regression stems from commonly used data sources in empirical growth research. $\log(\text{GDP}_{pc})$, INVS, GOVC, OPEN and INFL are from PWT 8.0 as documented in Feenstra et al. (2013), SCHOOLY is from Barro and Lee (2013), $\log(\text{LIFEEX})$ and $\log(\text{FERT})$ are from World Bank (2014).

and then use sufficiently lagged values of y_{it} , h_{it} , d_{it} , and \mathbf{X}_{it} as instruments for the first-differences. However, first differencing Equation (1) removes the information in the equation in levels. This drawback is particularly severe with regard to the purpose of this paper, as most of the variation in democracy data stems from the cross section rather than the time-dimension. This holds not only for SVM DI, but can similarly be observed for each of the benchmark indices as well. [Blundell and Bond \(1998\)](#) and [Bond et al. \(2001\)](#) show that the standard first-difference GMM estimator can be poorly behaved if time-series are persistent or if the relative variance of the fixed effects η_i is high. The reason is that lagged levels in these cases provide only weak instruments for subsequent first-differences, resulting in a large finite sample bias. In addition, difference GMM magnifies gaps in unbalanced panels, as it requires at least three consecutive lags for each of the variables. This requirement results in an asynchronous loss of observations, because data availability is typically more limited in developing countries. However, we are particularly interested in observations concerning developing economies, as these country-years contain information on the growth effect of regime changes in transition economies.

System GMM proposed by [Arellano and Bover \(1995\)](#) and [Blundell and Bond \(1998\)](#) provides a tool to circumvent these biases if one is willing to assume a mild stationary restriction on the initial conditions of the underlying data generating process.⁴ In this case, additional orthogonality conditions for the level equation in (1) can be exploited, using lagged values of ∇k and $\nabla_2 k$ as instruments. By these means, system GMM maintains some of the cross-sectional information in levels and exploits the information in the data more efficiently. Satisfying the [Arellano and Bover \(1995\)](#) conditions, system GMM has been shown to have better finite sample properties (see [Blundell et al., 2000](#)). To detect possible violations of these assumptions, we conduct Difference-in-Hansen tests for each of the system GMM regressions.⁵

Let $\tilde{\mathbf{X}}'_{it} \equiv [d_{it} \ \mathbf{X}'_{it}]$ and $\Theta'_{it} \equiv [y_{it} \ \tilde{\mathbf{X}}'_{it}]$, the moment conditions in our analysis used for the regression in first-differences are

$$\mathbb{E}[(v_{it} - v_{it-1})\Theta_{it-s}] = 0 \text{ for } t \geq 3, 2 \leq s \leq 3,$$

and the additional moment conditions for the regression in levels are given by

$$\mathbb{E}[(v_{it} + \eta_i)(\Theta_{it-1} - \Theta_{it-2})] = 0 \text{ for } t \geq 3.$$

We restrict the instrument matrix to lag 3. [Roodman \(2009a\)](#) illustrates the need to introduce such a restriction, as otherwise the problem of “instrument proliferation” may lead to severe biases. In principal, our specification can be estimated using one-step or two-step GMM. Whereas one-step GMM estimators use weight matrices independent of

⁴The assumption on the initial condition is $\mathbb{E}(\eta_i \nabla y_{i2}) = 0$, which holds when the process is mean stationary, i.e. $y_{i1} = \eta_i / (1 - \theta) + v_i$ with $\mathbb{E}(v_i) = \mathbb{E}(v_i \eta_i) = 0$.

⁵A more detailed description of the estimator in the context of the empirical application can be found in [Bond et al. \(2001\)](#) and [Roodman \(2009b\)](#).

estimated parameters, the two-step variant weights the moment conditions by a consistent estimate of their covariance matrix. [Bond et al. \(2001\)](#) show that the two-step estimation is asymptotically more efficient. Yet it is well known that standard errors of two-step GMM are severely downward biased in small samples. We therefore rely on the [Windmeijer \(2005\)](#) finite sample corrected estimate of the variance, which yields a more accurate inference.

4.2 Baseline results

Table 1 reports the results of the baseline regressions. The first column illustrates the effect of democracy measured by the SVMDI in a restricted model where the only covariate is the initial income level. The advantage of examining the effect of democracy in a very reduced specification is that the estimated parameter gives the general effect of democracy, leaving all possible transmission channels open. In addition, this estimation enables the investigation of SVMDI in a broad sample of 160 countries. The subsequent columns examine the effect of the SVMDI when additional controls are introduced.

The result in Column (1) provides clear indication that democracy and income increases are positively and significantly related. The column rejects the hypothesis of convergence, which is hardly surprising as a number of authors suggest that convergence can only be detected when holding constant a number of variables that distinguish the countries. Indeed, when introducing the investment share and the average years of schooling in Column (2), *conditional* convergence in the form of a negative relationship between initial incomes and growth can be observed. What is remarkable in this estimation is the robustness of the effect of SVMDI, which remains significantly positive and maintains its magnitude.

In Column (3) we incorporate life expectancy at birth, government consumption, the inflation rate, and the openness of countries. The effect of democracy remains positive and significant, but the marginal effect shrinks slightly. Investigating bivariate correlations between SVMDI and the covariates, our data implies that democracies tend to have higher life expectancies (correlation: 53 percent) and a lower probability of hyperinflation (-31 percent). Each of these effects stimulates growth, which is why the column suggests a lower marginal impact of SVMDI. Finally, when introducing the fertility rate, the effect of democracy becomes insignificant. This is hardly surprising, as democracies tend to have substantially lower fertility rates. In countries where non-democratic structures are prevalent, the trade-off between the quantity and the education of the children is often resolved in favor of having more offspring. In the light of binding budget constraints, families may consider this a substitute for missing social security systems. Overall, there is a clear indication of a positive effect of democracy measured by SVMDI and the growth rate.

Alternate estimation techniques of the baseline model yield quite similar results. Table 2 provides two alternative approaches. The first is first-difference GMM as proposed by [Arellano and Bond \(1991\)](#), the second method is a Within-Group (WG) estimator. Both methods have been commonly applied in recent studies concerning the effect of democracy

Table 1 The effect of SVMDI on growth, dependent variable is real per capita GDP growth.

	(1)	(2)	(3)	(4)
Log(GDP _{pc})	0.00479 (0.00492)	-0.00839** (0.00342)	-0.0180*** (0.00349)	-0.0197*** (0.00309)
SVMDI	0.0264*** (0.00941)	0.0242*** (0.00840)	0.0149** (0.00750)	0.00294 (0.00684)
INVS		0.120*** (0.0346)	0.0467 (0.0310)	0.0445 (0.0323)
SCHOOLY		0.00225 (0.00199)	0.00214* (0.00123)	0.000111 (0.00129)
Log(LIFEEX)			0.102*** (0.0222)	0.0635*** (0.0206)
GOVC			-0.0112 (0.0304)	-0.0168 (0.0291)
INFL			-0.00126* (0.000651)	-0.00110 (0.000680)
OPEN			0.00625* (0.00331)	0.00268 (0.00356)
Log(FERT)				-0.0333*** (0.00643)
Observations	1048	857	775	775
Countries	160	129	128	128
Hansen p-val	0.0000928	0.0262	0.878	0.991
Diff-in-Hansen	0.109	0.691	1.000	1.000
AR(1) p-val	0.0416	0.0777	0.116	0.119
AR(2) p-val	0.367	0.273	0.335	0.327
Instruments	40	78	154	173

Notes: Table reports system GMM estimations. All estimations use Windmeijer-corrections, robust standard errors in parentheses. The instrument matrix is restricted to lag 3. Hansen p-val. gives the p-value of Hansen's J-test, AR(1) p-val. and AR(2) p-val. report the p-values of the AR(1) and AR(2) test. Diff-in-Hansen reports the C statistic of the difference in the p-values of the restricted and the unrestricted model. The unrestricted model neglects the [Arellano and Bover \(1995\)](#) conditions. * $p < .10$, ** $p < .05$, *** $p < .01$.

on income increases (e.g. in [Acemoglu et al., 2014](#), [Rodrik and Wacziarg, 2005](#) and [Gerring et al., 2005](#)). The table reports three variants of each technique. The first specification is the reduced model of Column (1) of Table 1, the second and third columns refer to the more comprehensive models reported in Columns (3) and (4) of Table 1. The columns are labeled in accordance to the variant of the baseline table that is used for specification. The effect of democratization is remarkably stable across the regressions conducted in Table 2, resembling the findings of the baseline estimations in significance and magnitude.

One exception is the effect of SVMDI in the reduced model reported in Column (1), where the only difference to the referring specification of the baseline model is the neglect

Table 2 The effect of SVMMDI on growth, different estimation techniques. Dependent variable is real per capita GDP growth.

	First-difference GMM (Arellano-Bond)				Within-Group (WG)				
	(1)	(3)	(4)	(1)	(3)	(4)	(1)	(3)	(4)
Log(GDP _{pc})	-0.139*** (0.0341)	-0.0781*** (0.0131)	-0.0756*** (0.0136)	-0.0329*** (0.00636)	-0.0589*** (0.00873)	-0.0579*** (0.00849)			
SVMMDI	-0.00214 (0.0407)	0.0325** (0.0134)	0.0258* (0.0133)	0.0279*** (0.00584)	0.0134** (0.00616)	0.00881 (0.00600)			
INVS		0.0816** (0.0360)	0.0784** (0.0358)		0.0808** (0.0325)	0.0709** (0.0322)			
SCHOOLY		0.00292 (0.00468)	-0.00343 (0.00595)		0.00813*** (0.00170)	0.00300* (0.00176)			
Log(LIFEEX)		0.0218 (0.0475)	0.00948 (0.0432)		0.133*** (0.0245)	0.121*** (0.0231)			
GOVC		0.0269 (0.0320)	0.0290 (0.0328)		-0.00852 (0.0213)	-0.00502 (0.0212)			
INFL		-0.000960 (0.000636)	-0.000678 (0.000489)		-0.000731 (0.000549)	-0.000721 (0.000543)			
OPEN		0.00288 (0.00460)	0.00346 (0.00569)		-0.00107 (0.00400)	-0.000940 (0.00387)			
Log(FERT)			-0.0278 (0.0194)			-0.0405*** (0.00866)			
Observations	888	647	647	1048	775	775			775
Countries	160	128	128	160	128	128			128
Hansen p-val	0.00841	0.211	0.263						
AR(1) p-val	0.0582	0.113	0.115						
AR(2) p-val	0.0590	0.221	0.230						
Instruments	27	99	111						

Notes: Table reports first-difference GMM (Arellano-Bond) and Within-Group (WG) estimations. Robust standard errors in parentheses. WG uses cluster robust standard errors. The instrument matrix in Columns (1)-(3) is restricted to lag 3. Hansen p-val. gives the p-value of Hansen's J-test, AR(1) p-val. and AR(2) p-val. report the p-values of the AR(1) and AR(2) test. * $p < .10$, ** $p < .05$, *** $p < .01$.

of the additional orthogonality conditions proposed by [Arellano and Bover \(1995\)](#). These conditions ensure that some of the information of the equation in levels is maintained. The Difference-in-Hansen test reported in [Table 1](#) indicates that the additional moment conditions used in the system GMM estimation are valid, suggesting substantial efficiency losses when utilizing first-difference GMM. Especially in growth regressions where some of the time series exhibit a high degree of persistency, [Blundell and Bond \(1998\)](#) and [Bond et al. \(2001\)](#) provide evidence that system GMM dramatically increases efficiency, as lagged levels are often poor instruments for first differences. Note also that the number of observations declines from 1048 to 888, as first-difference GMM requires observations for at least three consecutive periods. First-difference GMM draws on variations over time rather than employing the information of the equation in levels. When conducting Arellano-Bond estimations in [Column \(1\)](#), we expect the main effect of democracy to appear via the transition of non-democracies to democracies, because the variation in the SVMDI score in OECD countries where democratization took place before the initial period of the sample is rather low. First-difference GMM mainly yields losses of precisely the observations that we are interested in, i.e. observations from developing economies in the transition process. However, even in light of this drawback, when introducing additional controls in the subsequent columns the positive and significant effect of SVMDI found in the baseline model reappears in the first-difference regressions. Apparently democracy exerts its influence via a number of transmission channels, which have an opposing effect on growth. If we do not control for these variables, the estimated parameter of SVMDI captures the contrary effects of the transmission variables and becomes insignificant.

The Within-Group (WG) estimations strongly support the results of the baseline table. This technique resembles the estimation strategy conducted by [Gerring et al. \(2005\)](#), [Rodrik and Wacziarg \(2005\)](#) and [Papaioannou and Siourounis \(2008\)](#). However, one concern is that introducing a lagged dependent variable in a WG model most likely results in a [Nickell \(1981\)](#) bias. In addition, WG does not account for possible problems caused by endogeneity, which we typically expect in growth regressions.

4.3 Non-linear relationships

[Barro \(1996\)](#) suggests a non-linear relationship between democracy and growth, arguing that democracy enhances income increases at low levels of political freedom but depresses growth once a moderate level has been attained. In dictatorships, an increase in political rights may be growth enhancing due to the advantages arising from limitations of governmental power, an increase in contractual freedom, and the reduction of foreign trade barriers. Yet, in countries that have succeeded in establishing at least moderate levels of democracy, a further increase may be an impediment to growth due to increases in redistributive efforts.

[Table 3](#) deals with the examination of a possible nonlinear effect of democracy on growth by introduction of SVMDI SQUARED in the baseline model, which simply squares the

Table 3 The non-linear effect of SVMDI on growth, dependent variable is real per capita GDP growth.

	(1)	(2)	(3)	(4)
Log(GDP _{pc})	0.00902* (0.00514)	-0.00892*** (0.00346)	-0.0186*** (0.00342)	-0.0200*** (0.00304)
SVMDI	0.121*** (0.0431)	0.0189 (0.0391)	0.00944 (0.0227)	0.00512 (0.0199)
SVMDI SQUARED	-0.107** (0.0446)	0.00297 (0.0421)	0.00428 (0.0235)	-0.000991 (0.0197)
INVS		0.112*** (0.0319)	0.0544* (0.0325)	0.0374 (0.0291)
SCHOOLY		0.00287 (0.00191)	0.00208* (0.00125)	-0.000616 (0.00136)
Log(LIFEEX)			0.107*** (0.0213)	0.0683*** (0.0205)
GOVC			-0.00545 (0.0302)	-0.0149 (0.0300)
INFL			-0.00122* (0.000641)	-0.00116* (0.000646)
OPEN			0.00584* (0.00332)	0.00212 (0.00347)
Log(FERT)				-0.0358*** (0.00672)
Observations	1048	857	775	775
Countries	160	129	128	128
Hansen p-val	0.000283	0.0425	0.987	1.000
Diff-in-Hansen	0.200	0.810	1.000	1.000
AR(1) p-val	0.0409	0.0779	0.116	0.119
AR(2) p-val	0.444	0.269	0.332	0.326
Instruments	54	92	168	187

Notes: Table reports system GMM estimations. All estimations use Windmeijer-corrections, robust standard errors in parentheses. The instrument matrix is restricted to lag 3. Hansen p-val. gives the p-value of Hansen's J-test, AR(1) p-val. and AR(2) p-val. report the p-values of the AR(1) and AR(2) test. Diff-in-Hansen reports the C statistic of the difference in the p-values of the restricted and the unrestricted model. The unrestricted model neglects the [Arellano and Bover \(1995\)](#) conditions. * $p < .10$, ** $p < .05$, *** $p < .01$.

SVMDI score. All the specifications in the table refer exactly to the estimations in the base-line estimations. Column (1) provides clear indication of a parabolic influence of democracy on growth. However, when incorporating additional covariates, this effect vanishes. The impact of both the linear and the quadratic term turn positive, where multi-collinearity results in insignificance of both effects. There are two explanations for why such a change in the effect may occur. The first (obvious) explanation is that the reduction in the number of observations results in a sample selection bias. However, we might expect losses of

observations from *developing* countries rather than from *advanced* economies, i.e. we might expect the negative effect to be more pronounced rather than the reverse. Indeed, when running the regression of Table 3 using only the observations of Column (2), the nonlinear effect of democracy is preserved. This is a strong argument for a second explanation: the parabolic effect of democracy is absorbed by a third variable, and this variable is most likely the investment share. If a country with a low SVMDI score gains increases in political rights, we might expect a strong marginal effect on the investment share. However, we anticipate diminishing marginal effects if the economy achieves further progress in democratization, which may eventually turn negative due to the negative effect of redistribution on capital accumulation.

4.4 Relation to alternative democracy indicators

Whereas the previous results provide strong evidence for a positive effect of democracy on growth when applying the SVMDI measure, we are interested if these results are superior compared to estimations which use alternative indices of democracy. We conduct two different estimation techniques to answer this question, namely difference GMM and system GMM. Difference GMM has been used as a baseline specification and sensitivity analysis in a number of recent studies (e.g. in Gerring et al., 2005 and Acemoglu et al., 2014). As first-differencing the model removes the information in the equation in levels, the procedure relies solely on the limited within country information. Since (non-)democratic countries differ in numerous historical, cultural, political, and institutional aspects, first-differencing the model yields a substantial loss in the precision of the estimates and requires indicators that react quite sensitively to political events in order to capture the effect of democratization. We argued previously that one major concern regarding hitherto existing democracy indicators is the absence of such a sufficient reaction to political events and regime changes.

Table 4 illustrates this shortcoming. The model uses the specification of Column (3) in Table 2, estimating the effect of the SVMDI score and six commonly used democracy indicators on economic growth. As reported in the sensitivity analysis in Table 2 the effect of SVMDI is positive and strongly significant. However, out of the six alternative democracy indicators, only the Vanhanen index yields a similarly positive effect of democracy on growth, where both the significance level and the marginal impact are lower than suggested by the SVMDI. The remaining democracy indicators provide little indication for a growth-enhancing effect of democratization, a result which strongly resembles the effects found in many recent studies. The reason for the lack of significance of the alternative democratic indicators is the slow and insufficient reaction of most of the indicators to regime changes.⁶ In contrast, SVMDI indicates a significantly positive effect of democracy even when consulting only the within variation of the sample.

Since most of the variation of the democracy indicators stems from the cross-section

⁶This argument is illustrated in detail in Gründler and Krieger (2015).

Table 4 The effect of different democracy indicators on growth, first-difference GMM (Arellano-Bond). Dependent variable is real per capita GDP growth.

	SVMDI	POLITY	VANHANEN	ACEMOGLU	FREEDOM HOUSE	BOIX	UDS
Log(GDP _{pc})	-0.0781*** (0.0131)	-0.0773*** (0.0146)	-0.0787*** (0.0138)	-0.0777*** (0.0129)	-0.0758*** (0.0120)	-0.0798*** (0.0132)	-0.0764*** (0.0124)
DEMOCRACY	0.0325** (0.0134)	0.000680 (0.000918)	0.000889* (0.000456)	0.00940 (0.0106)	-0.0107662 .006827	0.00940 (0.00944)	0.0100 (0.00694)
INVS	0.0816** (0.0360)	0.101** (0.0447)	0.0882** (0.0379)	0.0918** (0.0412)	0.0946** (0.0424)	0.0920** (0.0427)	0.0981** (0.0405)
SCHOOLY	0.00292 (0.00468)	-0.00116 (0.00549)	-0.0000604 (0.00570)	0.000855 (0.00464)	0.00515 (0.00487)	0.00116 (0.00469)	0.00302 (0.00453)
Log(LIFEEX)	0.0218 (0.0475)	0.0141 (0.0492)	-0.00894 (0.0465)	0.0197 (0.0505)	0.0286 (0.0448)	0.0191 (0.0514)	0.00339 (0.0468)
GOVC	0.0269 (0.0320)	0.0288 (0.0331)	0.0237 (0.0306)	0.0276 (0.0312)	0.0318 (0.0356)	0.0286 (0.0297)	0.0327 (0.0337)
INFL	-0.000960 (0.000636)	-0.00101 (0.000680)	-0.000865 (0.000612)	-0.000979* (0.000584)	-0.000833 (0.000564)	-0.00103 (0.000671)	-0.00108* (0.000565)
OPEN	0.00288 (0.00460)	0.00381 (0.00573)	0.00345 (0.00545)	0.00324 (0.00493)	0.00154 (0.00507)	0.00376 (0.00477)	0.00129 (0.00535)
Observations	647	614	646	645	646	644	645
Countries	128	121	128	128	128	128	128
Hansen p-val	0.211	0.170	0.114	0.188	0.137	0.169	0.166
AR(1) p-val	0.113	0.120	0.111	0.115	0.107	0.115	0.109
AR(2) p-val	0.221	0.240	0.229	0.225	0.228	0.222	0.226
Instruments	99	99	99	99	99	99	99

Notes: Table reports system GMM estimations. All estimations use Windmeijer-corrections, robust standard errors in parentheses. The instrument matrix is restricted to lag 3. Hansen p-val. gives the p-value of Hansen's J-test, AR(1) p-val. and AR(2) p-val. report the p-values of the AR(1) and AR(2) test. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 5 The effect of different democracy indicators on growth, system GMM (Blundell-Bond). Dependent variable is real per capita GDP growth.

	SVMDI	POLITY	VANHANEN	ACEMOGLU	FREEDOM HOUSE	BOIX	UDS
Log(GDP _{pc})	-0.0180*** (0.00349)	-0.0166*** (0.00393)	-0.0174*** (0.00318)	-0.0189*** (0.00366)	-0.0188*** (0.00363)	-0.0184*** (0.00361)	-0.0192*** (0.00373)
DEMOCRACY	0.0149** (0.00750)	0.000972** (0.000449)	0.000633*** (0.000228)	0.0117* (0.00618)	-0.00541 (0.00394)	0.00616 (0.00564)	0.00638* (0.00346)
INVS	0.0467 (0.0310)	0.0509 (0.0395)	0.0622* (0.0332)	0.0530 (0.0375)	0.0416 (0.0352)	0.0530 (0.0329)	0.0634* (0.0345)
SCHOOLY	0.00214* (0.00123)	0.00249* (0.00150)	0.00137 (0.00130)	0.00336** (0.00135)	0.00281** (0.00126)	0.00327** (0.00133)	0.00257* (0.00154)
Log(LIFEEX)	0.102*** (0.0222)	0.0878*** (0.0220)	0.0910*** (0.0220)	0.0962*** (0.0239)	0.109*** (0.0219)	0.0993*** (0.0252)	0.0985*** (0.0211)
GOVC	-0.0112 (0.0304)	-0.00751 (0.0343)	-0.00449 (0.0303)	-0.0164 (0.0326)	-0.0108 (0.0316)	-0.0140 (0.0295)	-0.00567 (0.0324)
INFL	-0.00126* (0.000651)	-0.00166*** (0.000614)	-0.00114 (0.000721)	-0.00133* (0.000723)	-0.00126** (0.000618)	-0.00119* (0.000694)	-0.00144** (0.000662)
OPEN	0.00625* (0.00331)	0.00514 (0.00378)	0.00818** (0.00324)	0.00753** (0.00319)	0.00583* (0.00330)	0.00701** (0.00345)	0.00691** (0.00344)
Observations	775	737	774	773	774	772	773
Countries	128	122	128	128	128	128	128
Hansen p-val	0.878	0.924	0.858	0.891	0.862	0.830	0.865
Diff-in-Hansen	1.000	1.000	1.000	1.000	1.000	1.000	1.000
AR(1) p-val	0.116	0.120	0.113	0.118	0.114	0.117	0.113
AR(2) p-val	0.335	0.348	0.344	0.334	0.331	0.335	0.335
Instruments	154	154	154	154	154	154	154

Notes: Table reports system GMM estimations. All estimations use Windmeijer-corrections, robust standard errors in parentheses. The instrument matrix is restricted to lag 3. Hansen p-val. gives the p-value of Hansen's J-test, AR(1) p-val. and AR(2) p-val. report the p-values of the AR(1) and AR(2) test. Diff-in-Hansen reports the C statistic of the difference in the p-values of the restricted and the unrestricted model. The unrestricted model neglects the [Arellano and Bover \(1995\)](#) conditions. * $p < .10$, ** $p < .05$, *** $p < .01$.

rather than the time-dimension, the utilization of additional orthogonality conditions proposed by [Arellano and Bover \(1995\)](#) and [Blundell and Bond \(1998\)](#) is beneficial, as these additional restrictions ensure that some of the information of the equation in levels is maintained. In addition, as difference GMM requires information from at least three consecutive periods for a country to be included in the estimation, the exploitation of the [Arellano and Bover \(1995\)](#) orthogonality conditions also yields an increase in the number of observations. This is crucial, because we might expect losses of observations especially for developing countries, which possess a higher within variation of democratization than advanced economies. Table 5 reports the results when conducting system GMM and using exactly the same model as in Table 4. What we observe is a dramatic change in the picture. The SVMIDI index remains positive and strongly significant, but four of the six alternative indices now yield marginal effects comparable in their magnitude and significance. In contrast, BOIX and FREEDOM HOUSE still provide no indication for a positive relationship to income increases.

5 The transmission channels of democracy

The previous results imply that democracy is positively associated with growth. We already suspected the existence various transmission channels through which political rights exert influence on income increases. This section is concerned with a more in-depth analysis of these mechanisms.

Table 6 illustrates the effect of democracy on schooling, investment, redistribution, and fertility. Each of these variables plays an important role in the growth progress, and theory suggests that democracy may have an influence on their values. We conduct two estimations for each of the transmission variables: the first variant basically uses the specification of Table 1, while the second variant introduces private credit to GDP (CREDIT) as a proxy for the development level of the financial sector in order to account for the capital market imperfection channel.⁷ Disentangling the effects of democracy and credit availability is important: both variables are closely correlated (correlation: 50 percent), but their effects on the transmission variables differ considerably. We use Within-Group estimations with cluster robust standard errors as estimation technique. As the model does not include a lagged dependent variable, WG can safely be applied without the dread of a potential [Nickell \(1981\)](#) bias. In addition, system GMM is not an option in this case. SVMIDI enters with a lag of one period in the regressions to ensure that causality runs from democracy to the transmission variables rather than the reverse.

The first transmission channel in Table 6 concerns education. The results imply that richer economies on average exhibit a higher average level of school attainment. In addition, better health measured by life expectancy enhances education. The trade-off between the

⁷The data source is [World Bank \(2014\)](#).

Table 6 The transmission channels of democracy

	Schooling		Investment		Redistribution		Fertility	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Log(GDP _{pc})	1.036*** (0.189)	0.650*** (0.183)	0.00803 (0.0223)	0.0000725 (0.0234)	0.000969 (0.00606)	-0.000556 (0.00553)	0.00845 (0.0347)	-0.0501 (0.0333)
SVMIDI($t-1$)	0.202 (0.185)	0.293* (0.161)	0.0294** (0.0132)	0.0295* (0.0151)	0.00178 (0.00379)	0.000810 (0.00429)	-0.114** (0.0453)	-0.0522 (0.0364)
INVS	-0.166 (0.702)	-0.327 (0.701)			-0.0781*** (0.0216)	-0.0783*** (0.0220)	-0.310** (0.148)	-0.370*** (0.138)
SCHOOLY			0.000906 (0.00552)	-0.00284 (0.00594)	0.00571*** (0.00152)	0.00492*** (0.00140)	-0.115*** (0.0165)	-0.120*** (0.0166)
Log(LIFEEX)	2.585*** (0.961)	2.123** (0.848)	0.230*** (0.0729)	0.229*** (0.0768)	0.0300** (0.0140)	0.0263** (0.0131)	-0.210 (0.160)	-0.192 (0.151)
GOVC	-0.729 (0.720)	-0.632 (0.689)	-0.107 (0.0920)	-0.126 (0.0862)	0.00198 (0.00904)	0.00242 (0.00880)	0.0972 (0.109)	0.0950 (0.0985)
INFL	-0.0139** (0.00668)	-0.0108 (0.00727)	-0.000165 (0.00134)	-0.00119* (0.000601)	0.000405 (0.000275)	0.000387 (0.000307)	0.000343 (0.000726)	0.000723 (0.000642)
Log(FERT)	-2.710*** (0.306)	-3.022*** (0.296)	-0.0633** (0.0294)	-0.0810*** (0.0296)	0.0162** (0.00679)	0.0125* (0.00654)		
OPEN	0.107 (0.123)	0.122 (0.112)	-0.00218 (0.0105)	-0.00359 (0.00979)	0.00524 (0.00348)	0.00469 (0.00334)	0.00246 (0.0221)	0.0112 (0.0189)
CREDIT		0.688*** (0.220)		0.00757 (0.0185)		0.0126** (0.00581)		0.122*** (0.0434)
REDIST			-0.683*** (0.189)					
Observations	670	648	560	648	560	544	670	648
Countries	128	126	121	126	121	119	128	126
R-squared	0.607	0.645	0.240	0.200	0.130	0.150	0.532	0.568
F-statistic	43.10	46.57	7.454	8.023	3.545	3.307	28.59	29.24
Model p-val	1.23e-30	6.06e-34	4.94e-08	1.08e-08	0.00102	0.00124	2.52e-23	2.99e-25

Notes: Table reports Within-Group (WG) estimations. Cluster robust standard errors in parentheses. F statistic reports the test statistic of joint significance of the model, Model p-val gives the p-value of the F-test. * $p < .10$, ** $p < .05$, *** $p < .01$.

quantity and the education of children is clearly visible, as we can observe a significantly negative effect of fertility on education. Controlling for these impacts, the influence of political rights is positive and becomes significant in Column (2) when we introduce CREDIT. The results imply that better credit availability softens the budget constraints of the household, thereby contributing to better education of individuals. However, even when controlling for this effect, the impact of enhanced political rights acts as an additional source of educational improvements.

The second transmission channel illustrates the effect on investment, which is significantly positive in both specifications. Apparently, democratic structures and political rights facilitate both national and foreign investments and capital inflows. These findings are in line with the well-known results of [Perotti \(1996\)](#), who finds that political stability has a huge impact on investment and growth. CREDIT has no significant effect on investment, suggesting that the positive contribution of the SVMIDI stems largely from foreign investments, which are not necessarily financed by loans acquired in the target country. To examine a possible negative effect of increasing political rights in countries with a medium or high level of SVMIDI, Column (1) also incorporates the level of effective redistribution measured by the difference of the Gini coefficient of household incomes before and after taxes and transfers.⁸ The results show a strongly significant impact of redistribution on investments, where a higher amount of redistribution is negatively related to investment activity. This, in principle, supports the hypothesis that a higher level of democratization may be an impediment to growth. However, this mechanism only comes into play if democracy enhances redistribution.

This is investigated in the third branch of transmission analysis. We observe that redistribution is lower in countries with a higher average level of education. Moreover, countries with higher life expectancies, higher government consumption and higher fertility rates typically tend to redistribute more. Controlling for these effects, we find no additional contribution of SVMIDI on redistribution, implying that the strong bivariate correlation between SVMIDI and REDIST (63 percent) is not due to an inherent causality running from democracy to redistribution, but is the result of numerous variables that are affected by democracy. The ambiguous effect of democracy on redistribution strongly resembles the recent findings of [Acemoglu et al. \(2013\)](#).

The last transmission channel refers to the effect of democracy on fertility. The first column highlights that democratization yields a significant decline of fertility rates. The process of democratization is often accompanied by a substantial increase in social security systems and a reduction of uncertainty due to higher political stability, both of which reduce families' incentives to have children as a substitute for social protection. However, it is crucial to disentangle the different effects of democracy and credit availability, as illustrated in Column (2). When holding constant CREDIT, the effect of democracy loses significance,

⁸Data source is the SWIID v5, documented in [Solt \(2009\)](#) and [Solt \(2014\)](#).

but remains negatively associated with fertility. Better credit availability increases the fertility rate, as access to capital markets alleviates the otherwise binding trade-off between the quantity and the education of children.

Summarizing the findings, we observe that democracy exerts its influence on growth via better education, higher investment shares, and lower fertility rates. In contrast, we find no evidence for a redistribution-enhancing effect of democratization.⁹

6 Conclusions

This paper challenges the predominant view that the wealth of nations is independent of regime types, providing evidence of a positive and strongly robust effect of democracy on economic growth. These results are based on SVM DI data, a novel approach for measuring democracy using Support Vector Machines, a mathematical algorithm for pattern recognition. SVM DI allows for a very detailed and sensitive measure of democracy, thereby modeling changes in democratization more accurately than previously available indicators.

Our results imply that the ambiguity in recent studies stems from two main sources. First, in light of the diversity of political institutions across countries, the lack of a sufficient reaction of traditional democracy indicators to political events and regime changes only allows for a rough and fragmentary reproduction of the “true” degree of democratization. This particularly applies with regard to dichotomous indicators. Second, most of the recent studies account for unobservable heterogeneity using time-demeaning or first-difference transformations of the equation in levels and rely solely on the limited within information of the data. As most of the variation of democracy stems from the cross-section rather than the time-dimension, the absence of a highly sensitive democracy indicator impedes consistent estimation of the “true” effect of democracy.

When digging deeper into the democracy-growth nexus, we find only little indication of a nonlinear relationship between the variables. The analysis of the transmission channels through which democracy exerts its influence on growth illustrates why: whereas democratic countries typically have higher educated populations, higher investment shares and lower fertility rates, we cannot find evidence of a redistribution-enhancing effect of democratization.

Taken together, our results emphasize that democratic structures facilitate economic growth, and its implementation may be a beneficial strategy for less-developed countries. However, countries differ in numerous cultural, historical, political, and institutional facets. Isolating the growth effect of different aspects of democratic institutions may thus be an

⁹We also do not find any robust effect of democracy on health, even though both variables reveal a high bivariate correlation (53 percent). What we do find, however, is a significant impact of initial wealth on life expectancy. Whereas we would suspect that democratic countries provide better public health supply, the estimations imply that incomes are much more decisive for health than regime types. However, life expectancy may be a poor proxy in this context, as changes in this variable may only occur a considerable amount of time after democratization took place.

advantageous field of future research. Likewise, it would be favorable to achieve a deeper empirical understanding concerning the transmission channels of democracy, particularly with regard to health, inequality, and redistribution.

Appendix

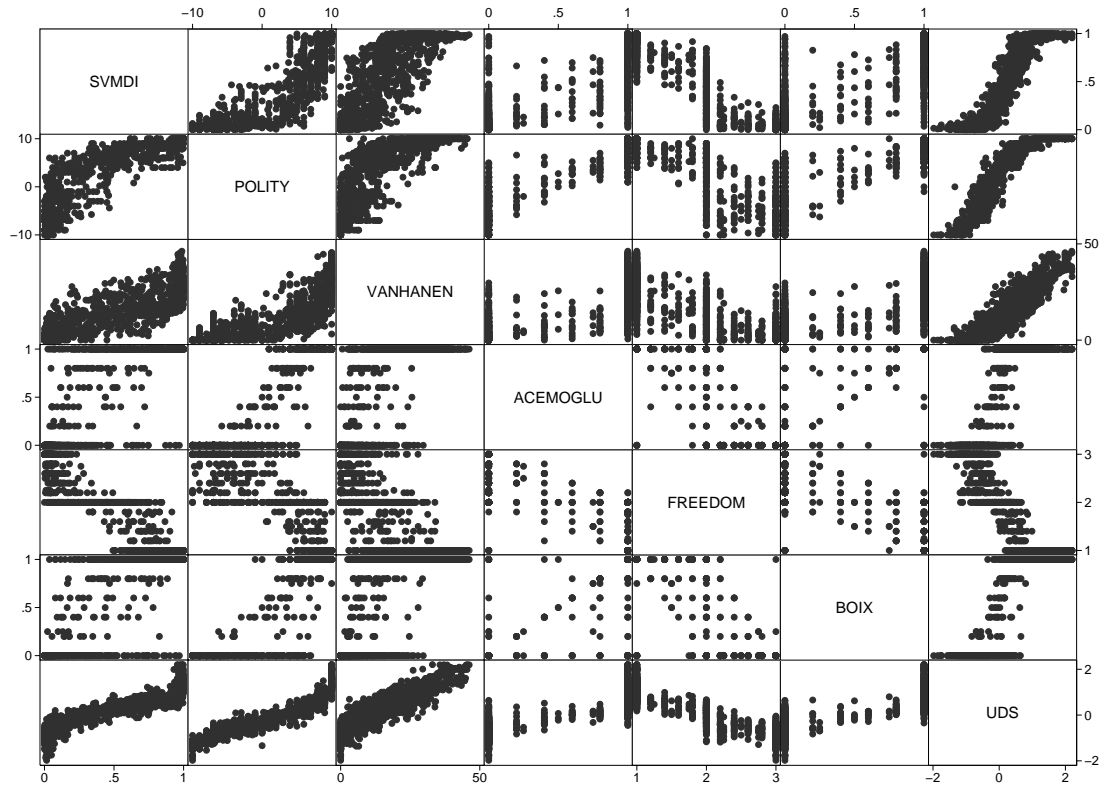


Figure A1 The relation between different democracy indicators

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