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Democracy and Economic Growth: A Reassessment

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This paper revisits the relationship between democracy and economic growth using a quantile regression method based on dynamic panel data. It explores the heterogeneous effects of democratization on economic growth when the effects depend on growth rates. Our evidence suggests that democracy can foster or hinder growth, depending on a country's growth rate. The effects of democracy on growth are positive and strong in countries with low growth rates, and weak in countries with high growth rates. The results imply that the lower the growth rate is, the more democracy is beneficial. We conclude that democracy fosters economic growth when countries are experiencing low or moderate growth. When countries have already experienced high growth, democracy is not conducive to economic growth.

Keywords: democracy, economic growth, quantile regression
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1 Introduction

Does democracy foster or hinder economic growth?[1] Before the mid-2000s, the predominant view, based on cross-country growth studies, was that democ-

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[1] In this paper, we are interested in the effect of democracy on growth. There is also a large empirical literature that considers the opposite effect, that of income on democracy. See, for

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racy has either a negative or no effect on growth; see Barro (1996) and Tavares and Wacziarg (2001). However, Rodrik and Wacziarg (2005) and Gerring et al. (2005) argued that these earlier cross-national studies only address the long-run relationship and do not investigate the short-run effects of democracy on growth. Thus, Rodrik and Wacziarg (2005), Papaioannou and Siourounis (2008a), and Madsen, Raschky, and Skali (2015) used a panel data method to consider country fixed effects and obtained a positive relationship between growth and democracy. Recently, Acemoglu et al. (2019) further controlled the dynamics of gross domestic product (GDP) and found a robust positive effect of democracy on growth. Although recent studies have found a positive relationship between economic growth and democracy, the view that democracy is a hindrance for growth remains prevalent. East Asian countries, such as China or Singapore, are examples of countries with high growth rates and low values for democratic measures.

In addition, some studies have found that the effects of democracy on growth are heterogeneous. Temple (2000), Sturm and De Haan (2005), and De Haan (2007) suggested that the coefficient on democracy should be allowed to vary across countries. Rodrik and Wacziarg (2005), Aghion, Alesina, and Trebbi (2007), and Persson and Tabellini (2008) also observed that the growth effects of democracy are heterogeneous across countries. These arguments indicate that the effect of democracy on growth could differ between countries or regions. Assiotis and Sylwester (2015) found that positive effects of democracy diminish and turn negative in countries with strong law and order. Flachaire, García-Penalosa, and Konte (2014) argued that political institutions are crucial determinants of growth, depending on different growth regimes. Acemoglu et al. (2019, p. 50) also found that the positive effects of democracy diminish and concluded that "after a democratization, GDP increases gradually until it reaches a level 20–25% higher than what it would reach otherwise." Based on their studies, the democratic effect on growth is heterogeneous and depends on growth rates.[2]

What accounts for the heterogeneity in the democratic effect on growth? Rodrik (1999) noted that countries that experienced low growth were those

instance, Barro (1999), Papaioannou and Siourounis (2008b), Acemoglu et al. (2008), and Gundlach and Paldam (2009).

[2]There is also a literature concerning the effect of democracy on growth depending on the level of development, in contrast to our focus on growth rates; see Aghion, Alesina, and Trebbi (2007).

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with weak institutions for conflict management, high levels of social conflict, and high inequality. According to the growth theory of Galor, Moav, and Vollrath (2009), democratizations can lower the inequality that adversely affects the emergence of institutions that promote human capital and thus, increase the growth process. This shows that countries experiencing low or negative economic growth rates have higher democratic effects on growth. For example, democratization in sub-Saharan Africa increased economic growth more than has been the case in other regions. On the other hand, countries in high-growth periods have strong institutions for conflict management, a high degree of law and order, and low inequality. Assiotis and Sylwester (2015, p. 647) argued that "*In such a case, the benefits of democratization on economic growth would diminish where law and order is already strong compared to where it is weak.*" Therefore, the positive effect of democracy on growth decreases and might become negative in countries with high growth rates.

This article introduces a quantile regression method to explain the effect of democracy on growth, along with different growth rates.[3] At different quantiles of growth rate, this methodology allows us to assess the possibility of parameter heterogeneity and to obtain the sign and magnitude of estimates concerning the effect of democracy on growth. Thus, the advantage of using the quantile regression method is that it provides greater flexibility in determining the relationship between democracy and growth across different growth periods. Unlike a cross-country regression, which would divide countries into high- or low-growth countries, quantile regression does not arbitrarily divide countries based on their levels of growth; the growth levels are determined by the characteristics of the data through the use of the quantile regression. The other advantage is that the quantile regression method is a robust estimation concerning the quantiles instead of the mean of growth rates and thus, it can deal with the problems of outliers in the growth studies.

Furthermore, because countries differ in many institutional and historical aspects, a panel data model is required to capture the unobserved heterogeneity of the fixed effects of each country when investigating the relation-

[3] Some studies in the existing literature have used quantile regressions to examine the effects of institutions on economic growth. For example, Cavalcanti and Novo (2005) investigated the relationship between nations' institutions and growth. Billger and Goel (2009) examined the effect of political and economic freedom on corruption.

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ship between democracy and growth. Panel data analyses, such as those in Rodrik and Wacziarg (2005), Papaioannou and Siourounis (2008a), Assiotis and Sylwester (2015), and Acemoglu et al. (2019), have considered unobserved heterogeneity. However, they focused only on the "*average*" growth effect of democracy, and did not develop a quantile regression approach that models the heterogeneous effect of democracy along with different growth rates. Thus, a method combining both quantile regression (parameter heterogeneity) and panel data (unobserved heterogeneity) should be considered to address the "*double heterogeneity*." This article uses the panel data quantile regression method of Koenker (2004) which explores the heterogeneous effect of democratization on economic growth when the effect depends on the growth rates, while accounting for time-invariant unobserved heterogeneity across countries and periods. The method ideally models the "double heterogeneity" phenomenon of the relationship between political democracy and economic growth.

To further capture the persistence in economic growth, we apply the dynamic panel data quantile regression (DPQR) method of Lin (2015) to control for lagged growth in the growth regression. In her paper, Lin (2015) suggests a fitted value approach to eliminate the dynamic bias and develops a two-stage estimation procedure. Comparing with the methods of Galvao and Montes-Rojas (2010) and Galvao (2011), Lin's estimator competes efficiently with those methods applying to the DPQR model; see Lin (2015). In addition, democracies and dictatorships have different chances of survival under various economic conditions; we thus need to account for the possibility that the level of democracy itself may also be endogenous. Therefore, in the first stage, we obtain the fitted values of the lagged dependent variable and democracy by regressing them on their respective potential instruments. In the second stage, we use the fitted values to replace the lagged dependent variable and democracy and implement the quantile regression panel data model. Thus, this paper contributes to the literature by proposing a two-stage estimation method that allows for parameter heterogeneity and unobservable heterogeneity, as well as persistence and endogeneity in studying the relationship between democracy and growth.

This paper provides a comprehensive empirical examination of the heterogeneous impacts of democracy on economic growth, using panel data that span 108 countries during the period 1960–2011. Unlike the ordinary regression estimates obtained in the previous literature that only provide an average effect, our empirical results show that the quantile regression esti-

mates of the coefficients of democracy on economic growth decrease along with the quantiles of growth. For the 0.1–0.3 quantiles, the estimates of democracy are larger than one; for the 0.4–0.7 quantiles, the estimates lie between zero and one; and for the 0.8–0.9 quantiles, the estimates of democracy are smaller than zero. This shows that the quantile regression estimates for the growth effect of democratization are heterogeneous and vary across different levels of growth rates. Thus, we build on and complement Assiotis and Sylwester (2015), Flachaire, García-Penalosa, and Konte (2014), and Acemoglu et al. (2019) by using quantile regression.

In addition, the quantile effects of democracy on economic growth are significantly positive for the lower and middle quantiles of growth and are insignificant at the higher quantiles of growth. The results demonstrate that democracy fosters economic growth in low- and moderate-growth periods, and is not conducive to growth in high-growth periods. Our analysis supports the view that became dominant after the mid-2000s, namely that the short-run effect of democracy on growth is positive for most countries; see, for example, Rodrik and Wacziarg (2005), Papaioannou and Siourounis (2008a), and Acemoglu et al. (2019). Our analysis can also help explain the pessimistic view that democracy may hinder growth in countries in high-growth periods. The empirical results suggest that considering the heterogeneous effects of democracy on growth is important in resolving the differing views of the existing studies. We conclude that the benefits of democratization are higher when economies experience lower growth rates.

To capture persistence in economic growth, we control the dynamics of GDP growth. The finding is robust to the dynamic specification, namely democracy is estimated to have heterogeneous and monotonic effects on economic growth, dependent on the growth rates. We also consider controlling lags of GDP per capita and the results obtained are similar. For more robustness, we use various indicators for democracy, consider different subsamples, and include further controls. Finally, to identify the effect of democracy on economic growth, we employ the two-stage quantile regression of Lin (2015) with four instrumental variables to control for the endogeneity of democracy. Our results confirm that there are heterogeneous and asymmetric effects of democracy on economic growth and suggest that the asymmetric effects may be a function of the distribution of growth. We conjecture that the reason why some studies find only a positive association between democracy and growth is because of the "averaging" effects of different levels of growth. If one averages those asymmetric effects of democracy

on economic growth, then the opposite effects experienced in high, middle, and low growth rates offset each other, resulting in positive effects. Using the applied method, we can explain both the positive and weakly negative views in the literature.

This paper proceeds as follows. Section 2 reviews the related literature. Section 3 introduces the econometric technique and defines the data. Section 4 discusses the results and provides robustness checks. Section 5 concludes the paper. The Appendix contains further information on the list of countries examined in the paper.

2 Related Literature

The nature of the relationship between democracy and economic growth is a long-standing controversy. A number of scholars argue that there is a positive relationship. Gerring et al. (2005) emphasized that democratic history has an effect on economic performance. That is, the longer a country remains democratic, the greater will be the aggregate effect of democracy on growth. Their empirical results showed that a prolonged democratic experience has a positive effect on growth performance. Doucouliagos and Ulubasoglu (2008) employed a meta-regression analysis on a population of 483 estimates derived from 84 studies, and found that democracy has significantly positive indirect effects on economic growth through higher human capital, lower inflation, lower political instability, and higher levels of economic freedom. Papaioannou and Siourounis (2008a) utilized a panel data model to control for omitted variables in the study of democracy and growth, and identified permanent democratic transitions to avoid a measurement error problem. Their empirical results for 174 countries over the period 1960–2005 showed positive effects of democratization on economic growth in the long run.

Madsen, Raschky, and Skali (2015) examined the income and growth effects of democracy using a dataset for 141 countries over two long periods, 1820–2000 and 1500–2000. They found that countries democratizing from complete autocracy can improve their income by between 158% and 278%. Gründler and Krieger (2016) also found a positive relationship linking growth to democracy for 185 countries over the period 1981–2011 by using a mathematical algorithm for pattern recognition to measure democracy. Acemoglu et al. (2019) argued that, on average, democratizations are preceded by a temporary dip in growth, based on investigating a panel of

countries from 1960 to 2010 using a dynamic panel data approach to control for both country fixed effects and model GDP dynamics. They provided evidence that democracy has a significant and positive effect on growth. They further found that democracy increases growth by encouraging investment, increasing schooling, inducing economic reforms, improving the provision of public goods, and reducing social unrest.

Conversely, Barro (1996) employed a panel of about 100 countries from 1960 to 1990 and his empirical results showed that the overall effect of democracy on growth is weakly negative and that there is a nonlinear relationship between democracy and growth. Democracy enhances growth at low levels of democracy, but depresses growth when a moderate level of democracy has been attained. Tavares and Wacziarg (2001) employed a system of simultaneous equations in their empirical study of 65 industrial and developing countries in the period 1970–1989, which showed that the overall effect of democracy on economic growth is moderately negative, once the indirect effects are accounted for. Sturm and De Haan (2005) argued that outlier and parameter heterogeneity is an important problem that has largely been ignored. They combined robust estimation and extreme bound analysis to control problems of outliers and model uncertainty. The results suggested that the effects of democratic freedom and political rights on growth are insignificant. Aisen and Veiga (2013) used the system generalized method of moments estimator for linear dynamic panel data models on a sample of 169 countries from 1960 to 2004. They found that a higher degree of political instability lowers the economic growth rates, and that democracy may have a small negative effect on growth.

The above review suggests that the previous theoretical and empirical studies provide inconclusive evidence on the relationship between democracy and economic growth. Some studies have found that the effects of democracy on growth are heterogeneous. Temple (2000) pointed out that model uncertainty, parameter heterogeneity, and outliers are important econometric problems in the growth literature. He argued that parameters should be allowed to vary across countries, and suggested adapting extreme bound analysis to address all three problems. De Haan (2007) also noted that most studies in the literature have been criticized for ignoring sample heterogeneity, the role of outliers, and measurement error in relation to political variables. Rodrik and Wacziarg (2005) used a panel data model for 154 countries from 1950 to 2000 and found that democratic transitions have a positive effect on economic growth in the short run. In particular, they observed

that there is tremendous heterogeneity of country experiences with democratization. Persson and Tabellini (2008) used a semi-parametric method that combined matching and difference-in-differences methods, and their empirical results for countries over 1960–2000 showed that the growth effects of democracy are positive and heterogeneous across countries.

Other papers consider that the impacts of democracy on growth may depend on a country's characteristics, such as technology, growth regimes, or the degree of law and order. Aghion, Alesina, and Trebbi (2007) argued that democracy has different effects on different sectors of the economy that depend on the specific characteristics of the technology and the industry's market. They explained that an important channel of this effect is freedom of entry in markets. More advanced economies benefit more from democratic institutions and the demand for democracy should increase with the level of GDP per capita. They employed disaggregated data on industrial sectors' growth rates for 180 countries for the period 1963–2003 and presented evidence that democracy has different influences on growth in different sectors. Flachaire, García-Penalosa, and Konte (2014) indicated that political institutions are crucial determinants of growth, depending on different growth regimes. They employed a two-regime model for 79 countries over the period 1975–2005. They found empirically that both types of institutions affect growth, and that the marginal impacts of the growth determinants vary across regimes. In particular, political institutions are the key factor that determine to what regime a country belongs. Assiotis and Sylwester (2015) argued that the effects of democracy on growth depend on the degree of law and order. Basing their study on 118 countries between 1984 and 2010, they found positive effects of democracy in countries where law and order is weak. The benefits of democratization are highest where institutional environments are least advantageous for economic growth. The positive effects weaken or become negative in countries where law and order is strong.

3 Methodology and data

3.1 Quantile regression and panel data models

This paper specifies the empirical model for the panel data quantile regression model, given the quantile $\tau \in (0, 1)$ is specified as follows:

$$g_{i,t} = \eta_i + \beta(\tau)d_{i,t} + x'_{i,t}\gamma(\tau) + u_{i,t}(\tau),$$

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where $g_{it} = (ln(y_{it}) - ln(y_{it-1})) \times 100$ is the annual economic growth rate of country i in period t; η_i represents country-specific fixed effects; $d_{i,t}$, which is the main variable of interest, represents the democracy index, which lies between zero and one, with one corresponding to the most democratic set of institutions; and $x_{i,t}$ represents all other growth-related covariates and a constant. The parameter $\beta(\tau)$ measures the effect of democracy on economic growth at different growth rates and is a function of the quantiles. Here, $\gamma(\tau)$ is a vector of parameters representing the effects of growth on the other growth-related covariates and it depends on the quantile τ. We note that η_i is intended to capture some individual specific effect or unobserved heterogeneity that is not adequately controlled for by the other regressors in the model. In our application, η_i represents the country fixed effects and is specified as not depending on the quantile, that is, the ηs have a pure location-shift effect on the conditional quantiles of $g_{i,t}$.

This empirical specification can be used to model the heterogeneous effects of democracy on economic growth and the unobserved heterogeneity of countries by combining the quantile regression method and a panel data model. Koenker (2004) proposed the adoption of the penalized quantile regression method, whereby the fixed effects involve a pure location shift and are subject to shrinkage toward a common value, along with a tuning parameter. To estimate the coefficients at different quantiles, $\hat{\beta}(\tau)$ and $\hat{\gamma}(\tau)$ can be obtained by estimating the model for several quantiles simultaneously:

$$\min_{\beta,\gamma} \sum_{k=1}^{q} \sum_{i=1}^{N} \sum_{t=1}^{T} \omega_k \rho_{\tau_k} \left(g_{i,t} - \eta_i - \beta(\tau) d_{i,t} - x'_{i,t} \gamma(\tau) \right) - \lambda \sum_{i=1}^{N} |\eta_i|,$$

where $\rho_\tau(u) = u(\tau - \mathbf{1}_{\{u<0\}})$ is the piecewise linear quantile loss function or "check" function for $\tau \in (0, 1)$. The weights ω_k control the relative influence of the q quantiles $\{\tau_1, \cdots, \tau_q\}$ on the estimation of the η_i parameters.

As it appears to be important to control for lagged growth, we include the lagged value of the economic growth rate on the right-hand side to capture persistence in economic growth. The dynamic panel data model is specified as follows:

$$g_{i,t} = \eta_i + \alpha(\tau) g_{i,t-1} + \beta(\tau) d_{i,t} + x'_{i,t} \gamma(\tau) + u_{i,t}(\tau), \qquad (1)$$

where $g_{i,t-1}$ is the one-year lagged annual growth rate and $\alpha(\tau)$ is the resulting parameter. The dynamic panel data model is able to capture the dynamic

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relationship of variables of interest, control for unobserved individual heterogeneity, and reveal heterogeneity effects of regressors on the growth rate. As the first-differencing procedure is not feasible in the conditional quantile function, the DPQR model should be estimated directly; however, the correlation between the lagged dependent variable and the fixed effect produces a dynamic bias in the estimation. Several studies have proposed ways to solve this endogeneity. For example, Arias, Hallock, and Sosa-Escudero (2001), following the control function approach, suggested a two-stage estimation. Galvao and Montes-Rojas (2010) and Galvao (2011) introduced the instrumental variable method for a DPQR model. Lin (2015) suggests a fitted-value approach to eliminate the dynamic bias and develops a two-stage estimation procedure. The first stage estimates the fitted value of $g_{i,t-1}$. The second stage applies the method of Koenker (2004) for the dynamic panel data model. Comparing with the estimators of Koenker (2004), Galvao and Montes-Rojas (2010) and Galvao (2011), the proposed estimator of Lin (2015) performs better than the other estimator regarding the bias and root mean squared error in her Monte Carlo simulations. For more details on the two-stage method, see Lin (2015).

As empirical studies on the growth effects of democratization have indicated, the democracy variable may be endogenous. Note that two sources of endogeneity arise in our paper: the first source is the lagged dependent variable in the dynamic panel data model, and the second source is the democracy variable. To identify the effect of democracy on economic growth, we follow the two-stage procedure in the previous paragraph to account for endogeneity. The first stage is that, for the first endogeneity from the lagged dependent variable, we obtain the fitted value of the lagged dependent variable, $\hat{g}_{i,t-1}$ by regressing it on potential instruments. A practical formulation for $\hat{g}_{i,t-1}$ is to use the least squares projection of $g_{i,t-1}$ on $\Delta g_{i,t-1}$. When considering the endogeneity of democracy, given a vector of instrumental variables, $z'_{i,t}$, we carry out the estimation procedure by obtaining the fitted value of democracy on the instrumental variables, $\hat{d}_{i,t}$. In the second stage, we consider the following objective function by using the fitted values ($\hat{g}_{i,t-1}$ and $\hat{d}_{i,t}$) obtained from the first stage:

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$$\min_{\alpha,\beta,\gamma} \sum_{k=1}^{q} \sum_{i=1}^{N} \sum_{t=1}^{T} \omega_k \rho_{\tau_k} \Big(g_{i,t} - \alpha\left(\tau_k\right) \hat{g}_{i,t-1} - \eta_i - \beta(\tau) \hat{d}_{i,t} - x'_{i,t} \gamma(\tau) \Big) - \lambda \sum_{i=1}^{N} |\alpha_i|.$$

Then, the coefficients of the independent variables in this paper can be estimated by the above objective function. The two-stage procedure is easy to implement and can be widely applied in research studies.

3.2 Data

The main dataset consists of a panel of 108 countries over the period 1960–2011. The variables used in this study are the growth rate of GDP per capita, a democracy index, real GDP per capita, life expectancy, government consumption, trade openness, and the investment ratio.[4] The main sources of the data are the World Bank's World Development Indicators (WDI), the Penn World Table Version 9.0 (PWT 9.0), the International Monetary Fund's International Financial Statistics (IFS), Polity IV, Freedom House, and Barro and Lee (2013).

Our main measure of democracy is the "Polity2" code from the Polity IV database. The Polity2 score ranges from –10 to 10, with higher values representing higher levels of political freedom. As the democracy index is subject to considerable measurement error, for the sake of robustness, we consider other democracy indicators from Freedom House (2013), Papaioannou and Siourounis (2008a), Cheibub, Gandhi, and Vreeland (2010), Boix, Miller, and Rosato (2012), Gründler and Krieger (2016), and Acemoglu et al. (2019). Two Freedom House indicators are used: political rights and status. The political rights indicator ranges from one to seven, with one representing the highest degree of liberty and seven the lowest. The status code has three categories: "not free," "partly free," or "free." To facilitate comparison with all democracy measures, we normalize Polity2, the polity rights, and the status codes to lie between zero and one, with one corresponding to the most democratic set of institutions.

[4]The analysis imposes the condition that a country is included in the data list only if it has at least 26 (half) of the total annual observations during the period 1960–2011 for each of the variables. A list of constituent countries is provided in the Appendix.

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Papaioannou and Siourounis (2008a) provided other codings of regime transitions and examined a variety of democracy measurement databases, numerous political archives, historical resources, and election databases, to identify the timing of each political transition. Their measure of democracy distinguished between full and partial democratization episodes and grouped the non-reforming countries into three categories: always democratic, always autocratic, and always intermediate. The dataset of Cheibub, Gandhi, and Vreeland (2010) and Boix, Miller, and Rosato (2012) extended the democratic measure of Przeworski et al. (2000) and provided a dichotomous measure of democracy. Note that the dichotomous index of Cheibub, Gandhi, and Vreeland (2010) and Boix, Miller, and Rosato (2012) consists of all transitions to democracy and reversals, whereas Papaioannou and Siourounis (2008a) only coded the last democratic reforms. Gründler and Krieger (2016) provided a measure of democracy that is continuous on the [0,1] interval, based on "support vector machines." Recently, Acemoglu et al. (2019) provided a complete discussion of the measures for democracy. They developed a measure that captures a bundle of institutions characterizing electoral democracies and incorporated the expansion of civil rights.

The growth rate of real GDP per capita is the annual change in the real GDP per capita measured in 2010 dollars, which we obtained from WDI. We use the government consumption expenditure scaled by GDP to represent the government consumption ratio, where the government consumption expenditure includes all government current expenditures for purchases of goods and services.[5] We measure trade openness by the ratio of annual imports plus exports to GDP, using the data provided by WDI. The investment ratio, from PWT 9.0, is the investment share of real GDP, and it represents physical capital investment. The life expectancy at birth from WDI is used as a control variable for the level of human capital and health differences. To increase the robustness of our results, we follow and control for additional growth-related variables. Two variables used by Barro and Lee (2013) represent male and female schooling and measure the average years of education attainment in secondary and higher schools.[6] The total

[5]National defense and security are also included.

[6]Male schooling and female schooling examined by Barro and Lee (2013) are constructed in five-year intervals and have been updated to 2010. Following Papaioannou and Siourounis (2008a) and Klomp and De Haan (2009), our paper uses a simple linear interpolation to obtain annual observations.

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fertility rate represents the number of children born to the average woman, obtained from WDI. Inflation is measured by the annual growth rate of the GDP deflator and is also obtained from WDI. The terms-of-trade change is measured by the change of the relative price of exports in terms of imports and is obtained from IFS.

Table 1 provides the basic summary statistics of the data. As shown, there is significant variation in growth rates, both over time and across countries, in the data. Panel (A) of Table 1 refers to the benchmark sample that we use. In this panel, the mean growth rate of 1.85% is smaller than the median growth rate of 2.16%, which illustrates that the distribution of the growth rate is left-skewed. The standard deviation of the growth rate is 5.50%, and the maximum and minimum growth rates are 65.06% and −69.79%, respectively. Thus, we find that the economic growth rate is volatile, and that the estimation results of the mean regression for the data can be sensitive to these extreme growth rates. We provide economic growth rates by quantile in Table 2 for benchmark sample countries. We find that the quantiles of economic growth are not affected by outlier values. For example, the economic growth rates of the 0.05 and 0.95 quantiles are −6.47% and 8.66%, respectively, which are far from the maximum and minimum rates. One advantage of using quantile regression is that the estimations are robust with respect to extreme values.[7] Moreover, the median Polity2 score is three, which implies that more than half of the episodes of our data are in democratic institutions. The government consumption and investment ratio are symmetric, as their means and medians are quite close. However, the distributions of real GDP per capita and trade openness are right-skewed.

Next, we consider smaller groups of countries to examine whether our quantile regression results are driven by a small number of countries that may have growth profiles that differ from those of all countries. First, we exclude the 24 developed countries from the sample. We also exclude resource-rich countries, the OPEC countries. Second, we consider only the 38 sub-Saharan African countries. Finally, we consider half of the countries with high levels of ethnic fractionalization. A list of these countries in the different subsamples is provided in the Appendix. The summary statistics of these samples are shown in Panels (B) to (E) of Table 1. When developed countries are excluded, the sample countries have a lower mean growth rate and

[7] We do not need to drop advanced economies from the benchmark model because the quantile analysis is not sensitive to extreme values.

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Table 1: Summary statistics

	Mean	Q1	Median	Q3	S.D.	Min	Max
(A) Benchmark sample (108 countries)							
GDP per capita growth rate (%)	1.85	−0.18	2.16	4.34	5.50	−69.79	65.06
Democracy (Polity2)	1.25	−7.00	3.00	9.00	7.49	−10.00	10.00
Real GDP per capita	7,261.43	529.43	1,893.17	7,557.53	11,599.96	50.04	87,716.73
Life expectancy	61.29	50.90	62.56	71.84	12.24	26.76	85.16
Government consumption (%)	15.02	10.58	13.90	18.21	6.21	2.05	64.39
Trade openness (%)	67.07	38.54	56.69	81.71	46.27	5.31	444.10
Investment ratio (%)	20.30	12.22	19.86	26.52	10.80	−8.63	88.90
(B) Excluding developed countries (84 countries)							
GDP per capita growth rate (%)	1.62	−0.76	2.01	4.41	6.03	−69.79	65.06
Democracy (Polity IV)	−0.87	−7.00	−3.00	6.00	6.90	−10.00	10.00
Real GDP per capita	2,147.71	437.82	1,002.71	2,771.38	2,790.12	50.04	22,109.70
Life expectancy	57.40	48.42	57.24	67.29	10.91	26.76	79.50
Government consumption (%)	14.13	10.05	12.87	16.83	6.18	2.05	64.39
Trade openness (%)	63.97	37.96	55.82	80.99	36.96	5.31	275.23
Investment ratio (%)	17.51	10.45	16.34	22.84	9.87	−8.63	88.90
(C) Excluding OPEC countries (100 countries)							
GDP per capita growth rate (%)	1.86	−0.10	2.20	4.33	5.25	−69.79	65.06
Democracy (Polity2)	1.57	−7.00	4.00	9.00	7.45	−10.00	10.00
Real GDP per capita	7,443.13	495.57	1,756.27	8,113.10	11,952.96	50.04	87,716.73
Life expectancy	61.57	51.29	63.01	72.08	12.28	26.76	85.16
Government consumption (%)	15.01	10.52	13.90	18.23	6.19	2.05	64.39
Trade openness (%)	67.22	38.22	56.70	81.67	47.10	5.31	444.10
Investment ratio (%)	20.00	12.18	19.52	26.20	10.50	−8.63	68.23
(D) Sub-Saharan African countries (38 countries)							
GDP per capita growth rate (%)	0.89	−1.80	1.18	3.77	6.91	−69.79	65.06
Democracy (Polity2)	−2.28	−7.00	−5.00	4.00	6.01	−10.00	10.00
Real GDP per capita	1,037.65	331.80	477.76	783.07	1,691.46	50.04	14,901.35
Life expectancy	49.34	44.48	48.81	54.41	7.48	26.76	73.27
Government consumption (%)	14.84	10.39	13.65	17.62	6.78	2.05	64.39
Trade openness (%)	66.43	39.97	58.02	83.11	36.27	6.32	275.23
Investment ratio (%)	14.08	7.52	12.52	18.59	9.14	0.55	88.90
(E) Ethnically diverse countries (54 countries)							
GDP per capita growth rate (%)	1.23	−0.98	1.70	3.95	5.67	−69.79	65.06
Democracy (Polity2)	−0.61	−7.00	−2.00	6.00	6.90	−10.00	10.00
Real GDP per capita	4,122.82	418.53	794.88	2,784.13	9,973.87	50.04	87,716.73
Life expectancy	56.21	47.05	55.03	65.97	11.61	28.21	82.70
Government consumption (%)	14.11	10.05	12.91	17.05	5.96	3.59	64.39
Trade openness (%)	66.84	38.05	55.79	82.70	41.82	6.32	333.53
Investment ratio (%)	17.32	10.03	16.12	23.43	9.72	0.56	68.23

Sources: World Development Indicators, Penn World Table Version 9.0, and Polity IV (2011).

higher variation. In addition, the mean and median Polity2 scores are lower than those of the benchmark sample. In contrast, when excluding OPEC countries, the mean and median of the democracy score are higher. The lower two panels in Table 1 suggest different variable properties between

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Table 2: Sample quantiles of economic growth rate (%)

Quantile	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
Benchmark sample	−6.47	−3.58	−2.05	−1.04	−0.18	0.36	0.89	1.38	1.80	2.16
Excluding developed countries	−7.46	−4.43	−2.69	−1.68	−0.76	0.01	0.53	1.07	1.55	2.01
Excluding OPEC countries	−6.22	−3.67	−1.96	−0.93	−0.11	0.44	0.94	1.41	1.84	2.20
Sub-Saharan African countries	−8.31	−5.66	−3.87	−2.68	−1.81	−1.06	−0.47	0.09	0.60	1.18
Ethnically diverse countries	−7.48	−4.61	−2.89	−1.84	−0.97	−0.21	0.25	0.76	1.26	1.70
Quantile	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	
Benchmark sample	2.58	2.96	3.35	3.77	4.35	4.95	5.73	6.86	8.66	
Excluding developed countries	2.46	2.86	3.31	3.80	4.42	5.07	5.89	7.00	8.95	
Excluding OPEC countries	2.60	2.96	3.35	3.77	4.33	4.91	5.66	6.78	8.46	
Sub-Saharan African countries	1.69	2.21	2.70	3.16	3.78	4.53	5.41	6.86	9.86	
Ethnically diverse countries	2.11	2.57	2.94	3.36	3.95	4.57	5.30	6.38	8.29	

Source: World Development Indicators.

sub-Saharan African countries and ethnically diverse countries. Sub-Saharan African countries have lower mean and median growth rates than do other country groups and they also experience less democracy, with mean and median values for the Polity2 code of −2.28 and −5, respectively. The mean and median growth rates in ethnically diverse countries are higher than those in sub-Saharan countries, but are lower than those in the benchmark sample. Polity2 in ethnically diverse countries has the same properties as the growth rate.

4 Empirical results

4.1 Benchmark results

To investigate the heterogeneous effects of democracy on growth, we apply the quantile regression panel data model, with the results presented in Table 3. The second column of Table 3 replicates the standard within estimates, and the remaining columns present our basic results from the quantile regression panel data model.[8] Nine quantiles are considered. For example, column 3 shows the relationship between economic growth and democracy when the growth rate is at the lowest quantile. The upper and lower panels of Table 3 show the benchmark models with two and six covariates, respectively. The mean effect of democracy on growth is significantly positive at the 10% significance level, which shows that democracy weakly increases economic growth. The quantile estimates of the coefficients of democracy on economic growth decrease along with the quantiles: for the 0.1–0.3 quantiles, the estimates of democracy are larger than one; for the 0.4–0.7 quantiles, the estimates lie between zero and one; and for the 0.8–0.9 quantiles, the estimates of democracy are smaller than zero. In addition, the quantile effects of democracy on economic growth are significantly positive for the lower and middle quantiles of growth and are insignificant at the higher quantiles of growth. The empirical results demonstrate that democracy fosters economic growth when countries are experiencing lower and moderate growth rates, but it is not conducive to growth when the growth rates are high.

The coefficients of democracy on growth are plotted in Figure 1. In the figure, the horizontal and vertical axes denote the quantile and the coeffi-

[8] We use the robust against heteroskedasticity and serial correlation at the country level to calculate the standard errors of the within estimates, and we use the bootstrapped standard errors at country level for the quantile regression estimates.

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Table 3: Benchmark model results

Dependent variable: GDP per capita growth rate

		Quantile								
	Mean	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Democracy (Polity2)	0.749*	3.355***	1.874***	1.134***	0.630*	0.700**	0.927**	0.490	−0.157	−1.370**
	(0.384)	(0.722)	(0.438)	(0.430)	(0.355)	(0.341)	(0.408)	(0.490)	(0.476)	(0.631)
Lagged 2 ln(GDP per capita)	−2.380***	−1.107***	−1.106***	−1.206***	−1.219***	−1.283***	−1.381***	−1.437***	−1.506***	−1.608***
	(0.466)	(0.283)	(0.289)	(0.299)	(0.301)	(0.304)	(0.313)	(0.318)	(0.322)	(0.350)
Constant	19.726***	3.766*	6.870***	9.444***	10.657***	11.616***	12.821***	14.327***	16.284***	19.391***
	(3.559)	(2.217)	(2.245)	(2.315)	(2.357)	(2.374)	(2.449)	(2.465)	(2.519)	(2.725)
Democracy (Polity2)	0.600	3.813***	1.822***	1.055***	0.717**	0.633*	0.446	0.155	−0.316	−0.880*
	(0.401)	(0.776)	(0.480)	(0.366)	(0.347)	(0.348)	(0.388)	(0.385)	(0.425)	(0.486)
Lagged 2 ln(GDP per capita)	−2.891***	−1.764***	−1.741***	−1.601***	−1.659***	−1.717***	−1.829***	−1.840***	−1.855***	−1.940***
	(0.482)	(0.358)	(0.334)	(0.320)	(0.304)	(0.297)	(0.300)	(0.310)	(0.314)	(0.373)
Life expectancy	0.024	0.044	0.044	0.010	0.009	0.011	0.018	0.014	−0.006	−0.032
	(0.025)	(0.040)	(0.028)	(0.023)	(0.019)	(0.017)	(0.017)	(0.019)	(0.021)	(0.027)
Government consumption	−0.198***	−0.196***	−0.182***	−0.180***	−0.159***	−0.148***	−0.141***	−0.141***	−0.144***	−0.153***
	(0.038)	(0.044)	(0.026)	(0.025)	(0.021)	(0.020)	(0.022)	(0.023)	(0.024)	(0.03)
Trade openness	0.026***	0.018***	0.023***	0.023***	0.024***	0.023***	0.024***	0.023***	0.024***	0.025***
	(0.007)	(0.007)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Investment ratio	0.106***	0.134***	0.091***	0.091***	0.081***	0.073***	0.075***	0.081***	0.094***	0.103***
	(0.016)	(0.020)	(0.014)	(0.013)	(0.011)	(0.012)	(0.014)	(0.015)	(0.015)	(0.020)
Constant	21.022***	3.997*	7.723***	10.434***	11.813***	12.748***	13.691***	14.791***	17.146***	21.194***
	(3.604)	(2.130)	(2.039)	(2.096)	(2.096)	(2.124)	(2.151)	(2.160)	(2.205)	(2.379)

Notes: 1. The numbers in parentheses are the standard errors of the mean regression estimates, which are robust against heteroskedasticity and serial correlation at the country level, and the bootstrapped standard errors of the quantile regression estimates. The replication number for bootstrapping is 1,000.

2. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

3. The sample includes 108 countries and 5,400 observations.

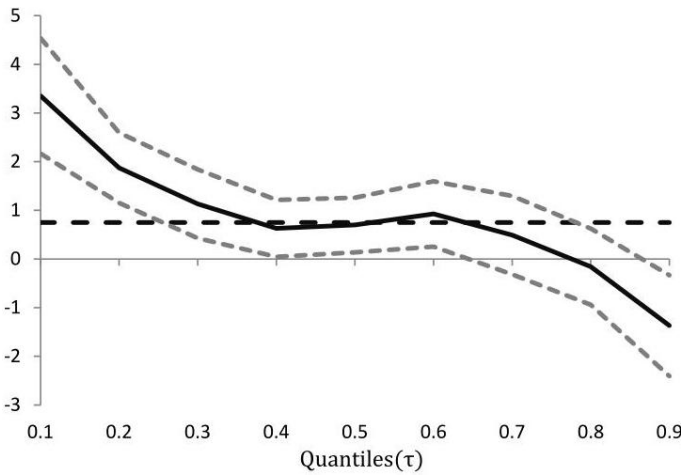


Figure 1: The impacts of democracy on economic growth

cients of democracy on growth, respectively. The black solid line depicts the quantile regression estimates, and the gray dotted lines represent their 95% confidence intervals. The black dashed line represents the mean regression estimates. Figure 1 shows that the impact of democracy on growth exhibits a clear trend. The quantile regression estimates of democracy decrease monotonically, along with the quantiles, in magnitude and significance — that is, the effects of democracy on growth are strong for the low- and moderate-growth quantiles, and become even stronger for the low-growth quantiles. The results are consistent with the arguments in the Introduction; the democracy–growth relationship is heterogeneous with different growth levels. As the effects of democracy on economic growth are negative when growth rates are high, but positive when growth rates are low, our empirical evidence implies that democracy changes the shape of the growth distribution.[9] The shape change effect of democracy on growth denotes that democracy can smooth shocks to the growth rate. Moreover, the coefficients of lagged GDP per capita are all significantly negative for both the mean and the quantile regressions; when the lagged GDP per capita increases, then the growth rate decreases. This shows that there is conditional convergence across countries.

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[9]Quinn and Woolley (2001), Mobarak (2005), Klomp and De Haan (2009), and Jetter (2014) also showed that democracy can changes growth volatility.

Following Papaioannou and Siourounis (2008a), this paper considers several growth-related variables, including two-year lagged log GDP per capita, life expectancy, government consumption, trade openness, and the investment rate.[10] The lower panel of Table 3 presents the mean as well as the quantile regression estimates of the democracy indicator on economic growth. The mean effect of democracy becomes insignificant when considering more controls. This shows that the results using the ordinary regression method are sensitive with respect to the model specification. However, all quantile regression results are similar to those in the benchmark model. The effects of democracy on growth are higher than one for the 0.1–0.3 quantiles of growth rates, lie between zero and one for the 0.4–0.7 quantiles of growth rates, and are negative at the 0.8–0.9 quantiles of growth rates. The coefficients of democracy on growth are significantly positive for the low- and moderate-growth regimes and are insignificant for the higher growth rates. Therefore, by using quantile regression, the relationship between democracy and economic growth is clear: there is a heterogeneous impact of democracy on growth, conditional on the different growth regimes in existence. We note that, when a country has already experienced high growth, democracy may hinder its growth. For example, at the 0.9 quantile of the growth rate, the democracy coefficient is significantly negative at the 10% significance level.

The coefficients of lagged GDP per capita are also stronger in our extension model than in the model that does not control for other explanatory variables, which implies that the rate of convergence is stronger in the extension model. The effects of government consumption on growth are all significantly negative and are homogeneous across quantiles. As government provides public goods and imposes taxes to adjust externalities, the higher the government spending rate is, the higher is the tax rate and the level of nonproductive government consumption; see Barro (1996). Thus, our empirical results support that "big government is bad for growth." Finally, the coefficients of trade openness and the investment ratio on growth are significantly positive and are homogeneous across quantiles. The results show that a rise in trade openness and the investment rate increases the steady-state

[10] As in model (2) of Papaioannou and Siourounis (2008a, p. 1533), two-year lagged log GDP per capita is used. We also consider one-year lagged log GDP per capita, and all the results are similar. For more information regarding the results of the empirical models, please contact the authors.

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level of output and thereby increases the growth rate, for a given starting value of GDP.

4.2 Dynamic panel data models

To capture persistence in economic growth, we consider the lagged growth rate in the growth regression. Although the quantile regression panel data model is useful in describing the heterogeneous effects of democracy on economic growth, it does not necessarily account for the dynamics of GDP growth. Thus, we consider the dynamic panel data model (1), where lagged GDP growth is used as a control variable. We apply a two-stage procedure for the DPQR model in this section. The impacts of democracy on growth for the dynamic panel data model are presented in the panel of Table 4. For the mean effect of democracy on economic growth in the dynamic model, we use the generalized method of moments estimation of Arellano and Bond (1991) and present the results in the first column. The remaining columns represent the coefficients of democracy on growth for the nine quantiles.

In the panel of Table 4, the mean effect of democracy on growth in the dynamic model is 1.472, which is twice as large as that in the benchmark model. On the other hand, the quantile estimates of democracy on economic growth in the dynamic model are close to those in the benchmark models. The coefficients of democracy on economic growth are significantly positive for the lower- and moderate-growth regimes and are insignificant for the higher-growth regimes. The quantile effects also decrease along with the quantiles in significance and magnitude. This implies that, for countries in low-growth regimes, the democracy impacts are stronger than for those in high-growth regimes. For those countries that have already experienced high growth, the impact of democracy may be lower. We plot the effects of democracy on economic growth in Figure 2. It can be clearly seen that the heterogeneous impacts of democracy on growth at different quantiles are found in both the benchmark and dynamic panel data models. Note that the lagged economic growth is highly significant, which indicates that there is a considerable degree of persistence in economic growth.

In addition to the variables considered in Tables 3–4, we consider three extensions. Following Papaioannou and Siourounis (2008a), we examine three extensions with corresponding control variables as follows:

Model A: $g_{i,t-1}$, $d_{i,t}$, $y_{i,t-2}$, $x_{i,t}$, $\Delta x_{i,t}$,

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Table 4: Dynamic panel data model results

Dependent variable: GDP per capita growth rate										
		Quantile								
	Mean	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Democracy (Polity2)	1.472**	3.784***	1.749***	1.096***	0.687**	0.727**	0.495	0.116	−0.272	−0.836*
	(0.688)	(0.805)	(0.471)	(0.363)	(0.344)	(0.359)	(0.379)	(0.392)	(0.436)	(0.488)
Lagged growth rate	0.164***	0.217***	0.161***	0.117***	0.104***	0.087***	0.068***	0.045*	0.024	0.062*
	(0.050)	(0.049)	(0.031)	(0.031)	(0.028)	(0.024)	(0.024)	(0.024)	(0.024)	(0.037)
Lagged 2 ln(GDP per capita)	−2.919***	−1.741***	−1.706***	−1.594***	−1.605***	−1.653***	−1.774***	−1.802***	−1.789***	−1.847***
	(0.815)	(0.364)	(0.339)	(0.325)	(0.309)	(0.304)	(0.307)	(0.316)	(0.318)	(0.379)
Life expectancy	0.084	0.037	0.046*	0.013	0.005	0.006	0.015	0.013	−0.012	−0.039
	(0.053)	(0.044)	(0.027)	(0.024)	(0.019)	(0.018)	(0.018)	(0.021)	(0.021)	(0.027)
Government consumption	−0.234***	−0.159***	−0.159***	−0.165***	−0.145***	−0.140***	−0.132***	−0.130***	−0.135***	−0.156***
	(0.050)	(0.043)	(0.028)	(0.026)	(0.022)	(0.020)	(0.023)	(0.023)	(0.024)	(0.030)
Trade openness	0.009	0.017**	0.021***	0.023***	0.023***	0.022***	0.023***	0.023***	0.023***	0.025***
	(0.010)	(0.008)	(0.006)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Investment ratio	0.146***	0.113***	0.082***	0.081***	0.074***	0.069***	0.071***	0.080***	0.095***	0.105***
	(0.024)	(0.022)	(0.014)	(0.013)	(0.012)	(0.013)	(0.014)	(0.016)	(0.016)	(0.020)
Constant	17.511***	3.927*	6.991***	9.912***	11.406***	12.357***	13.294***	14.450***	16.823***	20.732***
	(5.062)	(2.255)	(2.061)	(2.080)	(2.084)	(2.113)	(2.139)	(2.145)	(2.186)	(2.354)

Notes: 1. The numbers in parentheses are the standard errors of the mean regression estimates, which are robust against heteroskedasticity and serial correlation at the country level, and the bootstrapped standard errors of the quantile regression estimates. The replication number for bootstrapping is 1,000.

2. The instrumental variable $\Delta g_{i,t-1}$ is used in the DPQR model. Instrumental variables $g_{i,t-l}, l \geq 2$ are used in the dynamic generalized method of moments model of Arellano and Bond (1991), with estimates represented as means.

3. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

4. The sample includes 108 countries and 5,292 observations.

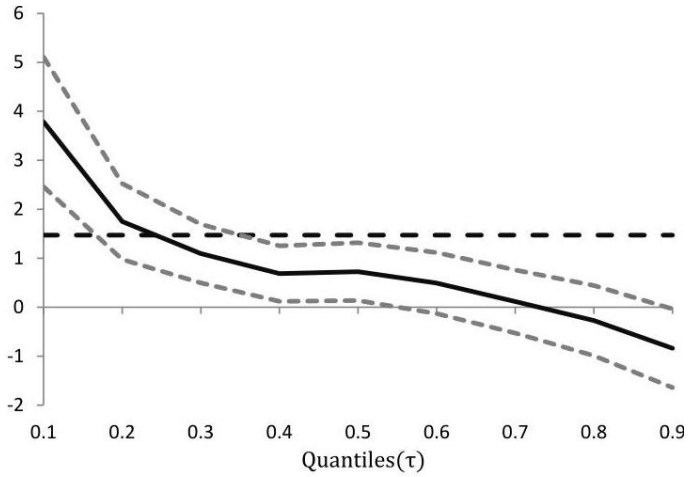


Figure 2: The impacts of democracy on economic growth in the dynamic model

Model B: $g_{i,t-1}, d_{i,t}, y_{i,t-2}, x_{i,t-2}, \Delta x_{i,t}, \Delta x_{i,t-1},$
Model C: $g_{i,t-1}, d_{i,t}, y_{i,t-1}, y_{i,t-2}, x_{i,t-2}, \Delta x_{i,t}, \Delta x_{i,t-1},$

where $y_{i,t-1}$ and $y_{i,t-2}$ are one-year and two-year lagged log GDP per capita, respectively, $x_{i,t-2}$ is a two-year lagged control variable, $\Delta x_{i,t}$ is the differenced control variable, and $\Delta x_{i,t-1}$ is a one-year lagged and differenced variable. Model B is exactly the same as Model (2) in Papaioannou and Siourounis (2008a).[11] Second, to avoid the potential omitted variable bias, we examine other factors that may determine economic growth. Following Barro (2015), we add variables, including male and female schooling, the total fertility rate, the terms-of-trade change, and the inflation rate. Third, based on the classical Solow growth model, we follow the empirical specification of and Ding and Knight (2009) to investigate the democratization effect on growth. The control variables are $g_{i,t-1}, d_{i,t}, y_{i,t-1}, \log(s_{i,t}), \log(n_{i,t} + g + \delta)$, where $s_{i,t}$ is the share of saving and we proxy it by the share of investment in real GDP, $n_{i,t}$ is the growth rate of the working-age population, and $g + \delta$ is assumed to be equal to 0.05.

Table 5 presents the mean and quantile coefficients of democracy on

[11] All the empirical models considered in Sections 4.3 and 4.4 of this paper are based on this model.

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Table 5: The estimates of democracy with different model specifications

Dependent variable: GDP per capita growth rate										
		Quantile								
	Mean	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Model A	0.863	2.751***	1.674***	0.962**	0.669*	0.613*	0.332	0.118	−0.297	−0.972*
	(0.629)	(0.766)	(0.452)	(0.408)	(0.353)	(0.334)	(0.356)	(0.359)	(0.415)	(0.528)
Model B	0.881	2.583***	1.551***	0.867**	0.599*	0.518	0.237	0.030	−0.351	−1.040**
	(0.584)	(0.791)	(0.445)	(0.402)	(0.357)	(0.342)	(0.357)	(0.359)	(0.398)	(0.529)
Model C	0.578	2.503***	1.424***	0.959***	0.712**	0.585**	0.340	0.133	−0.302	−0.927*
	(0.756)	(0.721)	(0.431)	(0.358)	(0.315)	(0.29)	(0.314)	(0.33)	(0.385)	(0.501)
Barro (2015)	0.692	2.845***	1.045**	0.526	0.244	0.355	0.280	−0.104	−0.316	−0.589
	(0.700)	(0.869)	(0.491)	(0.373)	(0.357)	(0.334)	(0.375)	(0.377)	(0.455)	(0.535)
Solow Model	3.306***	3.434***	1.642***	1.037***	0.885***	0.753**	0.719*	0.266	−0.399	−0.966*
	(0.698)	(0.698)	(0.542)	(0.392)	(0.318)	(0.319)	(0.373)	(0.409)	(0.436)	(0.560)

Notes: 1. The numbers in parentheses are the standard errors of the mean regression estimates, which are robust against heteroskedasticity and serial correlation at the country level, and the bootstrapped standard errors of the quantile regression estimates. The replication number for bootstrapping is 1,000.

2. The instrumental variable $\Delta g_{i,t-1}$ is used in the DPQR model. Instrumental variables $g_{i,t-l}, l \geq 2$ are used in the dynamic generalized method of moments model of Arellano and Bond (1991), with estimates represented as means.

3. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

4. The sample includes 108 countries 5,292 observations for Models A, B, and C, 95 countries 4,655 observations for the Barro (2015) Model, and 101 countries 4,949 observations for the Solow Model.

5. Model A controls for $g_{i,t-1}$, $d_{i,t}$, $y_{i,t-2}$, $x_{i,t}$, and $\Delta x_{i,t}$; Model B controls for $g_{i,t-1}$, $d_{i,t}$, $y_{i,t-2}$, $x_{i,t-2}$, $\Delta x_{i,t}$, and $\Delta x_{i,t-1}$; and Model C controls for $g_{i,t-1}$, $d_{i,t}$, $y_{i,t-1}$, $y_{i,t-2}$, $x_{i,t-2}$, $\Delta x_{i,t}$, and $\Delta x_{i,t-1}$. The Barro (2015) Model additionally includes male and female schooling, the total fertility rate, the terms-of-trade change, and the inflation rate. The Solow Model controls for $g_{i,t-1}$, $d_{i,t}$, $y_{i,t-1}$, $\log(s_{i,t})$, $\log(n_{i,t} + g + \delta)$; it also includes $s_{i,t}$ as the share of saving, which we proxy using the share of investment in real GDP, $n_{i,t}$ the growth rate of the working-age population, and $g + \delta$, which is assumed to be equal to 0.05.

economic growth for the three extensions.[12] We can observe that the mean effects of democracy are sensitive to the model specifications. For example, the mean effects are 1.472 in Table 4, between zero and one for the models of Papaioannou and Siourounis (2008a) and Barro (2015), and 3.306 for the Solow model. Nevertheless, the results of our quantile regression are robust, conditional on the growth levels: for countries with low growth rates, democracy can foster growth; for countries with higher growth rates, democracy does not have statistical effects on economic growth. The results in all extension models show that impacts of democracy on economic growth are heterogeneous and that these impacts decrease along with the quantiles. Thus, the growth effects of democracy are positive and strong when economies are experiencing low growth, and are weak or negative when economies are in high-growth regimes. The panel data quantile regression results of the extension models are consistent with the arguments introduced in Section 1. However, the impacts of democracy on economic growth are smaller than those in the basic dynamic model.

4.3 Robustness checks

This section considers seven democratization measures from Papaioannou and Siourounis (2008a), Cheibub, Gandhi, and Vreeland (2010), Boix, Miller, and Rosato (2012), Freedom House (2013), Gründler and Krieger (2016), and Acemoglu et al. (2019).[13] Table 6 investigates the robustness of the relationship between democracy. The table presents the mean and quantile impacts of democracy on growth with different measures. It can be seen that most of the mean effects are significantly positive, but manifest in a wide range. For instance, the impact of democracy using the political rights measure from Freedom House is 3.284, which is five times larger than that using the measure from Acemoglu et al. (2019). In contrast, the quantile effects using dynamic panel data quantile regressions are robust in terms of the coefficients with respect to democracy measures. In particular, the quan-

[12] To save space, we report only the coefficients of democracy on economic growth.

[13] The panel data models use democracy measures from Papaioannou and Siourounis (2008a), Cheibub, Gandhi, and Vreeland (2010), Boix, Miller, and Rosato (2012), Freedom House (2013), Gründler and Krieger (2016), and Acemoglu et al. (2019), and consist of 116 countries in the period 1960–2011, 117 in the period 1960–2008, 118 in the period 1960–2010, 134 in the period 1972–2011, 153 in the period 1981–2011, and 118 in the period 1960–2010.

Table 6: The estimates of democracy with different democratization measures

Dependent variable: GDP per capita growth rate										
		Quantile								
	Mean	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Political rights (Freedom House)	3.284***	2.041***	1.549***	0.890*	0.753*	0.663**	0.822**	0.701*	0.475	0.397
($N = 4{,}958$)	(1.270)	(0.770)	(0.553)	(0.454)	(0.392)	(0.318)	(0.323)	(0.390)	(0.437)	(0.576)
Status (Freedom House)	1.573	1.453**	0.936*	0.474	0.454	0.467*	0.500*	0.437	0.275	0.308
($N = 4{,}958$)	(1.176)	(0.658)	(0.479)	(0.385)	(0.322)	(0.269)	(0.290)	(0.338)	(0.389)	(0.510)
Papaioannou and Siourounis (2008a)	1.026*	1.764***	1.108***	0.849***	0.792***	0.730***	0.600**	0.570**	0.371	0.481
($N = 5{,}684$)	(0.551)	(0.559)	(0.351)	(0.301)	(0.262)	(0.251)	(0.263)	(0.263)	(0.301)	(0.380)
Cheibub, Gandhi, and Vreeland (2010)	0.917**	1.383***	0.619**	0.387	0.304	0.360	0.197	0.101	−0.009	−0.236
($N = 5{,}382$)	(0.419)	(0.487)	(0.299)	(0.254)	(0.236)	(0.225)	(0.233)	(0.248)	(0.261)	(0.410)
Boix, Miller, and Rosato (2012)	0.816**	1.549***	0.960***	0.577**	0.509**	0.537**	0.416*	0.346	0.178	0.111
($N = 5{,}664$)	(0.370)	(0.479)	(0.290)	(0.239)	(0.218)	(0.210)	(0.216)	(0.239)	(0.261)	(0.375)
Gründler and Krieger (2016)	2.348*	2.432***	1.790***	1.221**	1.088**	0.937**	0.632	0.524	0.405	0.357
($N = 4{,}284$)	(1.298)	(0.912)	(0.620)	(0.478)	(0.463)	(0.473)	(0.465)	(0.491)	(0.543)	(0.682)
Acemoglu et al. (2019)	0.655*	1.627***	0.944***	0.604**	0.572**	0.565***	0.399*	0.334	0.154	0.031
($N = 5{,}664$)	(0.398)	(0.492)	(0.309)	(0.255)	(0.228)	(0.212)	(0.213)	(0.222)	(0.247)	(0.364)

Notes: 1. The numbers in parentheses are the standard errors of the mean regression estimates, which are robust against heteroskedasticity and serial correlation at the country level, and the bootstrapped standard errors of the quantile regression estimates. The replication number for bootstrapping is 1,000.

2. The instrumental variable $\Delta g_{i,t-1}$ is used in the DPQR model. Instrumental variables $g_{i,t-l}, l \geq 2$ are used in the dynamic generalized method of moments model of Arellano and Bond (1991), with estimates represented as means.

3. N is the number of observation. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

tile effects of democracy on economic growth are significantly positive for the low and middle quantiles of growth, and are insignificant for the high quantiles of growth when using the democracy measures of Papaioannou and Siourounis (2008a), Boix, Miller, and Rosato (2012), Freedom House for political rights, Gründler and Krieger (2016), and Acemoglu et al. (2019). However, when using measures from Freedom House for status and from Cheibub, Gandhi, and Vreeland (2010), the impacts of democracy are significant only for the low-growth quantiles, but not for the middle-growth quantiles. All results with various measures show that the impacts of democracy on growth are heterogeneous and that they decrease along with growth rate levels. Our evidence implies that democracy fosters growth when countries are in low- and moderate-growth regimes.

Because the effects of democracy are heterogeneous across countries, we reestimate the DPQR model for subsamples of countries; first, we exclude the developed countries and then, we examine countries excluding the OPEC countries, followed by the sub-Saharan African countries, and, finally, countries with high levels of ethnic fractionalization (Rodrik and Wacziarg, 2005). The upper panels of Table 7 present the mean and quantile coefficients of democracy on economic growth for these subsamples. The mean effects of democracy are sensitive with respect to different subsamples. For example, the mean effect is insignificant for ethnically diverse countries, but it is significant for the other three subsamples. On the other hand, the quantile effects are significant for quantiles under the median but are insignificant for quantiles above the median for all subsamples. Again, in all four subsamples, the quantile impacts of democracy on economic growth decrease monotonically in magnitude along with the quantiles and exhibit similar patterns to the benchmark model. The democratization effects for sub-Saharan countries are the most heterogeneous, with the coefficients ranging from 4.504 to −2.301.

We explore five other scenarios to examine the robustness of our results, as follows. First, democracy may take some time to affect growth. If this is the case, then changes in the Polity index will not produce immediate effects on growth, implying that using the contemporaneous values of the index in the regression may not be the best option. Therefore, we employ the average values of the Polity index in the last five years in the regression. Second, annual data may be affected by short-term shocks. To smooth the possible shocks, we change the frequency of the data to nonoverlapping four-year

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Table 7: The estimates of democracy (Robustness checks)

Dependent variable: GDP per capita growth rate

		Quantile								
	Mean	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Excluding developed countries	1.192**	2.177***	1.261**	0.793*	0.589*	0.537	0.422	0.101	−0.178	−0.758
($N = 4{,}116$)	(0.568)	(0.811)	(0.497)	(0.406)	(0.350)	(0.353)	(0.358)	(0.384)	(0.418)	(0.563)
Excluding OPEC countries	1.515**	2.693***	1.451***	0.916**	0.606*	0.583	0.361	0.235	−0.255	−0.757
($N = 4{,}900$)	(0.589)	(0.789)	(0.494)	(0.434)	(0.367)	(0.357)	(0.378)	(0.400)	(0.427)	(0.559)
Sub-Saharan African countries	1.367**	4.504***	2.876***	1.929***	1.311**	0.918*	0.789	−0.018	−0.463	−2.301***
($N = 1{,}862$)	(0.658)	(1.215)	(0.724)	(0.672)	(0.586)	(0.482)	(0.500)	(0.637)	(0.677)	(0.814)
Ethnically diverse countries	0.357	2.452**	1.783***	1.277***	1.028**	0.861**	0.631	0.172	−0.125	−1.345*
($N = 2{,}646$)	(0.755)	(1.168)	(0.666)	(0.486)	(0.427)	(0.388)	(0.443)	(0.522)	(0.582)	(0.793)
Average democracy in the last 5 years	1.432**	3.089***	1.823***	1.038**	0.808**	0.679*	0.496	0.133	−0.246	−0.734
($N = 5{,}076$)	(0.553)	(0.847)	(0.477)	(0.435)	(0.383)	(0.387)	(0.413)	(0.406)	(0.439)	(0.562)
4-year periods data	0.004	2.349***	1.667***	0.897**	0.736*	0.547	0.511	0.401	−0.053	−0.331
($N = 1{,}080$)	(0.715)	(0.879)	(0.601)	(0.433)	(0.410)	(0.414)	(0.454)	(0.462)	(0.427)	(0.523)
Including 10-year period dummies	0.519	1.914***	1.167**	0.631	0.610*	0.503	0.246	0.080	−0.268	−0.730
($N = 5{,}292$)	(0.704)	(0.731)	(0.473)	(0.391)	(0.370)	(0.369)	(0.377)	(0.390)	(0.431)	(0.530)
Including world economic growth	0.598	2.155***	1.073**	0.717**	0.590*	0.453	0.180	−0.047	−0.504	−1.105**
($N = 5{,}292$)	(0.585)	(0.688)	(0.465)	(0.354)	(0.333)	(0.317)	(0.359)	(0.359)	(0.398)	(0.486)
GDP per capita from PWT 9.0	2.017***	2.136**	1.572***	0.721	0.566	0.454	0.291	−0.067	−0.450	−0.814
($N = 5{,}488$)	(0.693)	(0.891)	(0.525)	(0.451)	(0.392)	(0.336)	(0.332)	(0.353)	(0.410)	(0.552)
Including four lags of growth rates	0.886	2.631***	1.293***	0.677*	0.685*	0.615*	0.340	0.066	−0.393	−0.858*
($N = 4{,}968$)	(0.578)	(0.790)	(0.468)	(0.403)	(0.358)	(0.359)	(0.379)	(0.382)	(0.419)	(0.516)

Notes: 1. The numbers in parentheses are the standard errors of the mean regression estimates, which are robust against heteroskedasticity and serial correlation at the country level, and the bootstrapped standard errors of the quantile regression estimates. The replication number for bootstrapping is 1,000.

2. The instrumental variable $\Delta g_{i,t-1}$ is used in the DPQR model. Instrumental variables $g_{i,t-l}, l \geq 2$ are used in the dynamic generalized method of moments model of Arellano and Bond (1991), with estimates represented as means.

3. N is the number of observation. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

periods in our panel data studies.[14] Third, there are global shocks that may affect all countries at the same time. We control for the time effect by including period dummies or the world economic growth in the regression. Fourth, we explore the impact of democracy on growth using an alternative GDP per capita to avoid possible measurement errors from a specific data source. In place of the data from WDI, we use the GDP per capita computed from national accounts and converted to per capita terms using population data from PWT 9.0 and its growth rate. Last, as democratization is generally triggered by negative income shocks, and the negative shocks are succeeded by a catch-up process, we follow Acemoglu et al. (2019) and control for four lags of GDP growth rates. We consider these five issues to investigate the robustness of the relationship, with 108 countries from 1960 to 2011 and show our results in the lower panel of Table7. It is seen that the mean effects of democracy on economic growth range from 0.004 to 2.017, which indicates sensitivity to different scenarios. On the other hand, the results from the quantile regression are relatively robust. The democracy–growth relationship is heterogeneous and asymmetric at different growth levels. Moreover, the democratic effects are positive and significant at low quantiles, decrease along with quantiles, and become negative at high quantiles.

4.4 Endogeneity concerns

From the results presented so far, we have investigated the role of democratization and economic growth. However, the relationship between democracy and growth might be influenced by other omitted variables, which may simultaneously affect economic growth and political institutions. For example, Acemoglu et al. (2019) argued that bad news for an economy might decrease future growth and increase the demand for democracy. Moreover, sustained rapid growth might help maintain the original political institutions and, thus, there are concerns of reverse causality from growth to democracy. Therefore, we account for such endogeneities by employing instrumental variables for democracy.

There are four instruments employed in this paper. The first two instrumental variables are based on the democratization wave. Acemoglu et al. (2019, Section 5, pp. 79–82) argued that the regional pattern reflects

[14]There are 52 years in our data in total (from 1960 to 2011). Thus, we consider four-year periods instead of five-year periods in this robustness check.

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the diffusion within a region, but that democratization waves are not explained by regional economic trends. Democratization in a neighboring country spreads to other countries, but has no direct impact on the country's economic growth; one country's growth performance has no effect on the democracy scores in regional or neighboring countries. Following their construction, we experiment with using the democracy scores in regional or neighboring countries as instrumental variables of democracy with two potential weights: a regional weight and a distance weight. The regional weight is based on Acemoglu et al. (2019), who separated all countries into seven regions.[15] When a neighboring country is not in the same region, the weight is zero; when the neighboring country is in the same region, the weight is the inverse of the number of countries in this region. The distance weight is based on Giuliano, Mishra, and Spilimbergo (2013) and we use the geographic distance of other countries as our weight.[16] If a neighboring country is closer to a country, then the weight of that neighboring country is larger.

In contrast, it is argued that a neighboring country's democracy can influence its domestic income, and that a country's growth performance may have spillover effects to its geographically neighboring countries. Therefore, in addition to geographic distance, we also use instrument variables based on Madsen, Raschky, and Skali (2015) who used foreign democracy, weighted by linguistic distance and genetic distance, as instruments for democracy. The genetic distance is obtained from Spolaore and Wacziarg (2009), who measured the association with the time elapsed since the two populations' last common ancestors. The fourth instrument is suggested by Rock (2009), who used the durability of the political regime type as an instrument. The durability of political regime type is obtained from Polity IV (2011), and we separate it into two variables: durability of democracy and durability of autocracy. To justify that these instrument variables are valid, we compute the correlation coefficients between Polity2 and the instruments and further test the relevance of the instruments in the first-stage regression. In Table 8, the absolute value of the correlation coefficient is between 0.36 and 0.65,

[15]The seven regions of Acemoglu et al. (2019) were Africa, East Asia and the Pacific, Eastern Europe and Central Asia, Western Europe and other developed countries, Latin America and the Caribbean, the Middle East and the North of Africa, and South Asia.

[16]The source for geographic distance is the GeoDist database of the Centre d'Etudes Prospectives et d'Informations Internationales.

Table 8: The validity of instrumental variables

	IV1:	IV2:	IV3:	IV4:	
	Regional weight	Distance weight	Genetic distance weight	Durability of autocracy	Durability of democracy
Correlation with democracy	0.65	0.38	0.36	−0.58	0.56
First-stage estimates	0.819***	0.913***	0.935***	−0.011***	0.001
	(0.105)	(0.119)	(0.128)	(0.002)	(0.001)
First stage F-test	60.81	56.07	53.10	17.71	
Number of countries	108	108	107	108	
Sample period	1960–2011	1960–2011	1960–2011	1960–2011	

Notes: 1. The standard errors, which are robust against heteroskedasticity and serial correlation at the country level, are reported in parentheses.

2. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

3. The first stage F-test pertains to the coefficient of the external instruments only.

which shows that democracy and the instruments are not highly correlated. In addition, the coefficient estimates of the instrumental variables are significant at the 1% level, and the first stage F-test pertains to the coefficients of the external instruments are sizable in the four models. The evidence above suggests the validity of the instrumental variables in this paper.

The estimates from the two-stage quantile regression procedure of Lin (2015) are presented in Table 9. From Table 9, we find that the coefficients of democracy are significantly positive for the lower and middle quantiles and insignificant for the higher quantiles. The heterogeneous impacts of democracy on economic growth are robust with respect to the four instrumental variables using different weights or other considerations. The results show that, for countries experiencing low and moderate growth, democracy has a strong and significantly positive effect on economic growth, whereas for high-growth countries, democracy has weak or negative growth effects. Except for the scenario where the durability of institutions is used for the instruments, we note that both the mean and the quantile effects of democracy on economic growth are larger than those in the models that do not consider endogeneity. The effects of democracy on growth remain heterogeneous and are stronger when we control for the endogeneity of democracy.

5 Conclusions

By using a quantile regression panel data model, this study is able to investigate the "double heterogeneity" in the relationship between democracy and economic growth in greater depth. The results provide strong evidence of the heterogeneous and asymmetric impacts of democracy on growth, depen-

Table 9: The estimates of democracy with different instruments

Dependent variable: GDP per capita growth rate

		Quantile								
	Mean	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
IV1: Regional weight	2.339***	4.269***	3.441***	2.639***	2.201***	1.934***	1.672***	1.342**	0.763	0.299
($N = 5{,}292$)	(0.884)	(1.174)	(0.753)	(0.705)	(0.666)	(0.644)	(0.646)	(0.659)	(0.641)	(0.779)
IV2: Distance weight	2.210**	4.127***	2.853***	1.844**	1.488**	1.133	0.783	0.418	−0.226	−0.882
($N = 5{,}292$)	(0.916)	(1.146)	(0.811)	(0.758)	(0.750)	(0.761)	(0.747)	(0.750)	(0.743)	(0.878)
IV3: Genetic distance weight	2.505***	4.506***	3.251***	2.237***	1.866***	1.504**	1.170	0.863	0.150	−0.653
($N = 5{,}243$)	(0.936)	(1.117)	(0.795)	(0.752)	(0.725)	(0.731)	(0.721)	(0.730)	(0.734)	(0.853)
IV4: Durability of institutions	−0.219	3.669***	2.340***	1.601*	1.267	1.146	0.974	0.725	0.537	0.324
($N = 5{,}292$)	(0.977)	(1.168)	(0.889)	(0.876)	(0.872)	(0.875)	(0.904)	(0.910)	(0.971)	(1.118)

Notes: 1. The numbers in parentheses are the standard errors of the mean regression estimates, which are robust against heteroskedasticity and serial correlation at the country level, and the bootstrapped standard errors of the quantile regression estimates. The replication number for bootstrapping is 1,000.

2. The instrumental variable $\Delta g_{i,t-1}$ is used in the DPQR model.

3. N is the number of observation. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

ding on the economic growth rates. The impacts of democracy on growth are strong in low-growth regimes and weak in high-growth regimes. Thus, the results imply that the lower the growth rate is, the more that democracy is beneficial. The democracy–growth nexus becomes more convincing as a result of our panel data quantile regression analysis.

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Appendix: List of countries

Albania (ALB)*	Algeria (DZA)*‡	Argentina (ARG)*
Australia (AUS)	Austria (AUT)	Bahrain (BHR)*§
Bangladesh (BGD)*	Belgium (BEL)§	Benin (BEN)*†§
Bhutan (BTN)*§	Bolivia (BOL)*§	Botswana (BWA)*†
Brazil (BRA)*§	Bulgaria (BGR)*	Burkina Faso (BFA)*†§
Burundi (BDI)*†	Cameroon (CMR)*†§	Canada (CAN)§
Central African Republic (CAF)*†§	Chad (TCD)*†§	Chile (CHL)*
China (CHN)*	Colombia (COL)*§	Comoros (COM)*†
Congo, Dem. Rep. (ZAR)*†§	Congo, Rep. (COG)*†§	Costa Rica (CRI)*
Cote d'Ivoire (CIV)*†§	Cyprus (CYP)	Denmark (DNK)
Dominican Republic (DOM)*	Ecuador (ECU)*§‡	Egypt, Arab Rep. (EGY)*
El Salvador (SLV)*	Equatorial Guinea (GNQ)*†‡	Ethiopia (ETH)*†§
Fiji (FJI)*§	Finland (FIN)	France (FRA)
Gabon (GAB)*†§‡	Gambia, The (GMB)*†§	Ghana (GHA)*†§
Greece (GRC)	Guatemala (GTM)*§	Guinea Bissau (GNB)*†§
Honduras (HND)*	Hungary (HUN)*	India (IND)*
Indonesia (IDN)*§	Iran, Islamic Rep. (IRN)*§‡	Israel (ISR)
Italy (ITA)	Japan (JPN)	Jordan (JOR)*§
Kenya (KEN)*†§	Korea, Rep. (KOR)	Lesotho (LSO)*†
Liberia (LBR)*†§	Luxembourg (LUX)§	Madagascar (MDG)*†§
Malawi (MWI)*†§	Malaysia (MYS)*§	Mali (MLI)*†§
Mauritania (MRT)*†§	Mauritius (MUS)*†	Mexico (MEX)*§
Mongolia (MNG)*	Morocco (MAR)*	Mozambique (MOZ)*†§
Nepal (NPL)*§	Netherlands (NLD)	New Zealand (NZL)
Nicaragua (NIC)*	Niger (NER)*†§	Nigeria (NGA)*†§‡
Norway (NOR)	Oman (OMN)*	Pakistan (PAK)*§
Panama (PAN)*§	Peru (PER)*§	Philippines (PHL)*
Portugal (PRT)	Rwanda (RWA)*†	Saudi Arabia (KSA)*‡
Senegal (SEN)*†§	Sierra Leone (SLE)*†§	Singapore (SGP)
South Africa (ZAF)*†§	Spain (ESP)	Sri Lanka (LKA)*
Sudan (SDN)*†§	Suriname (SUR)*§	Swaziland (SWZ)*†
Sweden (SWE)	Switzerland (CHE)§	Syrian Arab Republic (SYR)*§
Thailand (THA)*§	Togo (TGO)*†§	Trinidad and Tobago (TTO)*§
Tunisia (TUN)*	Turkey (TUR)*	Uganda (UGA)*†§
United Kingdom (GBR)	United States (USA)	Uruguay (URY)*
Venezuela, RB (VEN)*‡	Zambia (ZMB)*†§	Zimbabwe (ZWE)*†

Notes: Codes used to represent countries are in brackets. Countries with the symbols *, †, §, and ‡ are nondeveloped, sub-Saharan African, ethnically heterogeneous, and OPEC countries, respectively.

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再探民主與經濟成長

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本文運用追蹤資料分量迴歸模型檢視民主與經濟成長的關係, 由於民主化對經濟成長的影響隨經濟成長的高低而不同, 因此分量迴歸可捕捉此異質性的效果。我們的研究證實, 民主化對一國經濟成長的影響可正可負, 取決於該國經濟成長率的高低。當一國處於低經濟成長時期, 民主化對該國經濟成長有顯著正向效果, 但當一國處於高經濟成長階段, 民主化的效果明顯減弱, 亦即經濟成長率愈低, 實施民主化將有促進經濟成長的好處。本文的實證結果意味, 當一國正經歷低迷的經濟成長環境下, 民主化有助於刺激該國經濟, 並達成經濟成長; 但當一國的經濟成長已在較高的水準時, 民主制度無助於經濟成長。

關鍵詞: 民主, 經濟成長, 分量迴歸
JEL 分類代號: O4, O5, H1

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