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DEMOCRACY AND THE VARIABILITY OF ECONOMIC PERFORMANCE

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Sah (1991) conjectured that more centralized societies should have more volatile economic performances than less centralized ones. We show in this paper that this is true both for cross-country and within-country variability in growth rates. It is also true for some measures of policies. Finally, we show that both the best and worst performers in terms of growth rates are more likely to be autocracies. We argue that the evidence in the paper is consistent with the theoretical implications in Sah and Stiglitz (1991) and Rodrik (1999a).

1. INTRODUCTION

WHAT IS the link between economic growth and the political regime of a given country? A large empirical literature examines this question by looking at the relationship between democracy indices and cross-country average economic growth rates.[1] This literature, taken as a whole, is fairly inconclusive. Roughly the same number of studies find positive and negative effects of democracy on mean per capita growth rates.[2] This does not imply that there is no relationship between democracy and growth: the conditional distribution of growth rates as a function of democracy indices might differ from the unconditional distribution, even when the conditional mean is the same.

In this paper, we look at the relationship between centralization of political decisions and variability in economic performance. Sah (1991) conjectured that

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[1] See, for example, De Haan and Siermann (1995), Barro (1996), Sala-i-Martin (1997), and Minier (1998). Przeworski and Limongi (1993) and Brunetti (1997) are useful surveys.

[2] In a survey of 17 empirical studies of this relationship, Brunetti (1997) found that "9 studies report no, 1 study a positive, 1 study a negative, 3 studies a fragile negative and 3 studies a fragile positive relationship between democracy and economic growth" (p. 167). Sensitivity analyses of this relationship have led to different conclusions. Using the extreme bounds approach of Leamer (1983) and Levine and Renelt (1992), De Hann and Siermann (1995) conclude that the relationship between democracy and economic growth is not robust. In his critique of the extreme bounds approach, Sala-i-Martin (1997) develops a less extreme sensitivity analysis technique and concludes (among other things) that democracy and political rights are indeed "significantly" positively correlated with growth.

dictatorships should have greater variability in their economic performances than democracies. In his words:

> It is not suggested here that highly centralized societies cannot have very good performances. Such society may get a preceptor like Lee Kwan Yu of Singapore or the late Chung Hee Park of South Korea, who have been viewed as having made substantial contributions to their societies. By the same token, such a society may get a preceptor like Idi Amin of Uganda, with correspondingly opposite consequences. Nor is it claimed here that mean performance of more centralized and less centralized societies will be similar. What is suggested here is that, setting aside a number of considerations, an effect of human fallibility is that *more centralized societies will have more volatile performances*.
>
> (p. 71, emphasis added)

We call the idea that more centralized societies have more variable performances than less centralized societies Sah's conjecture.[3] We describe two theories that are consistent with this conjecture: Sah and Stiglitz's (1991) theory of fallibility in decision-making and Rodrik's (1999a) theory of asymmetric adjustments to external shocks.

Sah justifies his conjecture by appealing to the notion of human fallibility. People can make good or bad decisions and they differ in their decision-making abilities. Therefore, in a society in which only a small group of people is responsible for the most relevant decisions, the risk arising from human fallibility in decision-making is not well diversified. That is, the likelihood of either very good or very bad decisions is higher in a centralized society than in a society in which many persons are involved in decision-making, since deviations from the "average" opinion have a tendency to cancel each other out.

A formal theoretical argument along these lines can be found in Sah and Stiglitz (1991). They assume the existence of good and bad decision-makers, the good decision-makers having a higher probability of making good decisions than the bad ones. Since their theory is rather abstract, here we adapt it to fit into the context of political choices. Suppose a chief executive makes all his decisions alone. If he is of the good type, he will make good decisions more often than if he were of the bad type. Suppose now the chief executive and a second party, say the parliament, must agree before a policy is implemented. The parliament again can be either of a good or of a bad type. The average quality of decisions might not have changed, but if the quality of both the chief executive and the parliament are not perfectly correlated ex ante, the likelihood that a

[3] This conjecture is not uncontroversial. Roemer (1995) proposes a model in which risk-averse individuals face a tradeoff between the intrinsic advantages of democracy and the higher uncertainty associated with it. His crucial assumption is that democracies are "risky projects." Quoting him,

> In a democracy, there will be several political parties, presumably representing different economic interests, and which one will win the elections is uncertain. Investors, being risk-averse, may prefer the certainty of dictatorship to the electoral lottery [p. 29].

proposed good or bad policy is vetoed by one of the parties is higher than it was before. Therefore, fewer policies would be adopted and, assuming that policies affect economic performance, there would be less variability in outcomes in this less centralized society.[4]

Rodrik (1999a) develops a theory that is also consistent with Sah's conjecture. He explains the instability in economic performance based on the assumption that domestic social conflicts may affect the efficiency of adjustments to external shocks. While his is primarily a theory to explain growth collapses, it also has implications for growth variability. The idea is that external shocks – like deterioration in the terms of trade – can be magnified by distributional conflicts that lead to delayed or inadequate adjustment policies. If different groups act in opportunistic ways in the face of a reduction in economic surplus due to external shocks, they may not agree on the most efficient adjustment policies and then surplus will be reduced even further.

An implication is that the weaker a country's institutions of conflict management, the larger the effect of external shocks on growth. Democratic institutions are important conflict-management devices. For example, opportunistic expropriation of minorities is more likely when civil and political liberties are too fragile to protect them. Because democracy makes social conflict less likely (or more easily manageable), external shocks are thus partially offset by domestic macroeconomic policies.

The common implications of Sah and Stiglitz (1991) and Rodrik (1999a) for the relationship between political centralization and economic performance can be summarized as Hypotheses I, II, and III:

Hypothesis I. The within-country time-series variability of performance measures should be higher in centralized (authoritarian) societies.

In Sah and Stiglitz (1991), this is a direct implication of the fact that because the chief executive is less constrained by parties with veto power, more policies (either good or bad) will be adopted. In Rodrik (1999a), this happens because democracies are better at absorbing external shocks.

Hypothesis II. The cross-country variability of performance measures should be higher among centralized (authoritarian) societies.

In Sah and Stiglitz (1991), this happens because autocracies are more sensitive than democracies to the quality of their chief executives. In Rodrik (1999a), countries with weaker conflict-management devices (autocratic countries) will be more sensitive to external shocks at any given point in time.

[4] The relationship between political centralization and authoritarianism is certainly not one-to-one, but the correlation is high. Consider our example of a chief executive and a parliament. In autocracies, parliaments are more likely to be inexistent or incapable to veto the autocrat's decisions than in democracies. If we define decentralization as the existence of many parties with veto power, then democracy should be a very good proxy for decentralization.

Hypothesis III. Measures of policies should be more variable among centralized (authoritarian) societies.

Since the theoretical arguments are based on decision-making, it must be the case that autocracies exhibit higher variability in policies which are relevant for growth. Here, Rodrik's theory is more specific about which type of policies should be more volatile under autocratic governments: they are macroeconomic policies, usually fiscal, monetary, and exchange-rate policies. Rodrik measures macroeconomic mismanagement by a combination of increases in the rate of inflation and the black market premium.

Sah and Stiglitz's (1991) theory has an extra implication:

Hypothesis IV. The best and worst economic performances happen in centralized (authoritarian) societies.

According to Sah and Stiglitz (1991), an unconstrained chief executive who happens to be good will make above-average decisions with high probability, leading to high rates of growth. On the other hand, an unconstrained bad chief executive can inflict much damage on a country's economy. In democracies, the chief executive is less powerful and his quality is therefore less important. This hypothesis is not an implication of Rodrik's (1999a) theory. In Rodrik (1999a) even positive shocks can lead to lower growth, since they trigger social conflict. Therefore, this theory does not imply that autocracies have a higher probability of generating very good performances than democracies. According to Rodrik (2000), ''. . . democracies are actually better at adjusting policies in response to shocks'' (p. 141).

In the paper, we formally test and provide evidence supporting these four hypotheses. We show that autocracies have more variable growth rates than democracies and that this result holds both within and across countries. This corroborates Hypotheses I and II. These results are not sensitive to specific time periods, to different democracy indices, to different econometric procedures, and to model specification. They hold even after controlling for many plausible determinants of growth rates and democracy indices, including time dummies and country fixed-effects. In particular, we find that controlling for GDP, natural resource dependence, OECD membership, primary schooling, and other variables, does not affect the results. In direct comparisons, democracy seems to explain more of the growth variability than per capita GDP and about the same as resource dependence in cross-sectional tests. However, both per capita GDP and resource dependence (proxied by an oil country dummy) are not significantly related to within-country variance of growth rates.

These results also do not seem to be driven by the arguably worse quality of data from less-democratic countries. Even when we restrict the sample to countries for which we have no missing data, the results are not changed. It is also not true that most economic variables are more homogeneous among democratic countries, due to better quality of data or any other reason. We

found democracies to be significantly more heterogeneous than autocracies in their per capita GDP levels, fertility rates, male and female primary and secondary schooling, and to be statistically similar to autocracies in their variability in investment rates and life expectancy measures.

Consistent with Rodrik (1999a) and Sah and Stiglitz (1991), we find that variability of policies does seem to explain at least part of the results (Hypothesis III). We found that autocracies seem to be more heterogeneous than democracies in some policy measures like government spending in education, the black market premium, the protection of property rights and the regulation of businesses. Rodrik's theory has the precise implication that exchange rate policies should be more volatile in less-democratic countries, which is corroborated by our evidence.

Finally, we show empirically that both the best and worst performers in terms of growth are more likely to be autocracies. This strengthens the case for the theoretical arguments in Sah and Stiglitz (1991).

Our results add to the existing literature in several ways.

First, our paper is the first to formulate and empirically test all the theoretical implications about political centralization and the variability of economic performance which can be derived from existing literature such as Rodrik (1999a) and Sah and Stiglitz (1991). Other papers have considered part of these implications. Weede (1996) and Rodrik (1997) compare the cross-sectional variances of per capita GDP growth rates of a sample of countries, grouped according to some measure of democracy and political rights. Their descriptive results are consistent with the formal evidence presented in this paper. Rodrik (2000) presents formal evidence that the time-series standard deviation of annual growth rates for each country is negatively correlated with a beginning-of-period measure of democracy. However, our paper is the first one to test all four hypotheses described above in a consistent and integrated way.

More specifically, our work is novel in the following ways. In our view, the existing theoretical arguments have implications both for time-series and cross-country variability of performance measures. We show separate evidence for panel data and for the variance of growth in individual countries, which is consistent with this interpretation. The result that less democratic political systems display greater variability of economic growth rates holds both within and across countries (Hypotheses I and II).

In addition to unifying the cross-sectional and time-series results of the previous literature, we extend this literature in two different ways. The existing theoretical arguments imply that measures of economic policies should be more variable among authoritarian societies. In other words, if the theoretical arguments are correct we should be able to show that the results on the volatility of outcomes are at least partially driven by volatility in policies that are relevant for growth (Hypothesis III). In this paper, we provide new evidence that autocracies do seem to be more heterogeneous than democracies in some policy measures like government spending in education, the black market

premium, the protection of property rights, and the regulation of businesses. One might argue that democracies are uniformly more homogeneous than autocracies. However, we show this is not true. Democracies are more heterogeneous in some outcome measures like GDP, fertility rates, and secondary and higher schooling.

Finally, we provide evidence that extreme growth experiences occur almost entirely in autocratic countries. This is an additional theoretical implication of Sah and Stiglitz (1991) which to our knowledge has not been explored before.

The empirical result that dictatorships are more variable both in terms of outcomes and policies (Hypotheses I, II, and III) has fundamental implications for the literature on political systems and economic performance. The greater stability of growth rates of democratic countries adds to an existing list of desirable features of democracies, such as the positive correlations between democracy and per capita GDP *levels* and between democracy and years of primary schooling (see Barro, 1999). There is also a positive correlation between wages and democracy indices (see Rodrik, 1999b).

Our evidence is also compatible with the common view that some autocratic countries had the most impressive growth experiences (Hypothesis IV). Our findings show that dictatorships indeed have positive effects on the growth rates of some countries, those that were lucky enough to have dictators who happened to take actions that were conducive to growth.

This paper is organized as follows. In section 2, we provide evidence that autocracies have more volatile economic growth rates than democracies, without controlling for the effects of other variables. In section 3, we present procedures to control for some other factors that may affect growth. In section 4, we discuss and test an alternative explanation for our findings, which is the possibility that variables highly correlated with democracy are the primary source of variation of growth rates. In section 5, we show that our results also hold for within-country time-series variability of growth rates. In section 6, we consider the effect of democracy on economic policies. In section 7, we show that the most extreme growth experiences are almost always associated with dictatorships. Section 8 concludes the paper.

2. THE VARIABILITY OF GROWTH RATES

We first analyze whether Sah's conjecture (the idea that more centralized societies are more variable than less centralized ones) is true for the raw (uncontrolled) data. The theoretical arguments in Sah and Stiglitz (1991) and Rodrik (1999a), which we have discussed in the introduction, suggest that Sah's conjecture should apply both for cross-country and within-country measures of variability. These are Hypotheses I and II above. Thus, we start by taking a panel data approach, which allows for both effects. In order to show that Sah's conjecture holds for both measures of variability, later we analyze time-series variability measures for individual countries.

Our initial strategy is to rank the observations in increasing order, according to their democracy indices. Then we divide the sample into two groups: the lowest ranked observations (''autocracies'') and the highest ranked ones (''democracies''). The choice of the cutoff point is somewhat arbitrary, but the qualitative results are fairly insensitive to this choice. We calculate the sample variances of the growth rates for each group and, under the assumption of normality of growth rates, we test the null hypothesis of equality of variances against the alternative that the variance of autocracies is higher than the variance of democracies.

We use two measures of democracy. Gastil's index is a subjective measure of political rights that ranks countries on a discrete scale, from 1 (highest level of political rights) to 7 (lowest level of political rights). Here we normalize Gastil's index to range from 0 (less democratic) to 1 (more democratic). These data are available from 1972 on. The Polity III database provides the other index which measures the general openness of political institutions (0 = low, 10 = high; we normalized it to range from 0 to 1). These data are available for all politically independent countries for all years in which they retained their sovereignty. The main reference is Jaggers and Gurr (1995). To define our sample, we use all of the 138 countries in the Barro–Lee (1994) data set for which at least one of the democracy measures is available for at least one five-year subperiod between 1960 and 1989. For each test, the relevant sample changes according to the availability of data.

For the purposes of this section we construct our sample as follows. For each country, we take its annually averaged per capita GDP growth rate in 1970–1975, 1975–1980, 1980–1985, and 1985–1989.[5] We then take the average Gastil's index in 1972–1974, 1975–1979, 1980–1984, and 1985–1989 and construct a panel of country-years.

In Figure 1, we divide country-years from 1970 to 1989 into two groups: the country-years for which Gastil's index is between 0 and 0.1 are called ''autocracies,'' while the country-years for which the index is equal to 1 are called ''democracies.''[6] The two groups are then plotted against their five-year-average annual growth rates. The greater variability of the autocracies' growth rates is evident to the eye. This first impression is confirmed by the calculation of the variances: in Figure 1, the ratio of the variances of autocracies to democracies is 4.5.

In Table 1 we report some of our results.[7] In the first row of Table 1, each observation is constructed as follows. For each country, four observations are

[5] Growth data are from Summer and Heston's *Penn World Table*, 5.6. Both growth and Gastil's index data can be found in Barro and Lee's data set.

[6] This sample takes therefore only the cases for which there is little doubt if a country is democratic or autocratic. None of the results is sensitive to the specific way we divide countries into democracies and autocracies.

[7] We performed many other calculations with different specifications (not reported in Table 1), and all of them were in favor of Sah's conjecture.

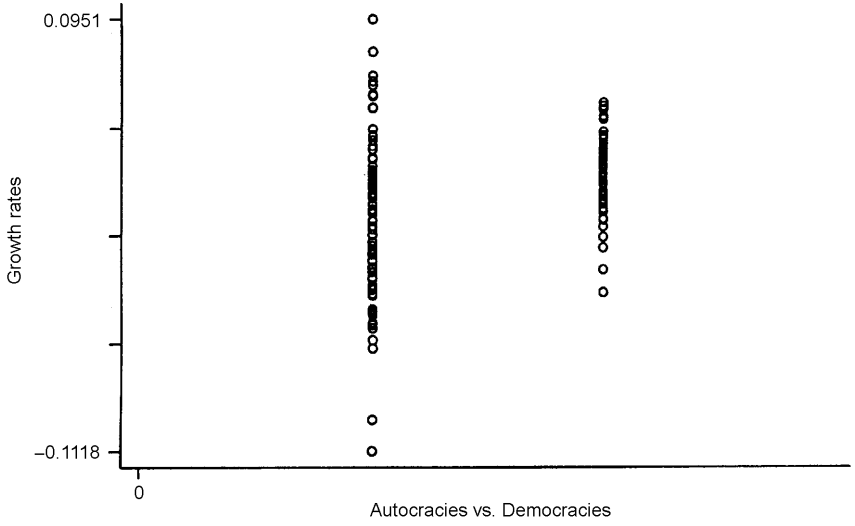

Figure 1. Growth rates for autocratic and democratic countries, 1970–1989.

generated (when available). For subperiods of 1970–1975, 1975–1980, 1980–1985, and 1985–1989, their average (over the subperiod) annual growth rates are calculated and matched with their average (over the subperiod) democracy indices for 1972–1974, 1975–1979, 1980–1984, and 1985–1989.[8] Therefore, we have a panel data set of 490 observations. We divide the sample into two samples of the same size for the purpose of testing.

In column (a), we report the ratio of the variances of autocracies to democracies. In all the reported specifications (from columns 1 to 10), this ratio is greater than 1, which is in line with Sah's conjecture. In column (b) we show the *p*-values for these ratios from an *F*-distribution, with the degrees of freedom of the numerator and the denominator given by the number of observations (minus one) in the autocratic and the democratic groups, respectively.[9] All these *p*-values are remarkably low, under conventional levels of significance. For example, in a one-sided test with a 1% significance level, the null is rejected in all 10 specifications given in Table 1.

Rows (2) to (5) report the results from the same kind of test, but for each one of the four subperiods in isolation. Comparing row (1) with rows (2) to (5), we see that our results are similar whether we use the full panel or any of the subperiods. We find no indication that the results are being driven by any specific subperiod.

In rows (1) to (5), the cutoff points are roughly in the middle of the sample. As noticed before, countries with "intermediate" values of the democracy index are

[8] Gastil's democracy index starts at 1972. All data for this entry come from the Barro–Lee (1994) data set.

[9] The numbers of observations in each group are given in columns (h) and (i).

TABLE 1 RATIO OF THE VARIANCES OF GROWTH RATES OF AUTOCRACIES TO DEMOCRACIES
(Many periods)

	Ratio (a)	*p*-Value (b)	Var. Aut. (c)	Var. Dem. (d)	Period (e)	Time horizon (f)	Democracy index (g)	No. obs. Aut. (h)	No. obs. Dem. (i)	Omitted range (j)
(1)	1.8278	$1 \times (10)^{-7}$	0.0016	0.0009	1970–89	5 yrs	Gastil	245	245	none
(2)	2.4111	0.0004	0.0015	0.0006	1970–75	5 yrs	Gastil	61	60	none
(3)	1.8768	0.008	0.0017	0.0009	1975–80	5 yrs	Gastil	60	60	none
(4)	2.6650	$8 \times (10)^{-5}$	0.0014	0.0005	1980–85	5 yrs	Gastil	62	61	none
(5)	1.9795	0.004	0.0015	0.0007	1985–89	5 yrs	Gastil	63	61	none
(6)	4.5037	$1 \times (10)^{-11}$	0.0013	0.0003	1970–89	5 yrs	Gastil	89	86	(0.133, 1)
(7)*	2.4470	0.0005	0.1466	0.0599	1970–89	20 yrs	Gastil	56	56	none
(8)	2.2095	$1 \times (10)^{-9}$	0.0016	0.0007	1970–89	5 yrs	Polity III	230	228	none
(9)	2.7748	$1 \times (10)^{-9}$	0.0017	0.0006	1970–89	5 yrs	Polity III	213	123	(0, 0.9)
(10)	3.6696	$7 \times (10)^{-11}$	0.0017	0.0004	1970–89	5 yrs	Polity III	213	86	(0, 1)

Sources: Authors' calculations using the Barro–Lee (1994) data set for growth rates and Gastil's indices, and the Polity III data set (see Jaggers and Gurr, 1995). All variables are annual averages over a five-year period, except for (*). Observations are ranked by their democracy indices, in increasing order. The *p*-values are calculated for *F*-distributions: $F[(a), (h)-1, (j)-1]$. Ratios are (a)=(c)/(d).
*Growth rates for the whole period (not averages).

the most likely to be misclassified. To check whether this misclassification is driving our results, in row (6) we omit all the observations with democracy levels (strictly) greater than 0.133 and (strictly) lower than 1. As one can see, this makes the ratio of variances jump to 4.5, with a *p*-value virtually equal to zero. Therefore, if anything, the possible misclassifications in rows (1)–(5) are actually working against the alternative hypothesis, instead of helping it.

We also check whether our results are robust to the choice of a time horizon of five years. In row (7), we do not divide the sample in subperiods; rather, we use one observation per country and calculate their total (not annualized) growth rates from 1970 to 1989. Results are robust to this change too.

Finally, we check whether our results are sensitive to the choice of the democracy measure. In rows (7) to (10), instead of the Gastil index, we use the Polity III index. As one can see, results are virtually the same.

From the evidence in this subsection, we conclude that, without conditioning on other factors, less democratic societies have more volatile growth rates than more democratic ones. Sah's conjecture and the theoretical arguments in Rodrik (1999a) and Sah and Stiglitz (1991) seem to be confirmed by our data.

3. CONTROLLING FOR THE DETERMINANTS OF GROWTH

The evidence presented in section 2 is very compelling. Democracies have more stable growth, irrespective of the index of democracy we use, the time period, or the time horizon. Furthermore, the result seems to be stronger if we eliminate countries with "intermediate" values of the democracy index, which are the most likely to be misclassified.

However, it is important to control for variables that are known from the literature to be correlated with growth rates. The results that we found so far might be due to omitted-variable heteroskedasticity. We want to be sure that the real link is between the variability of growth and democracy. Therefore, in subsection 3.1 we control for other determinants of growth rates by running growth regressions and studying the relationship between the variance of the regression residuals and the democracy indices.

If the variance of the residuals is higher for countries which are relatively autocratic, our result is strengthened. On the other hand, if the difference in variances disappears after controlling for the determinants of growth, further considerations would be necessary. We know from previous literature that investment is positively correlated with growth. Suppose, for example, that the difference in variances disappears after we include investment in the growth regressions. This means one of two things. Either the effect of the political system operates entirely via investment, or else the variance in investment determines the choice of political system. If the first hypothesis is true, Sah's conjecture could still be true, but we would have to argue why the mechanism operates only through investment. On the other hand, the second hypothesis

clearly undermines our interpretation of the correlation between democracy and the variability in growth rates.

In subsection 3.2 we investigate whether country-specific or time-specific factors might explain our findings. We regress our panel of growth rates on a set of country and time dummies. If there are some country-specific factors (like culture or origin of law) which jointly determine the political regime and growth rates, in order for Sah's conjecture to be valid, the difference in variances of growth between autocratic and democratic countries should still be present in the residuals of those regressions. If the country dummies are proxies for historically or culturally determined variables, it would be very hard to argue that the current democracy scores are affecting them. However, we could easily think of a situation in which there are many different factors that lead to autocratic regimes, while only a few would lead to democratic ones. That is, democratic countries may have very similar characteristics, while autocratic countries are generally more diverse. In such a case, the correct conclusion to take from the data would be that political centralization itself does not lead to greater variability of growth rates.

All the results in this section strongly support Sah's conjecture. The difference in variances remains after controlling for the determinants of growth, and for time-specific and country-specific factors.

3.1 Testing for Heteroskedasticity in Cross-Country Regressions

In this subsection, we test Sah's conjecture by ranking the residuals of cross-country growth regressions according to the democracy indices. We experimented with many different regression specifications, all of them yielding similar results. Therefore, we only report one result for each of two different econometric procedures.[10]

3.1.1 Results from Ordinary Least Squares Regressions

Here, we apply the Goldfeld–Quandt (1965) test for heteroskedasticity of the residuals of an OLS growth regression on a set of explanatory variables.[11]

[10] The validity of cross-country growth regressions is a controversial issue. Among all the criticism, the endogeneity of right-hand variables seems to be the most damaging (see McGrattan and Schmitz, 1998). Despite that, there is a large literature that tries to uncover the determinants of growth from these regressions (for examples that include democracy variables see Barro, 1996; Sala-i-Martin, 1997; and Minier, 1998).

[11] The test is as follows. We rank the observations by their democracy indices and separate the observations into two groups: an n_1 subsample for the autocracies and an n_2 subsample for the democracies, with some of the intermediate observations omitted. Then we run two independent regressions for each group on the same set of K explanatory variables. The test statistic is the ratio of the sum of the squares of the residuals of the autocratic group to the sum of the squares of the residuals of the democratic group. Under the assumptions of normality of the errors, this ratio has an F-distribution with $n_1 - K$ and $n_2 - K$ degrees of freedom, under the null hypothesis of homoskedasticity.

We construct a panel of observations from 1970 to 1985 for all countries in the Barro–Lee data set for which all data were available. Each country provides observations for three subperiods: 1970–1975, 1975–1980, and 1980–1985. Growth rates are the annual average growth over the subperiod, as they appear in the *Penn World Table* database of Summers and Heston. The right-hand-side variables include the log of GDP, the black market premium, the terms-of-trade shock, investment rates, log of fertility, log of life expectancy at birth, government consumption, government investment in education, the average number of years of (male and female) enrollment in secondary and higher education, and Gastil's democracy index and its square. The Appendix contains the definitions of these variables and their sources.

This specification is very similar to those found in Barro (1996) and Minier (1998), both of which are cross-country studies specifically concerned with the effects of democracy on growth. The democracy index enters in a non-linear form, as in Barro's preferred specification. Table 2 reports the estimated coefficients. Our results are very much in line with those found in Barro and Minier.

For the autocracy group, we use the range of observations with democracy indices from 0 to 0.388. For the democracy group, the range goes from 0.667 to 1. There are 116 observations in the first group and 105 in the second. The number of independent variables is 15, since we included two subperiod dummies and one intercept. The results of the heteroskedasticity test are given in column (a) of Table 3.[12]

The null hypothesis of the equality of variances is easily rejected even with very small levels of significance. As stated earlier, this result is not due to our particular specification. When we added or removed variables, or changed the period of analysis, *p*-values were also remarkably low.

3.1.2 Results from Instrumental Variables Regressions

A common approach to deal with endogeneity problems is to use lagged variables as instruments for their current values.[13] In this section, we ask whether the results of our tests still hold for regressions estimated by IV techniques.

For this specification, we use data from the period of 1965–1985. The democracy index used is from the Polity III data set.[14] The other right-hand-side variables are the same as in subsection 3.1.1. The log of GDP, the black market premium, the investment rates, the log of fertility rates, government consumption, and government investment in education are all instrumented by their

[12] We do not report the estimated coefficients of the restricted regressions, since they are irrelevant for our purposes.

[13] Again, see Barro (1996) and Minier (1998) for examples of this approach.

[14] Gastil's index is not available for years before 1972.

TABLE 2 GROWTH REGRESSIONS
(Dependent variable: growth rates of real per capita GDP)

	OLS (a)	IV (b)
Log per capita GDP	−0.0698	−0.0754
	(0.0151)	(0.0144)
Black market premium	−0.0055	−0.0025
	(0.0026)	(0.0026)
Terms-of-trade shock	0.0817	0.0512
	(0.0318)	(0.0364)
Investment	0.0818	0.0251
	(0.0315)	(0.0389)
Log fertility	−0.0325	−0.0540
	(0.0232)	(0.0187)
Log of life expectancy	0.1807	0.2138
	(0.0594)	(0.0530)
Government consumption	−0.0748	−0.1370
	(0.0458)	(0.0649)
Government investment in education	0.0011	0.3814
	(0.1613)	(0.2222)
Male secondary and higher education	0.0123	0.0152
	(0.0047)	(0.0049)
Female secondary and higher education	−0.0084	−0.0141
	(0.0051)	(0.0057)
Democracy	0.0097	−0.0254
	(0.0303)	(0.0199)
Democracy squared	−0.0099	0.0145
	(0.0268)	(0.0216)
Number of observations	251	295
R^2	0.3900	0.3872
F-statistic	10.84	15.30

Sources: Authors' calculations using the Barro–Lee (1994) data set and the Polity III data set (see Jaggers and Gurr, 1995). The dependent variable is the average per capita GDP growth rate over each subperiod of five years. See the description of the variables in the Appendix. All variables are defined for a five-year subperiod. In (a), the democracy variable is Gastil's index and the time period is 1970–85. In (b) the democracy variable is the Polity III index and the time period is 1965–85. Heteroskedasticity-corrected standard errors for the coefficient's estimates are in parentheses.

five-year lagged values, while all the other variables are instrumented by their current values.[15] We exclude 15 intermediate observations (from democracy levels of 0.2 to 0.35), so each group has 140 observations. The results of the test are given in column (b) of Table 3.[16]

As expected, whether we use OLS or IV estimation does not matter for the test results.

[15] This is the same specification as Barro's (1996).

[16] Goldfeld–Quandt tests of heteroskedasticity in IV models are carried in an analogous way as their OLS versions (see Harvey and Phillips, 1981).

TABLE 3 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT)
$H_0 : \text{var}_{\text{aut}} \leqslant \text{var}_{\text{dem}}$
$H_A: \text{var}_{\text{aut}} > \text{var}_{\text{dem}}$

	OLS (a)	IV (b)
(1) Sum of the squares of the residuals of the regression for the autocracy group	0.1085	0.1285
(2) Sum of the squares of the residuals of the regression for the democracy group	0.0345	0.0503
(3) Degrees of freedom of the numerator	101	124
(4) Degrees of freedom of the denominator	90	124
(5) *F*-statistic	3.1426	2.5518
(6) *p*-Value	$3 \times (10)^{-8}$	$2 \times (10)^{-7}$

Sources: Authors' calculations using the Barro–Lee (1994) data set and the Polity III data set (see Jaggers and Gurr, 1995). The tests are based on residuals of regressions of growth rates on log per capita GDP, the black market premium, the terms-of-trade shock, investment rates, log of fertility rates, log of life expectancy at birth, government consumption, government investment in education, the average number of years of enrollment in secondary and higher education, the democracy index and its square, time dummies, and a constant. (See the description of the variables in the Appendix. The complete output of the regressions is available from the authors upon request.) Observations are ranked by their democracy indices, in increasing order. In (a), the democracy variable is Gastil's index and the time period is 1970–85. In (b) the democracy variable is the Polity III index and the time period is 1965–85. *F*-statistics are (1)/(2). The *p*-values are calculated for *F*-distributions: *F*[(5), (3), (4)].

3.1.3 A Caveat

One could still argue that the heteroskedasticity pattern that we have found might still be due to some omitted variable correlated with democracy. This is because our benchmark model for the determinants of growth has limited explanatory power, as evidenced by the poor fit of the regressions, with R^2's around 0.39.

We deliberately chose not to play the game of maximizing R^2 in picking our growth model. Instead, we chose a model specification that is representative of the empirical growth literature. It is a fact that the fit is arguably low: in Minier's (1998) specification that is analogous to ours, the R^2 is 0.29 (using more data points than we did), while Barro's (1996) R^2's vary from 0.29 to 0.66 (using fewer data points than we did).

One should not conclude, however, that the omission of variables that affect growth and are correlated with democracy would necessarily bias our result towards acceptance of Sah's conjecture. This would be so only if the *variances* of these omitted variables were positively correlated with the *average* of democracy indices. That is, the omission of a variable that affects mean growth rates that is positively correlated with democracy will not bias the results of heteroskedasticity tests in our favor, unless its variance is one of the determinants of democracy indices.

Nevertheless, it could still be the case that intrinsic heterogeneity among autocracies, opposed to homogeneity of democracies, might be the driving force behind our results. In the following section, we use a different specification which leads to a substantial improvement in the goodness-of-fit of the regressions. We show that, even accounting for the differences between the two groups of countries using fixed effects, Sah's conjecture is strongly supported by the data, and the heterogeneity/homogeneity story does not seem to explain the relationship between democracy and the variability of growth rates.

3.2 Results from Country Fixed-Effects Regressions

Under the identifying assumption that country-specific factors that might affect growth rates do not change over time for a given country, we introduce a dummy for each country in our panel. We use the Polity III index to classify countries through the 1960–1990 period. (Because Gastil's index starts only at 1972, using the Polity III index gives us more degrees of freedom, which is important since we are adding many country dummies.) We work with two different specifications for the growth model. The first, which maximizes the number of usable observations, adds to the country dummies only the log of per capita GDP in the beginning of each five-year period and six time dummies, one for each subperiod of five years. We exclude the observations in which growth rates, GDP, or the Polity III indices were missing. This left us with a total of 658 observations. The second specification replicates the previous section's specification, to which we add country dummies, six time dummies, and an OECD dummy. We exclude all observations for any of the regressors that were missing. As expected, this specification has many fewer degrees of freedom, leaving us with 372 observations. Table 4 reports the estimated coefficients. As we can see, these models do a better job of explaining the variation in growth rates than the models in the previous section, if we use R^2 as a measure of goodness-of-fit.

The second specification is the toughest test for Sah's conjecture, for several reasons. First, the specification does seem to explain a good deal of the variation in growth rates (the R^2 is 0.66), thus reducing the scope for omitted-variable heteroskedasticity. Second, this specification has considerably fewer degrees of freedom than all the preceding ones, with 268 explanatory variables for only 372 observations, implying a reduced power for the heteroskedasticity tests. Thus, accepting the alternative hypothesis (Sah's conjecture) becomes less likely. Third, we introduce an OECD dummy in the specification. This controls for the possibility that the democracy group is overrepresented by OECD countries, which are a fairly homogeneous group with many common characteristics, including growth rates.[17] Fourth, it could be true that our results are being

[17] The possibility that our results could have been driven by the OECD countries was suggested by a referee.

TABLE 4 GROWTH REGRESSIONS WITH FIXED EFFECTS
(Dependent variable: growth rates of real per capita GDP)

	(1)	(2)
Log per capita GDP	−0.0556	−0.0869
	(0.0063)	(0.0099)
Black market premium	–	−0.0059
		(0.0016)
Terms-of-trade shock	–	0.0591
		(0.0224)
Investment	–	0.1875
		(0.0355)
Log fertility	–	−0.0262
		(0.0131)
Log of life expectancy	–	0.0648
		(0.0495)
Government consumption	–	0.3864
		(0.1670)
Government investment in education	–	0.0410
		(0.0616)
Male secondary and higher education	–	0.0100
		(0.0075)
Female secondary and higher education	–	−0.0024
		(0.0096)
OECD dummy	–	0.0830
		(0.0391)
Democracy	–	0.0004
		(0.0021)
Democracy squared	–	−0.0001
		(0.0002)
Number of observations	658	372
R^2	0.48	0.66
F-statistic	3.81	5.02

Sources: Authors' calculations using the Barro–Lee (1994) data set and the Polity III data set (see Jaggers and Gurr, 1995). The dependent variable is the average per capita GDP growth rate over each subperiod of five years, from 1960–90. See the description of the variables in the Appendix. All regressions include six time dummies and 138 country dummies. Heteroskedasticity-corrected standard errors for the coefficient's estimates are in parentheses.

driven by the presumably worse quality of data from less-democratic countries.[18] As long as bad quality data are correlated with missing data for some variables, our non-random sample that excludes all observations with at least one missing value will tend to overrepresent countries with high quality of data. As a matter of fact, democracies are overrepresented in the sample for this specification. This means that we can test Sah's conjecture using only data from countries that have better data disclosure.

[18] This possibility was suggested by a referee.

In Table 5, we report our results from heteroskedasticity tests for four different ranges of omitted central observations. Rows (1) to (4) show the results for the first specification. In row (1), we divide the sample into two subsamples of the same size, without omitting any observation. As we can see from column (a), the point estimate for the ratio of the variances of the errors of growth rates of autocracies and democracies is 2.14, and is highly significant at any reasonable significance level. Similar results are found when some central observations are omitted. In row (2), democracy indices from 0.20 to 0.28 are excluded, resulting in a slightly smaller democracy group than the autocracy group. In row (3), democracy indices from 0.08 to 0.24 are excluded, to keep the two subsamples with the same size. In both cases, the *F*-statistic is greater than 2 and is highly significant. In row (4), we eliminate all but the extreme cases: only countries with a democracy index of 0 or 1 were used for the test. As in the previous section, this procedure exaggerates our results: the *F*-statistic is greater than 10 in this case.

Rows (5) to (8) show the results for the second specification. In row (5), we omit no observations. In row (6), democracy indices from 0.3 to 0.4 were

TABLE 5 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT) FOR THE COUNTRY FIXED-EFFECTS REGRESSIONS

H_0: $\text{var}_{\text{aut}} \leqslant \text{var}_{\text{dem}}$

H_A: $\text{var}_{\text{aut}} > \text{var}_{\text{dem}}$

	F-statistic (a)	*p*-Value (b)	No. obs. 1st group (c)	No. obs. 2nd group (d)	RSS 1st group (e)	RSS 2nd group (f)	DF 1st group (g)	DF 2nd group (h)
(1)	2.14	$2 \times (10)^{-9}$	329	329	0.2388	0.1112	241	243
(2)	2.76	$5 \times (10)^{-15}$	343	293	0.2420	0.0875	254	209
(3)	2.24	$2 \times (10)^{-9}$	300	300	0.2155	0.0960	215	220
(4)	10.58	$4 \times (10)^{-32}$	288	144	0.2099	0.0198	204	109
(5)	2.19	$1 \times (10)^{-5}$	186	186	0.0665	0.0304	116	115
(6)	2.42	$3 \times (10)^{-6}$	182	173	0.0652	0.0269	112	108
(7)	2.33	$7 \times (10)^{-6}$	176	176	0.0641	0.0274	107	109
(8)	6.72	$3 \times (10)^{-13}$	128	103	0.0448	0.0066	66	65

Sources: Authors' calculations using the Barro–Lee (1994) data set for growth rates and per capita GDP, and the Polity III data set (see Jaggers and Gurr, 1995). The tests in rows (1)–(4) are based on residuals of regressions of growth rates on log per capita GDP for the period 1960–90, six time dummies, and country dummies for each country included (specification 1 in Table 4). The tests in rows (5)–(8) are based on residuals of regressions of growth rates on log per capita GDP for the period 1960–90, six time dummies and country dummies for each country included, the black market premium, the terms-of-trade shock, investment rates, log of fertility, log of life expectancy at birth, government consumption, government investment in education, the average number of years of (male and female) enrollment in secondary and higher education, the Polity III democracy index and its square, and the OECD dummy (specification 2 in Table 4). (The complete output of the regressions is available from the authors upon request.) Observations are ranked by their democracy indices, in increasing order. The first group is the more autocratic, while the second is the more democratic. RSS stands for "residual sum of squares." DF stands for "degrees of freedom." The *p*-values are calculated for *F*-distributions: *F*[(a), (g), (h)]. *F*-statistics are (e)/(f).

excluded, resulting in a slightly smaller democracy group than the autocracy group. In row (7), 20 central observations were excluded, but the two groups are kept at the same size. In row (8), all countries but those with a democracy index of 0 or 1 are excluded. It is remarkable how Sah's conjecture seems to hold in all these cases, given the possible sources of failure discussed above. Not even the dramatic reduction in the degrees of freedom in this second specification affects the extremely high significance of the findings, which is reflected in the virtually zero *p*-values.

Our results suggest that the differences in growth variability among democracies and autocracies cannot be explained by country-fixed or time-fixed characteristics, by the predominance of OECD countries in the democratic group, by the low R^2's of typical growth regressions, or by the low quality of data from less-democratic countries. Sah's conjecture is clearly strengthened by the results in this subsection.

4. IS THE DEMOCRACY INDEX JUST A PROXY FOR OTHER (RELEVANT) VARIABLES?

In this section, we address the possibility that some other variable, highly correlated with the democracy index, is actually driving the difference in variances of growth rates.

4.1 Controlling for GDP

Per capita income is an obvious candidate in explaining the variability of growth. A negative correlation between per capita GDP and the variance of growth might be expected for many different reasons. There could be a mechanical reason: poor countries can achieve both higher and lower growth rates merely because the value in the denominator of their growth rates is low. There could be theoretical reasons as well. For example, Roemer (1995) suggests that if economic growth is accompanied by more egalitarian income distribution, the political process becomes less polarized, therefore reducing the variance of the electoral lottery. And it is also possible that income is highly correlated with some other variable that directly affects the variability of growth. For example, income might be negatively related to the quality of the data we use or to the degree of natural resource dependence of a given country.[19] All these possibilities suggest a negative relation between income and growth volatility.

These stories do not imply that Sah's conjecture is false. It might be that two or more forces work in the same direction. However, given that income seems to be one of the most important determinants of democracy,[20] our tests may be

[19] We discuss how natural resource dependence might affect the variability of growth in subsection 4.3.

[20] Many empirical studies document this relationship. Recent examples include Barro (1996, 1999), La Porta et al. (1999), and McGrattan and Schmitz (1998). In their 1993 survey, Przeworski and Limongi wrote that ". . . all the developed countries in the world constitute stable democracies while stable democracies in the less developed countries remain exceptional."

only capturing the link between income and growth variability and we are misinterpreting our results as evidence of Sah's conjecture.[21]

To deal with this potential problem, we adopt the following approach. We rank observations by the part of their associated democracy indices which are not explained by their per capita GDP levels. One straightforward way of achieving this is to rank the observations by the residuals of a simple regression of the democracy index on per capita GDP. Then, by construction, we would have an index that is orthogonal to the observed values of per capita GDP. If Sah's conjecture is true, less democratic countries with this new index must still have more volatile growth rates.

In Table 6 we show the results of the same tests performed in Table 5, but now using the residuals of a simple regression of the democracy index on the log of per capita GDP as the new democracy index. We keep the same four "omitted ranges" as in Table 5 to ease the comparison. As we can see, the *F*-statistics are consistently lower than those found in Table 5, which is a sign that income might also be important in explaining growth volatility, but all results are still remarkably significant, strengthening the case for Sah's conjecture.

In Table 7 we perform the reverse experiment: we use the residuals of a simple regression of the log of per capita GDP on the democracy index to rank observations from poorest to richest. This is a specific test of the hypothesis that poor countries have more volatile growth. In this case, the evidence is less conclusive: while all eight-point estimates indicate that poor countries have greater growth variance indeed (but not as much as autocracies when compared to democracies), only the extreme cases (rows 4 and 8) are actually strictly significant at the 1% significance level. The statistics in rows (1), (5), (6), and (7) are not significant even at the 10% level. In other words, if we run a horse race of democracy versus wealth as potential explanations for the variability in growth rates, democracy wins easily.

We conclude that the evidence overwhelmingly supports Sah's conjecture. Even if one also accepts that per capita income might be associated with growth variability, it seems that its contribution is rather modest as compared to the effects of political centralization on the volatility of economic performance across countries.

4.2 Other Determinants of Democracy

In this section, we try to control for a broad set of variables which might determine democracy in a given country. We use Barro's (1999) as our benchmark model of determinants of democracy and we perform tests based

[21] Intuitively, one can think of democracy and income as the variables in the true econometric model for the variability in growth rates. If we omit income from the specification, and given the positive correlation between income and democracy, our estimate of the impact of democracy is biased upwards.

TABLE 6 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT) FOR THE COUNTRY FIXED-EFFECTS REGRESSIONS
(Based on the residuals of regressions of the democracy index on per capita GDP)
H_0 : $\text{var}_{\text{aut}} \leqslant \text{var}_{\text{dem}}$
H_A: $\text{var}_{\text{aut}} > \text{var}_{\text{dem}}$

	F-statistic (a)	*p*-Value (b)	No. obs. 1st group (c)	No. obs. 2nd group (d)	RSS 1st group (e)	RSS 2nd group (f)	DF 1st group (g)	DF 2nd group (h)
(1)	1.59	0.0001	329	329	0.2048	0.1282	236	236
(2)	2.03	$7 \times (10)^{-8}$	343	293	0.2126	0.1043	250	209
(3)	1.68	$7 \times (10)^{-5}$	300	300	0.1833	0.1088	215	214
(4)	4.34	$9 \times (10)^{-13}$	288	144	0.1685	0.0387	208	84
(5)	1.93	0.0003	186	186	0.0618	0.0320	113	109
(6)	2.40	$5 \times (10)^{-6}$	182	173	0.0596	0.0248	109	104
(7)	2.07	0.0001	176	176	0.0568	0.0274	105	106
(8)	4.39	$3 \times (10)^{-7}$	128	103	0.0382	0.0086	66	46

Sources: Authors' calculations using the Barro–Lee (1994) data set for growth rates and per capita GDP, and the Polity III data set (see Jaggers and Gurr, 1995). The tests in rows (1)–(4) are based on residuals of regressions of growth rates on log per capita GDP for the period 1960–90, six time dummies, and country dummies for each country included (specification 1 in Table 4). The tests in rows (5)–(8) are based on residuals of regressions of growth rates on log per capita GDP for the period 1960–90, six time dummies and country dummies for each country included, the black market premium, the terms-of-trade shock, investment rates, log of fertility, log of life expectancy at birth, government consumption, government investment in education, the average number of years of (male and female) enrollment in secondary and higher education, the Polity III democracy index and its square, and the OECD dummy (specification 2 in Table 4). (The complete output of the regressions is available from the authors upon request.) Observations are ranked by their residuals of regressions of the democracy index on log per capita GDP, in increasing order. The first group is the more autocratic, while the second is the more democratic. RSS stands for "residual sum of squares." DF stands for "degrees of freedom." The *p*-values are calculated for *F*-distributions: F[(a), (g), (h)]. *F*-statistics are (e)/(f).

on the residuals of regressions of the democracy indices on Barro's variables. Since causation cannot be determined from regressions of democracy on other variables, it is not clear whether acceptance of the null in the following tests really means rejection of Sah's conjecture. Still, the results shown in this paper are more convincing if the null is still rejected even when one ranks the observations according to the part of democracy that is orthogonal to a number of other variables which are believed to be correlated with democracy.

Following Barro (1999), we regress the democracy index on log of per capita GDP, years of primary schooling, the gap between male and female primary schooling, the urbanization rate, the log of total population, and an oil country dummy. To these variables we add an OECD country dummy, to make sure that our results are not being driven by the apparent homogeneity of OECD countries. Table 8 reports the main regression. All signs conform to Barro's

TABLE 7 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT) FOR THE COUNTRY FIXED-EFFECTS REGRESSIONS
(Based on the residuals of regressions of per capita GDP on the democracy index)
H_0 : $\text{var}_{\text{poor}} \leqslant \text{var}_{\text{rich}}$
H_A: $\text{var}_{\text{poor}} > \text{var}_{\text{rich}}$

	F-statistic (a)	*p*-Value (b)	No. obs. 1st group (c)	No. obs. 2nd group (d)	RSS 1st group (e)	RSS 2nd group (f)	DF 1st group (g)	DF 2nd group (h)
(1)	1.15	0.135	329	329	0.1936	0.1680	240	244
(2)	1.32	0.015	343	293	0.1971	0.1482	250	216
(3)	1.23	0.061	300	300	0.1843	0.1495	215	221
(4)	2.57	$8 \times (10)^{-7}$	288	144	0.1831	0.0712	204	86
(5)	1.18	0.181	186	186	0.0514	0.0433	105	118
(6)	1.20	0.172	182	173	0.0504	0.0419	102	108
(7)	1.08	0.342	176	176	0.0463	0.0427	99	111
(8)	2.02	0.005	128	103	0.0303	0.0149	66	48

Sources: Authors' calculations using the Barro–Lee (1994) data set for growth rates and per capita GDP, and the Polity III data set (see Jaggers and Gurr, 1995). The tests in rows (1)–(4) are based on residuals of regressions of growth rates on log per capita GDP for the period 1960–90, six time dummies, and country dummies for each country included (specification 1 in Table 4). The tests in rows (5)–(8) are based on residuals of regressions of growth rates on log per capita GDP for the period 1960–90, six time dummies and country dummies for each country included, the black market premium, the terms-of-trade shock, investment rates, log of fertility, log of life expectancy at birth, government consumption, government investment in education, the average number of years of (male and female) enrollment in secondary and higher education, the Polity III democracy index and its square, and the OECD dummy (specification 2 in Table 4). (The complete output of the regressions is available from the authors upon request.) Observations are ranked by their residuals of regressions of log per capita GDP on the democracy index, in increasing order. The first group is the poorest, while the second is the richest. RSS stands for "residual sum of squares." DF stands for "degrees of freedom." The *p*-values are calculated for *F*-distributions: $F[(a), (g), (h)]$. *F*-statistics are (e)/(f).

result, except the log of total population, which enters with a negative (but not very significant) sign.[22]

In Table 9 we report the results of the tests based on the residuals of this regression. In row (1), we report the outcome of the test that uses the raw growth variable with no controls. In row (2), we use the same specification as in Table 2 for the model of growth and we base our test on the residuals of growth regressions. In row (3), we use the residuals of growth regressions on the log of GDP, six time dummies and 138 country dummies, similar to Table 4, column (1). In row (4), we use the residuals of growth regressions on the same variables as in Table 4, column 2, plus six time dummies and 138 country dummies. This last specification is the toughest case for Sah's conjecture: it is based on fully specified models for both growth rates and democracy indices.

[22] We do not include 5- and 10-year lags of the dependent variable as regressors as Barro does, because that would not make sense for the tests. It is also true that the inclusion of the OECD dummy critically affects the estimated coefficient for the log of population.

TABLE 8 DEMOCRACY REGRESSION

	Dependent variable: democracy index
Log per capita GDP	1.6065
	(0.3538)
Years of primary schooling	0.3206
	(0.0594)
Gap between male and female primary schooling	−0.5700
	(0.2972)
Urbanization rate	−0.0296
	(0.0112)
Log of population	−0.1796
	(0.1124)
Oil country dummy	−0.8430
	(0.0112)
OECD country dummy	2.5791
	(0.5272)
Number of observations	543
R^2	0.5273
F-statistic	198.75

Sources: Authors' calculations using the Barro–Lee (1994) data set, the Polity III data set (see Jaggers and Gurr, 1995) and the World Bank's Global Development Network Growth Database. The dependent variable is the average Polity III index over each subperiod of five years, from 1960–90. See the description of the variables in the Appendix. All variables are defined for a five-year subperiod. Heteroskedasticity-corrected standard errors for the coefficient's estimates are in parentheses.

The evidence in favor of Sah's conjecture remains very strong. *p*-Values are extremely low in rows (1) and (3) and around 1% and 2% in rows (2) and (4). A large part of the fall in the significance of the results should be attributed to the decrease in the degrees of freedom, especially in row (4). Our conclusion is that, even after controlling for many factors which might explain growth rates and factors which might explain democracy indices, Sah's conjecture is still strongly supported by the data. This is even more compelling since the results hold after discarding observations that are most likely to be poorly measured and after a substantial decrease in the degrees of freedom.

4.3 Natural Resource Dependence

In this subsection, we ask whether natural resource dependence is the force driving our results. One reasonable story is the following. Some countries might have to rely too much on one or a few export products (like oil), while other countries might have a well-diversified portfolio of exports. If access to international financial markets is less than perfect, resource-dependent countries will be unable to reduce the risk of their export portfolio due to the volatility of the prices of the few goods that they export, which will reflect in more volatile

TABLE 9 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT) USING BARRO'S MODEL OF DETERMINANTS OF DEMOCRACY
(Based on the residuals of regressions – see the list of variables below)
H_0: $\text{var}_{\text{aut}} \leqslant \text{var}_{\text{dem}}$
H_A: $\text{var}_{\text{aut}} > \text{var}_{\text{dem}}$

	F-statistic (a)	*p*-Value (b)	No. obs. 1st group (c)	No. obs. 2nd group (d)	RSS 1st group (e)	RSS 2nd group (f)	DF 1st group (g)	DF 2nd group (h)
(1)	1.86	$2 \times (10)^{-7}$	268	268	0.3878	0.2091	267	267
(2)	1.44	0.010	179	179	0.1028	0.0713	162	162
(3)	2.01	$1 \times (10)^{-6}$	268	268	0.1893	0.0941	191	191
(4)	1.47	0.026	179	179	0.0486	0.0331	103	103

Sources: Authors' calculations using the Barro–Lee (1994) data set, the Polity III data set (see Jaggers and Gurr, 1995) and the World Bank's Global Development Network Growth Database. Row (1) uses the uncontrolled growth rate. Row (2) uses the residuals of growth regressions on the same variables in Table 2. Row (3) uses the residuals of growth regressions on the log of GDP, six time dummies, and 138 country dummies. Row (4) uses the residuals of growth regressions on the same variables in Table 4, column 2, plus six time dummies and 138 country dummies. Observations are ranked in increasing order by their residuals of regressions of the democracy index on the log of per capita GDP, years of primary schooling, the gap between male and female primary schooling, the urbanization rate, the log of total population, and an oil country dummy. The first group is the more autocratic, while the second is the more democratic. RSS stands for "residual sum of squares." DF stands for "degrees of freedom." The *p*-values are calculated for *F*-distributions: $F[(a), (g), (h)]$. *F*-statistics are (e)/(f).

economic growth.[23] Wantchekon (2000) provides a theory and evidence that resource-dependent countries are more likely to be authoritarian.[24] All this suggests that we could be capturing the effect of resource dependence on both democracy and the volatility of growth.

It should be noted that we have already controlled for resource dependence in the previous subsection by including the oil country dummy as one of the determinants of democracy. But given the plausibility of the resource dependence story, in this subsection we substitute a more general measure of natural resource availability for the oil dummy in the democracy regressions. We use the share of exports of primary goods in GNP from the Sachs and Warner (1997) database[25] as our alternative measure of natural resource dependence.

In Table 10 we display the results of our tests. In row (1), we rank the observations by the residuals of a regression of democracy on the same variables as in the previous subsection, except that we use the Sachs and Warner variable instead of the oil dummy. Because the Sachs and Warner variable is only available for 1970 and 1980, we were not able to use as many observations as we did in previous tests. Therefore, a substantial drop in the significance levels was

[23] This possibility was suggested to us by Raaj K. Sah.
[24] We thank an anonymous referee for the reference to Wantchekon (2000).
[25] This measure was suggested to us by a referee.

TABLE 10 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT) USING SACHS AND WARNER'S MEASURE OF RESOURCE DEPENDENCE

H_0 : $\text{var}_{\text{1st group}} \leqslant \text{var}_{\text{2nd group}}$

H_A: $\text{var}_{\text{1st group}} > \text{var}_{\text{2nd group}}$

	F-statistic (a)	*p*-Value (b)	No. obs. 1st group (c)	No. obs. 2nd group (d)	RSS 1st group (e)	RSS 2nd group (f)	DF 1st group (g)	DF 2nd group (h)
(1)	1.68	0.008	87	87	0.1197	0.0711	86	86
(2)	1.67	0.008	87	87	0.1196	0.0713	86	86
(3)	1.50	0.063	73	73	0.0417	0.0278	58	58
(4)	1.43	0.086	73	73	0.0393	0.0274	58	58
(5)	1.70	0.020	75	75	0.0423	0.0248	60	60
(6)	1.59	0.036	75	75	0.0466	0.0292	60	60

Sources: Authors' calculations using the Barro–Lee (1994) data set, the Polity III data set (see Jaggers and Gurr, 1995), the World Bank's Global Development Network Growth Database and the Sachs–Warner (1997) data set. In row (1), we rank the observations by the residuals of the regression of democracy on the same variables as in Table 9, except that we use the Sachs and Warner variable instead of the oil dummy. In row (2) we perform the same test as in row (1) except that we excluded the resource-dependence variable from the democracy regression. In row (3), we perform the same test as in (1), but now using the residuals of growth regressions as in Table 2. In row (4), we repeat the test in (3) without using the resource dependence variable in the democracy regression. In row (5), we rank the residuals of a growth regression according to the part of democracy that is orthogonal to resource dependence. In row (6), we rank observations according to the part of resource dependence that is orthogonal to democracy. RSS stands for "residual sum of squares." DF stands for "degrees of freedom." The *p*-values are calculated for *F*-distributions: *F*[(a), (g), (h)]. *F*-statistics are (e)/(f).

expected. Nevertheless, the results are still quite significant. In order to be sure that the drop in the significance levels is mainly due to using fewer observations and not to the use of the Sachs and Warner variable, in row (2) we perform the same test as in row (1) except that we excluded the resource dependence variable from the democracy regression. As one can see, this makes almost no difference to the results, hinting that correlation between democracy and resource dependence is not a driving force behind our results. In row (3), we perform the same test as in (1), but now using the residuals of growth regressions as in Table 2. The *p*-value is around 6%. In row (4), we again repeat the test in (3) without using the resource-dependence variable in the democracy regression. The *p*-value increases to 8%. Therefore, it seems that, if anything, not controlling for resource dependence actually makes the acceptance of Sah's conjecture more difficult. To test for this possibility, in rows (5) and (6) we set up a "horse race" between democracy and resource dependence similar to the one set up earlier between democracy and GDP (see Tables 6 and 7). In row (5), ranking the residuals of a growth regression according to the part of democracy that is orthogonal to resource dependence, Sah's conjecture is accepted at 2%. In row (6) we rank observations by the part of resource dependence that is orthogonal to democracy. The first group has a higher share of primary exports

than the second. We see that resource dependence is a fairly good predictor of volatility, but it does not affect at all the validity of Sah's conjecture.

We conclude that, although resource dependence does seem to explain part of the cross-country variability of growth rates, its effect does not operate through democracy. Therefore, the direct effect of democracy on the variability of growth is not changed when we control for resource dependence.

5. TIME-SERIES VOLATILITY

Our empirical approach so far has focused on a panel of country-years, in order to show that Sah's conjecture is true in the data. As we argued in the introduction, Sah's conjecture can be validated theoretically by the models in Rodrik (1999a) and Sah and Stiglitz (1991). These theories imply that both the over-time variance of growth rates in a given country (Hypothesis I) and the cross-country variability of growth rates (Hypothesis II) should be negatively related to democracy. Our use of panel data in most of the tests performed allows for both types of variability. However, the nature of our sample could suggest that the results are driven mostly by the cross-country variation in growth rates. We have 138 countries, but only six time periods in the sample.

Therefore, in this section we estimate the effect of democracy on the within-country time-series volatility of growth rates. In other words, we perform a direct test of the theoretical Hypothesis I. Following the approach of Rodrik (2000), we regress the standard deviation of growth rates over 1960–1990 on the democracy index, averaged for the same period. We also include other variables known to be correlated with democracy, again using Barro's (1999) model as our benchmark. We report the results in Table 11.

The coefficient on democracy is negative and significant at all conventional significance levels. Therefore, more democratic countries have less over time variability in their growth rates. The other variables that are significant at least at the 10% significance level are the log of population and the OECD dummy. Bigger countries have less volatile growth rates and being an OECD member makes a country's growth rates more stable. The oil country dummy enters with the expected sign, but the coefficient is not very significant. The only variable that enters with the "wrong" sign is GDP, but again the coefficient is not significantly different from zero at the 10% significance level.

We conclude that Hypothesis I is true in the data. In other words, Sah's conjecture still holds when one looks only at the within-country time-series volatility of growth rates. Interestingly, both income and resource dependence fail to explain the pattern in time-series volatilities.

6. DEMOCRACY AND THE VARIABILITY OF POLICIES

Why is it that autocracies have more variable performances? Do dictators adopt different policies that affect growth? If so, what are they? In this section, we

TABLE 11 EXPLAINING THE TIME-SERIES VOLATILITY OF GROWTH RATES

	Dependent variable: standard deviation of growth rates
Democracy index	−0.1127
	(0.0393)
Log per capita GDP	0.5203
	(0.3226)
Years of primary schooling	−0.0468
	(0.0449)
Gap between male and female primary schooling	0.1166
	(0.2146)
Urbanization rate	−0.0095
	(0.0066)
Log of population	−0.2174
	(0.0658)
Oil country dummy	1.2748
	(0.8318)
OECD country dummy	−0.8326
	(0.3572)
Number of observations	88
R^2	0.4237
F-statistic	9.18

Sources: Authors' calculations using the Barro–Lee (1994) data set, the Polity III data set (see Jaggers and Gurr, 1995) and the World Bank's Global Development Network Growth Database. The dependent variable is the standard deviation of each country's growth rate, over 1960–90. All variables are averages over 1960–90. See the description of the variables in the Appendix. All estimates of coefficients and standard errors were multiplied by 100 for better visualization. Heteroskedasticity-corrected standard errors for the coefficient's estimates are in parentheses.

provide evidence that some types of government intervention are more variable among less democratic countries than among democracies. This (Hypothesis III) is also an implication of the models in Rodrik (1999a) and Sah and Stiglitz (1991).

A natural starting point is to look at some set of variables that are believed to affect growth and check whether their cross-sectional variabilities are greater under autocratic regimes. In Table 12 we report the results of tests performed on the variables that we have used as determinants of growth in this paper. Most of these variables are measures of outcomes instead of policies, but some of them can be seen as good proxies for government policies.

The first noticeable conclusion that we get from Table 12 is that the hypothesis that democracies are uniformly more homogeneous than autocracies is not true. For example, democracies display more heterogeneity in their GDP levels, fertility rates, and the average number of years of secondary and higher education, both for men and women. Government consumption also seems to be more variable among democracies, but this result is not very significant. On the

TABLE 12 RATIO OF VARIANCES (AUTOCRACIES TO DEMOCRACIES)
$H_0: \text{var}_{\text{aut}} \leqslant \text{var}_{\text{dem}}$
$H_A: \text{var}_{\text{aut}} > \text{var}_{\text{dem}}$

	F-statistic	*p*-Value
Log per capita GDP	0.58	0.999
Black market premium	6.43	$8 \times (10)^{-33}$
Terms-of-trade shock	3.42	$2 \times (10)^{-16}$
Investment	1.12	0.211
Log fertility	0.45	0.999
Log of life expectancy	1.12	0.219
Government consumption	0.83	0.890
Government investment in education	1.77	$5 \times (10)^{-5}$
Male secondary and higher education	0.20	0.999
Female secondary and higher education	0.12	0.999

Sources: Authors' calculations using the Barro–Lee (1994) data set and the Polity III data set (see Jaggers and Gurr, 1995). See the description of the variables in the Appendix. All variables are defined for a five-year subperiod, from 1960–90. All observations with at least one missing variable were dropped. All variables are ranked in increasing order by their Polity III democracy indices and then divided in two groups of 186 observations each. *p*-Values are computed for *F*-distributions.

other hand, investment rates and life expectancies at birth seem to be more variable among autocracies, but again the results are not significant. Three variables have significantly greater variance under autocracies: government investment in education, the black market premium, and the terms-of-trade shock. Government investment in education is a true policy measure. Our findings suggest that different autocracies adopt fairly different educational policies. The black market premium is also a direct consequence of government intervention in foreign exchange markets. Barro (1996) argues that "the premium likely serves as a proxy for government distortions of markets more generally" (p. 8). Our results suggest that autocratic governments are far less predictable in the extent to which they distort the market than democratic governments. Finally, the volatility of the terms of trade, while plausibly influenced by trade policies, are possibly heavily influenced by resource dependence. We believe that this last result is more due to resource dependence than to democracy itself.

While investment in education and the black market premium are proxies for public goods provision and government distortions, respectively, they do not measure government direct interference with businesses through laws and regulations. Following La Porta et al. (1999), we use Holmes et al. (1997) property rights and business regulation indices as proxies for government interference in the private sector. To control for determinants of these variables, we run regressions of each index on two different sets of regressors, the same as those used by La Porta et al. (1999). All regressions include the log of GNP per capita, the country's latitude and a measure of ethnolinguistic fractionalization

TABLE 13 HETEROSKEDASTICITY TESTS (GOLDFELD–QUANDT) FOR PROPERTY RIGHTS AND BUSINESS REGULATION INDICES

H_0 : $\text{var}_{\text{1st group}} \leqslant \text{var}_{\text{2nd group}}$

H_A: $\text{var}_{\text{1st group}} > \text{var}_{\text{2nd group}}$

	Dep. variables	Indep. variables	*F*-statistic (a)	*p*-Value (b)	RSS 1st group (e)	RSS 2nd group (f)	DF 1st group (g)	DF 2nd group (h)
(1)	Property rights index	"Legal origin" model	1.60	0.048	29.281	18.275	51	50
(2)	Property rights index	"Religion" model	1.75	0.025	34.113	19.535	50	50
(3)	Business regulation index	"Legal origin" model	1.57	0.056	26.110	16.621	51	50
(4)	Business regulation index	"Religion" model	1.60	0.048	27.273	16.999	50	50

Sources: Authors' calculations using the La Porta et al. (1999) data set. Tests are based on residuals of regressions of the property rights and business regulation indices on the log of GNP per capita, latitude, ethnolinguistic fractionalization, a constant and legal origin dummies or religion dummies, for the "legal origin" and "religion" models respectively. Observations are ranked in increasing order by their Polity III democracy scores, averaged over 1970–94. The first group is the more autocratic, while the second is the more democratic. Both groups have 57 observations each. RSS stands for "residual sum of squares." DF stands for "degrees of freedom." The *p*-values are calculated for *F*-distributions: F[(a), (g), (h)]. *F*-statistics are (e)/(f).

as independent variables. In the "legal origin" regressions, we add to that list dummies representing the legal origin of each country: socialist, French, German, or Scandinavian (the English legal origin is our omitted dummy). In the "religion" regression we added dummies for dominant religions in each country: Catholic, Muslim, Protestant, and others. We based our tests on the residuals of these regressions.[26]

We test whether the measures of government interference in the private sector are more variable under autocracies than under democracies, after controlling for possible determinants of those measures. Table 13 shows the results. For both indices, the property rights index and the business regulation index, and for both sets of regressors, the "legal origin" and the "religion" models, the *F*-statistics are all significant at 5%. These results corroborate the idea that autocracies are more heterogeneous in their propensities to protect property rights and to regulate businesses.

[26] The outcomes of these regressions virtually replicate the results in La Porta et al. (1999) and are therefore omitted.

TABLE 14 FASTEST GROWING AND SLOWEST GROWING COUNTRY-YEARS

Country-year	Growth rate	Democracy score
Fastest growing country-years		
Uganda 1985–90	0.1654	0.0
Rwanda 1965–70	0.1235	1.0
Lesotho 1970–75	0.1208	0.0
Cape Verde 1975–80	0.1117	2.0
Jordan 1975–80	0.1098	0.0
Cyprus 1975–80	0.1026	10.0
Singapore 1965–70	0.1020	2.0
Japan 1965–70	0.1009	10.0
South Korea 1965–70	0.0969	1.0
Syria 1970–75	0.0951	0.0
South Korea 1985–90	0.0937	4.8
Singapore 1970–75	0.0926	2.0
Yemen 1970–75	0.0925	0.0
Gabon 1970–75	0.0917	0.0
Poland 1970–75	0.0901	0.0
Slowest growing country-years		
Iraq 1980–85	−0.1118	0.0
Guinea Bissau 1975–80	−0.1024	0.0
Angola 1970–75	−0.0968	1.1
Burundi 1960–65	−0.0957	2.0
Iran 1975–80	−0.0945	0.0
Guyana 1980–85	−0.0924	0.0
Rwanda 1960–65	−0.0844	1.0
Suriname 1985–90	−0.0826	4.6
Gambia 1980–85	−0.0720	9.2
Iran 1985–90	−0.0693	0.0
Nigeria 1980–85	−0.0665	6.4
Swaziland 1980–85	−0.0662	0.0
Uganda 1975–80	−0.0624	0.0
Nicaragua 1975–80	−0.0611	0.0
Panama 1985–90	−0.0603	0.0

Sources: Barro–Lee (1994) data set and Polity III data set (see Jaggers and Gurr, 1995).

The results in this section can be summarized as follows. The idea that democracies are uniformly more homogeneous than autocracies does not seem to be true. Democracies are more heterogeneous in some outcome measures like GDP, fertility rates, and secondary and higher schooling. However, autocracies do seem to be more heterogeneous than democracies in some policy measures like government spending on education, the black market premium, the protection of property rights, and the regulation of businesses. In other words, Hypothesis III is also confirmed in the data, further strengthening the case for the theoretical arguments of Rodrik (1999a) and Sah and Stiglitz (1991).

7. EVIDENCE FROM THE EXTREME GROWTH EXPERIENCES

We have described three different (but related) sets of results: (i) the greater cross-country variability of growth rates of less democratic countries; (ii) the greater within-country variability of growth rates of less democratic countries; and (iii) the greater heterogeneity of some policy measures among less democratic countries. Results (i)–(iii) are implications of both Rodrik's (1999a) theory of asymmetrical adjustments to external shocks and Sah and Stiglitz's (1991) theory of centralization. As we have discussed above, Sah and Stiglitz's theory has an extra implication: the best and worst performances are more likely to occur in less-democratic countries. Table 14 shows the 15 fastest growing and the 15 slowest growing country-years in our sample, with their respective democracy scores. Most of the fastest growing countries have very low democracy scores, with the notable exception of Japan in 1965–1970 and Cyprus in 1980–1985.[27] Similar results are found among the slowest growing country-years, where Gambia in 1980–1985 is the exception.

Hypothesis IV is also true in the data. This further supports Sah and Stiglitz's theory, since all four implications of that model seem to be true.

8. CONCLUDING REMARKS

Less-democratic countries do seem to have more variable growth rates and policies than more democratic ones. This corroborates the conjecture of Sah (1991). Possible explanations for this fact can be found in Rodrik (1999a) and in Sah and Stiglitz (1991).

The evidence presented in this paper strongly supports Sah's conjecture. The empirical results are unaffected by many robustness and specification checks. The results are not sensitive to specific time periods, to different democracy indices, to different econometric procedures, or to model specification. The results hold even after controlling for many plausible determinants of growth rates and democracy indices, including the usual variables from the empirical growth literature, time dummies and country-fixed effects, GDP, natural resource dependence, and OECD membership.

The greater stability of growth rates and policy measures among democratic countries adds to an existing list of desirable features of democracies, such as the positive correlations between democracy and per capita GDP *levels*, between democracy and primary schooling (Barro, 1999) and between wages and democracy indices (Rodrik, 1999b). Our evidence also corroborates the common view that some autocratic countries have had the most impressive growth experiences. However, since the worst experiences are also associated with autocratic countries, in an ex-ante sense, autocracy is no prescription for growth.

[27] It should be noted, however, that the Gastil normalized democracy score for Cyprus 1980–1985 is 6.3, which is much lower than its Polity III score of 10.

APPENDIX

Data description

The following variables were taken from the Barro–Lee data set (description of the data is available on-line at http://www.columbia.edu/~xs23/data/readme.txt).

Log of GDP: log value of real per capita GDP in 1985 international prices from Summer and Heston's *Penn World Table*, version 5.5.

Growth rates: growth rates of real GDP per capita.

Investment rate: ratio of real domestic investment (private plus public) to real GDP.

Government consumption: ratio of real government consumption expenditure net of spending on defense and on education to real GDP.

Government investment in education: ratio of total nominal government expenditure on education to nominal GDP.

Average number of years of enrollment in secondary and higher education: for male and female populations over age 25.

Average number of years of enrollment in primary education: for male and female populations over age 25.

Log of fertility: log of total fertility rate (children per woman).

Log of life expectancy at birth: at age 0.

Log of total population.

Terms-of-trade shock: growth rate of export prices minus growth rate of import prices.

Black market premium: ratio of black market exchange rate to official exchange rate, minus 1.

OECD dummy: 1 if OECD member.

From the World Bank's Global Development Network Growth Database (see http://www.worldbank.org/research/growth/GDNdata.htm).

Urbanization rate: urban population as % of total population, values for beginning of each period.

Oil country dummy

From Sachs–Warner (1997) data set:

Resource dependence: share of exports of primary products in GNP in 1970 and 1980.

From La Porta et al. (1999) data set:

Property rights index: a rating of property rights in each country (on a scale from 1 to 5).

Business regulation index: a rating of regulation policies related to opening a business and keeping open a business (on a scale from 1 to 5).

Ethnolinguistic fractionalization: average value of five different indices of ethnolinguistic fractionalization.

Legal origin: identifies the legal origin of the Company Law or Commercial Code of each country.

Religion: identifies the percentage of the population of each country that belonged to the three most widespread religions in the world in 1980.

Latitude: the absolute value of the latitude of the country, scaled to take values between 0 and 1.

Democracy indices

Gastil: subjective index of political rights, from 1 to 7 (1 = most freedom). We normalized it to range from 0 to 1 (1 = most freedom). Data are available from 1972–1989, from *Freedom in the World*, various years, and in the Barro–Lee data set.

Polity III: democracy score: general openness of political institutions (0 = low, 10 = high; we normalized it to range from 0 to 1). Data available for independent countries for various years, depending on the country. The main reference is Jaggers and Gurr (1995). The data description is available on-line at ftp://isere.colorado.edu/pub/datasets/polity3.

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