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"Law, institutions and growth. A semiparametric study."

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Law, institutions and growth
A semiparametric study*

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Abstract:

The empirical literature relating political variables and economic growth has almost exclusively relied on linear econometric models. By introducing a semi-parametric specification, we are able to gain further insight into the nature of this relationship. Moreover, we study the nature of the selection problem that arises if the choice of the political system of a country depends on economic growth. We derive worst-case bounds on the treatment effect of changing a country's political system and then improve upon them by introducing an instrumental variable assumption. When exogenous selection is assumed, we find a strongly non-linear relationship between political indicators and economic growth. When selection issues are accounted for, we find that moderate political improvement is unlikely to have unambiguous effects on income.

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I. Introduction

Since the appearance of the first models of economic growth, economists have been concerned with identifying and quantifying the factors that contribute to the prosperity of nations. That political institutions play a key role in determining the economic well being of a country has become common wisdom among both economists and political scientists; quantitative appraisals of the impact of the institutional environment on economic growth, though elusive until recently, are also available in several flavors[1]. Close attention has been paid to the construction of variables reflecting the different characteristics of political institutions across countries and historical periods; however, the widespread use of traditional econometric techniques has left enough room to reexamine the data through the more revealing lenses of semi-parametric and non-parametric analysis.

This study builds on the approach taken by Barro (1996) and Henisz (2000) to examine the impact of political variables on per-capita GDP growth rates. Following the observation that political variables and economic growth are related in a non-linear fashion[2], we specify a model a-la-Robinson [Robinson (1988)], where the rate of economic growth depends linearly on a number of standard control covariates, but the effect of the political variable is represented by an unknown functional form, which we proceed to estimate.

The nature of the relationship between economic prosperity and political institutions remains obscure; Przeworski and Limongi (1993) point out that the problems of simultaneity, selection and attrition render useless the standard regression techniques. The basic identification problem stems from the observation that the values of the political variables are no longer a pure determinant of economic growth, but a response to economic growth as well. We show that this fact can be treated as a selection problem as in Manski (1995) and we study its consequences on the estimated effect of political features on growth. We derive worst-case bounds for the effect of

[1] For excellent surveys on institutional indicators and on quantitative studies of their impact on economic growth, see Barro (1996) and Henisz (2000).

[2] This observation, often overlooked, should be straightforward from the moment that several political variables are coded following qualitative categories rather than continuous measurable scales.

the political variable on economic growth and then improve upon them by using an instrumental variable assumption as in Manski (1990).

Our approach allows us to address several questions. What is the effect of introducing different levels of democratic and institutional reform in a country under a dictatorial regime? What is the impact on economic growth of raising the political constraints faced by the executive? What is the effect of enhancing the rule of law? We provide answers to these and other questions under the maintained assumptions of exogenous selection, instrumental variables, and under no assumptions at all. We also seek to provide a comparison between our results and those reported in Henisz (2000).

In section II we present the data used in estimation and discuss different properties of the variables. Section III introduces a semi-parametric model, which allows the political variables to enter in an unspecified functional form. Section IV presents the main estimation results, and section V concludes.

II. The data

The variables used in our estimation are the same as in Henisz (2000). The dependent variable is the rate of growth of real per-capita GDP, while the independent variables are ten determinants of economic growth identified in Barro (1996) and a political variable. To examine the properties of different kinds of political variables, we select two different indexes: the political constraints index constructed by Henisz (2000)[3] and the *International Country Risk Guide* law and order index. The polity persistence average, used as an instrumental variable, is a construction based on the POLITY database[4]. All the data, except for the political constraints index, the polity persistence average and the rule of law index, is taken from the Barro-Lee dataset[5]. The variables are coded as shown in Table 1 in the appendix.

[3] The POLCON index dataset is available on the web at http://www-management.wharton.upenn.edu/henisz/

[4] The POLITY IIId database is available on the web at http://www.colorado.edu/IBS/GAD/spacetime/data/Polity.html

[5] The Barro-Lee dataset is available on the web at http://www.nuff.ox.ac.uk/Economics/Growth/barlee.htm

All variables are taken over 5 year intervals during the periods 1960-1965, 1965-1970, 1970-1975, 1975-1980 and 1980-1985. The scarcity of data prior to 1960 makes it very difficult to add previous periods to the sample. The original panel contains 138 countries over these five-year periods. After the missing data instances are removed, the resulting sample contains 409 observations when the political constraints index is used and 388 observations when the law and order index is used. We now proceed to examine some characteristics of the regressors.

The political constraints index

Henisz (2000) constructs the POLCON index to reflect the number of effective veto points faced by the executive power. Veto points can be a legislature (one point for each chamber), a judiciary power and sub-federal structures. Spatial modeling techniques are used to calculate the range of policies over which all the veto holding powers in a country would disagree. The larger this number, the more constrained the executive power would be. Since the range of policies is normalized to 1, the POLCON index can also be interpreted as the probability that a proposal taken at random from the executive's sphere of interest does not become policy because it doesn't fall within the range of acceptable policies of one of the veto holding powers. The index takes into account the degree of alignment of the veto holding powers with the executive. Clearly, more veto points imply a larger value for the POLCON index, while a larger degree of alignment of a veto point reduces the value of the index.

Figure 1 shows the frequency distribution of the POLCON index. As the index is a continuous variable, the categories of the histogram have a less than or equal interpretation. An immediate observation is that over 45% of the observations are concentrated at the value of zero, which corresponds to political systems with an unchecked executive power (dictatorships, absolute monarchies and other forms of autocracies). Also, 30% of the observations exhibit POLCON values between 0.7 and 0.9, roughly corresponding to political systems with one or more effective veto points (the exact value for one effective veto point is 2/3). The remaining observations correspond to political systems with less than one effective veto point; these values are possible since alignment with the executive reduces the weight of each nominal veto point.

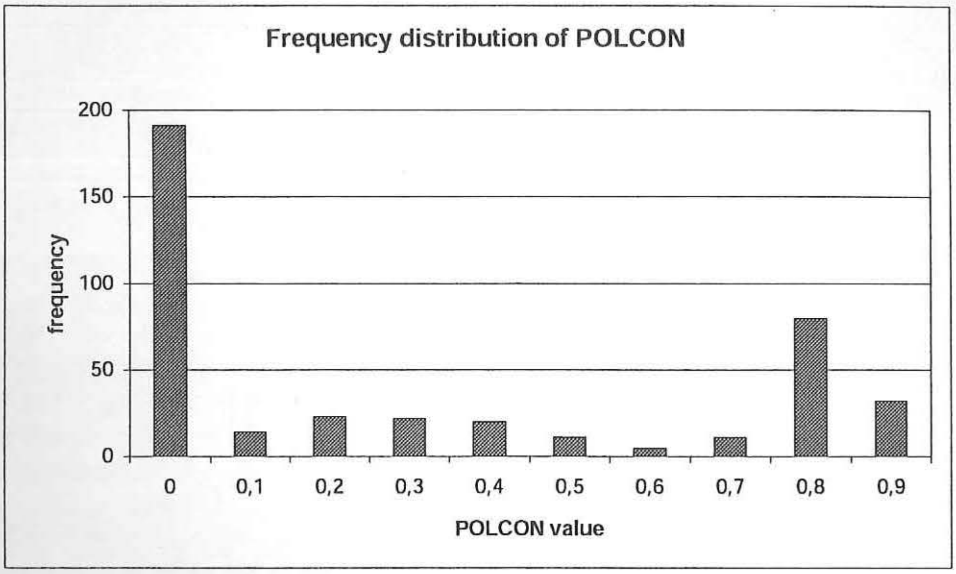

Figure 1: Frequency distribution of the political constraints index

Both the data and the nature of the index suggest that a value of zero is qualitatively different from strictly positive values. Due to this observation, we shall introduce a dummy variable for observations with POLCON=0 in the corresponding specification of our econometric model.

Law and order index

The law and order index, constructed by the *International Country Risk Guide* (ICRG) is one of several measures that seek to provide orientation for international investors regarding the respect for property rights and the adherence to the rule of law in a given country. Each country is coded on two dimensions: strength and impartiality of the legal system (from zero to three) and an assessment of popular observance of law (zero to three). The index has therefore a range which goes from zero (lowest) to six (highest), and takes only integer values. As opposed to the political constraints index, this measure is largely subjective, though several authors have sought to establish a case that the index is highly correlated with private investment and growth [e.g. Barro (1996), Knack and Keefer (1995)]. The main problem with the law and order index is that its coding starts only in 1982. We follow Mauro (1995) in using the earliest available value as a proxy for previous values, as the index does not exhibit much variation, and in almost no instances does it change by more than one category.

Figure 2 shows the frequency distribution of the law and order index. We note for further reference that the histogram is fairly even across the six values with a strictly positive index (no instances in our dataset are coded as zero, and only a few are in the whole sample).

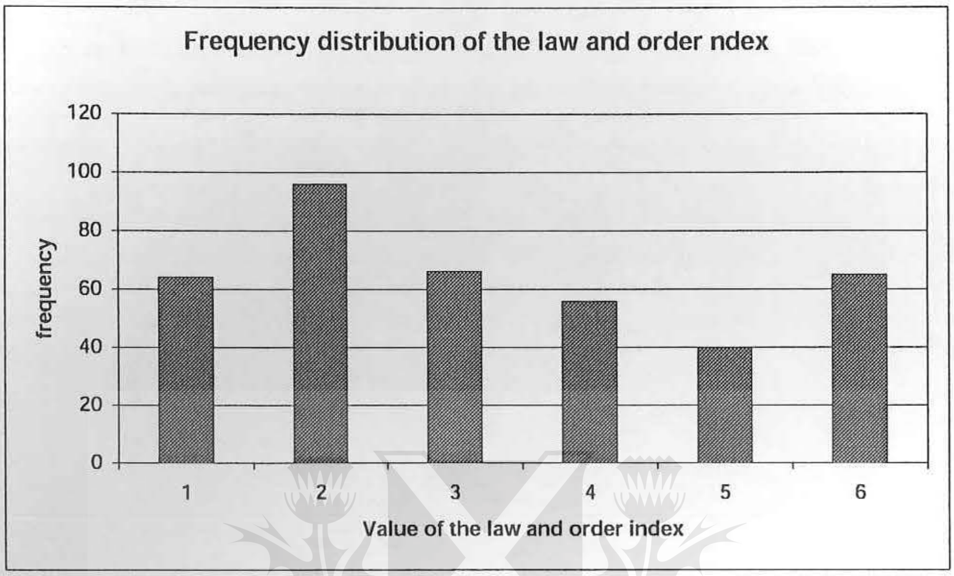

Figure 2: frequency distribution of the law and order index

Interaction between human capital and initial GDP

In Barro (1996) the interaction variable is constructed as the product of initial GDP and an overall human capital variable. This variable is a weighted average of the years of male secondary education, the years of female secondary education and the logarithm of life expectancy at birth. The weights used are the estimated coefficients of these three variables in a linear model including all regressors; since a change in the human capital variable affects all the coefficients, iteration until convergence is necessary.

Iteration, however, is not possible in our model, since the estimation of the effect of the political variable must take place after the effect of the linear regressors has been subtracted from the dependent variable. An alternative would be to distribute the interaction term and estimate the parametric part of the new equation using non-linear least squares; however, no theory exists regarding the consistency and asymptotic properties of the resulting estimates in a semi-parametric framework.

Since our focus is on the non-parametric part of the model, we use the parameters estimated in Henisz (2000) GLS regression #9 to construct the interaction variable[6]. This procedure allows us to keep the interaction effect as a control variable with the same effect as in Henisz's work; since the results of the linear models are not particularly sensitive to its inclusion, using these GLS estimates instead of a more accurate calculation should not have a major impact on the non-parametric part of the estimation.

Polity persistence average

While dealing with the identification problem, we shall use an instrumental variable assumption to improve upon the worst-case bounds on conditional expectations and treatment responses for the dependent variable. We construct a polity persistence average based on the changes in polity (the set of major institutional arrangements) reported in the POLITY database. Since the database reports changes in polity for each country starting in 1800, our polity persistence average is a measure of the stability of political institutions in a country throughout its history. We argue that GDP growth rates over given short periods are mean independent of the institutional history of a country. The experience of Latin American countries in the nineties, for example, confirms that it is possible to generate short term growth spurts in countries with very low polity persistence averages. Very politically stable countries, on the other hand, can experience recessions or low growth rates over short periods. However, the quality of a country's institutions bears significant relation to its institutional history; we can therefore expect the political constraints index and the law and order index to be correlated with historical and political processes, thus making our polity persistence average an ideal instrumental variable[7].

[6] GLS estimates are used because Robinson estimates have a GLS interpretation. See Robinson (1988), page 935.

[7] The simple correlation between the polity persistence average (POLPER) and per capita GDP growth is 0.04, while the correlations between POLPER and the POLCON index and POLPER and the law and order index are 0.46 and 0.43 respectively. We also experimented with other possibilities. However, the ethnolinguisitic fractionalization index proposed by Mauro (1995) proved to be highly correlated with growth, while the settler mortality rate proposed by Acemoglu, Johnson and Robinson (2000), limited to former colonies, reduced the sample to an unacceptably small size.

This correlation, though, is not homogeneous throughout the domain of the political variables. At high levels of the polity persistence average and of the political measures the correlation tends to be very high, while in the medium and low ranges of both variables the correlation is weaker. This means that we will derive significantly more identifying power from the instrumental variables for those countries associated with high levels of polity persistence than for those with a rather turbulent institutional track.

III. A simple econometric model

Due to the different nature of our two political variables, we shall use slightly different estimation techniques when dealing with each of them. The law and order index, being an entirely discrete variable, poses the least complications, and it will fit seamlessly into our first and most simple model.

We specify a model of the form

$$Y = \alpha + \beta' X + \theta(Z) + \varepsilon \qquad (1)$$

where Y represents the rate of growth of real per-capita GDP, X is a vector of covariates capturing the standard determinants of economic growth, Z is the political variable (the law and order index in this case) , $\theta(\cdot)$ is an unknown function, β is a vector of coefficients and ε is a random error term satisfying $E[\varepsilon \mid Z] = E[\varepsilon] = 0$. Taking expectations conditional on the value of Z, equation (1) becomes

$$E[Y|Z] = \alpha + \beta' E[X|Z] + \theta(Z) \qquad (2).$$

Subtracting (2) from (1), we have

$$Y - E(Y|Z) = \beta'[X - E(X|Z)] + \varepsilon \qquad (3).$$

Robinson (1988) shows that, after replacing $E[Y|Z]$ and $E[X|Z]$ by standard kernel estimates, β can be consistently estimated by ordinary least squares. Due to the panel nature of our data, we shall introduce a standard error correction, clustering the calculation of the variance-covariance matrix around a country index. Let $\hat{\beta}$ denote the OLS estimate of β from equation (3) and $\hat{E}[\cdot]$ the estimates of the conditional expectations; replacing them in equation (2), we have

$$\hat{\theta}(Z)+\alpha = \hat{E}[Y|Z]-\hat{\beta}'\hat{E}[X|Z] \qquad (4)$$

The constant term α is not identified. We shall therefore adopt a convenient location normalization and focus on treatment effects rather than on levels of $\theta(Z)$ [8]. We can estimate normalized values for $\theta(Z)$ from equation (4) with the same cell means used to construct the regressors of equation (3); confidence intervals on $\theta(Z)$ can be obtained by bootstrapping. Once again, taking into account that we are dealing with a panel, we construct the bootstrap pseudo-samples by taking not single observations (i.e. a country in a given period) but clusters, choosing a country at random and including in the bootstrap sample all the periods for which data is available for that given country.

When the POLCON index is used as the political variable, additional considerations are necessary. As discussed in section II, a value of zero for the POLCON index should be considered as qualitatively different from a strictly positive value. We therefore propose a modified model, with an added dummy variable to account for this feature of the data.

$$Y = \alpha + \beta' X + \gamma w + \theta(Z) + \varepsilon \qquad (1')$$

$$\begin{cases} w = 1 & \text{if } Z = 0 \\ w = 0 & \text{otherwise} \end{cases}$$

[8] This normalization is even more important in light of the fact that, in standard regressions of growth on several covariates, the constant term has very wide confidence intervals. If it were left free, the functions estimated by bootstrapped would have very different intercepts, and the confidence intervals would be meaningless.

In equation (1'), γ acts as a shift parameter when the POLCON index equals zero. If the above derivation is repeated, we obtain

$$\hat{\theta}(Z)+\alpha = \hat{E}[Y|Z] - \hat{\beta}'\hat{E}[X|Z] \qquad \text{when } Z \neq 0 \qquad (4')$$

$$\theta(Z)+\alpha+\gamma = \hat{E}[Y|Z] - \hat{\beta}'\hat{E}[X|Z] \qquad \text{when } Z = 0 \qquad (5')$$

After the same normalization as in the standard case, we can estimate $\theta(Z)$ from equation (4') using a standard kernel estimate and including only the subset of the data for which Z is strictly positive. $\theta(0)+\alpha+\gamma$ can be estimated from equation (5') using a cell mean as in the standard case[9].

IV. Estimation

We now proceed to report our main results. Since we are running the estimation twice, once for each political variable, we report the results for both at each step of the process. In every case, we will present first the results for the POLCON specification and then repeat the analysis for the model containing the law and order index.

Table 2 in the appendix reports the estimates of $\hat{\beta}$ from equation (3') (the Robinson regression containing POLCON) while table 3 reports the same estimates for the regression conditional on the law and order index. All the variables have the expected signs, except for the female education variable, which is not significant; this result, however, is consistent across other studies of determinants of growth. Significant variables at the 95% level include male years of education, log of life expectancy at birth, government share and investment share of GDP, the black market premium, terms of trade shocks and, in the law and order specification, the human capital interaction term. The log of initial GDP (which can be interpreted as a conditional rate of

[9] Since the total impact of the POLCON index on GDP growth when Z=0 is $\theta(0)+\gamma$, the fact that γ is not identified does not pose a problem.

convergence) and the interaction variable in the POLCON specification have low levels of significance. The interested reader can compare these results to the regression #9 in Henisz (2000). Barro (1997) provides a detailed discussion of the meaning and role of each variable.

1. Exogenous selection

If the effect of economic growth in shaping the institutional framework is neglected, estimation of equations (4') and (5') yields the impact of the POLCON index on economic growth, while equation (4) provides the same insight for the impact of the law and order index.. Figure 3 shows the point estimates of the values of $\theta(Z)$ when the POLCON index is used as the political variable, and figure 4 presents the results of the same analysis when the law and order index is considered. The normalizations adopted are $\theta(0.9)=0$ for the POLCON case and $\theta(1)=0$ for the law and order estimate.

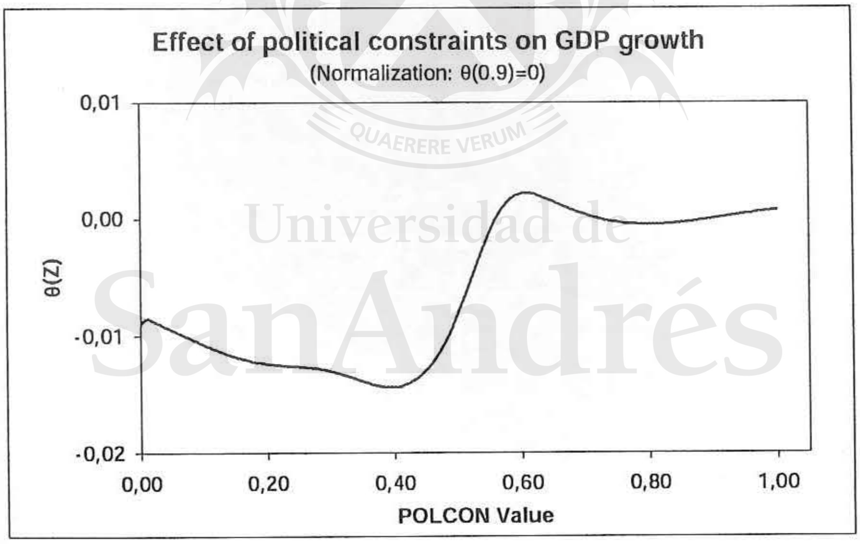

Figure 3: estimated effect of political constraints on growth rates[10]

[10] Since a normalization is necessary, confidence intervals on the $\theta(Z)$ function do not convey any graphical insight, and therefore are not depicted.

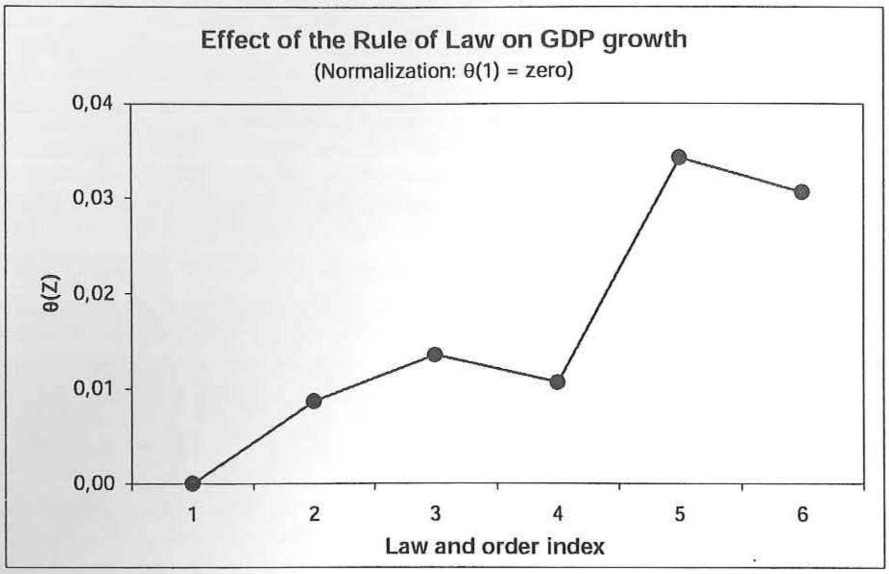

Figure 4: Estimated effect of the law and order on growth rates

The first insight provided by figures 3 and 4 is that, by specifying a linear relationship between political variables and economic growth, researchers have been missing a very interesting part of the story. We focus on the political constraints index first. The estimated function implies that the relationship between political constraints and economic growth is not monotone in the POLCON index, and much less linear, as it adopts an S shape. The negative slope of the first part of the estimated function implies that countries with low levels of political constraints perform worse than pure dictatorships. This tendency is only reversed after a moderate level of political constraints is achieved. After the turning point at a value of about 0.4 in the POLCON index, further increases in political constraints have a strong effect on economic growth. This tendency is maintained until a level of .65 is reached for the POLCON index (roughly one effective veto point); further increases in political constraints do not have a significant impact on economic growth.

When the law and order index is used (figure 4), the most salient feature is the jump of nearly two and a half percentage points in the estimated function when the index is increased from a value of four to a value of five. Mimicking the behavior of the function estimated under the POLCON index, growth shows a declining trend when rule of law is further improved. The observation that law and order has a stronger impact on growth than political constraints is consistent with the results reported in Henisz (2000).

Henisz (2000) also reports that, under the linear specification, an increase in one standard deviation in the POLCON index would increase growth by 0.9 (OLS estimation), 0.8 (GMM estimation) or 0.5 (GLS estimation) of a percentage point per year. To compare our estimates to these values, Figure 5 shows the effect of increasing the POLCON index by one standard deviation (0.35) for different initial values of the index. Also shown are bootstrapped confidence intervals at the 90% significance level.

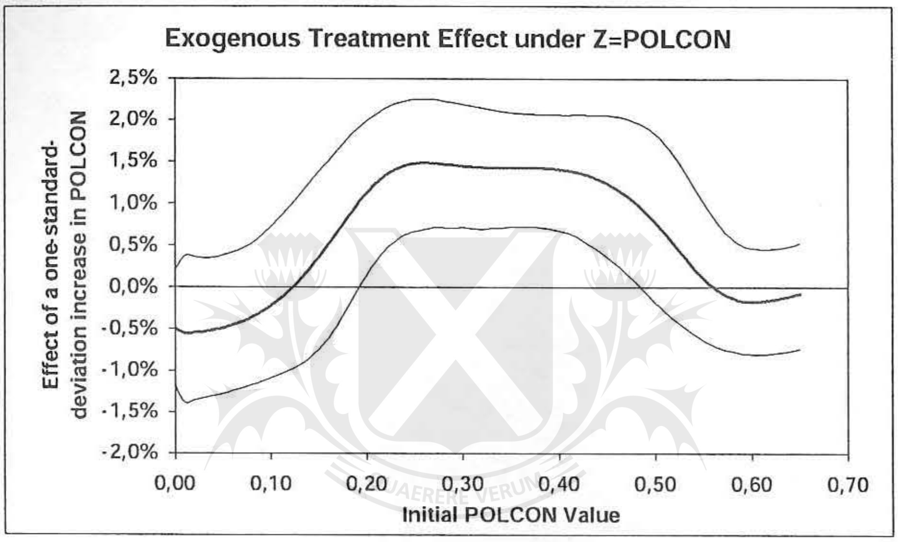

Figure 5: effect of increasing the POLCON value by one standard deviation

The treatment effect of increasing the level of political constraints by one standard deviation is calculated as $\theta(Z_0+\sigma_Z)-\theta(Z_0)$, where Z_0 is the initial POLCON index value. From figure 5, it is clear that increasing the political constraints index by one standard deviation would not have the same results for every initial situation. While countries with an initial POLCON value between 0.25 and 0.45 would stand to gain the most, with increases in per-capita GDP growth rates of up to 1.3% per year on average, applying the same treatment to a dictatorship or to a weak democracy would have, on average, a negative impact on economic growth. The policy starts losing effectiveness for initial values of POLCON higher than 0.45. However it should be kept in mind that, under a non-parametric framework a one standard deviation increase in the treatment variable does not have any particular meaning of its own (and it is actually infeasible for values of the political constraints index greater than 0.65, since the after-treatment value would have to exceed the maximum possible value, which equals 1); the results are reported here only for the sake of comparison with the previous literature.

Figure 6 is the analogous to figure 5 for the law and order index. In this case, the exogenous treatment is taken to be an increase of one category in the law and order measure. The effect of increases of more than one category can be computed by adding as many consecutive one-category increases as desired. Again, 90% bootstrapped confidence intervals are reported.

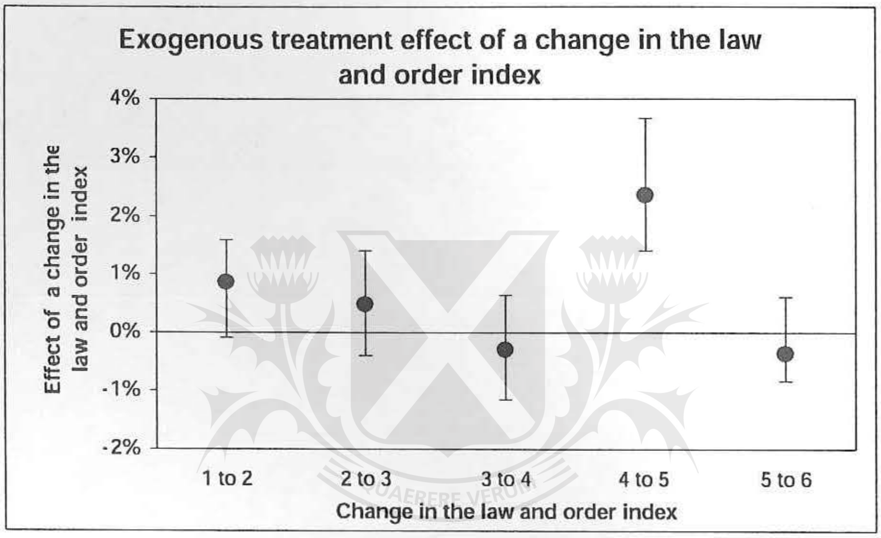

Figure 6: effect of increasing the law and order index by one category

Again, there is no clear effect of increases in the value of the law and order index at very low or very high values of the index. The only effect significantly different from zero at the 10% level is an increase from a value of 4 to a value of 5, though the effect is very strong, averaging over two percentage points of per-capita GDP growth. This result is consistent with the one obtained for the analysis of political constraints, where the effects at low or high levels are uncertain. In both cases, political reform (here narrowly defined as increasing these measures) seems to have the strongest impact on countries in the middle ranges of institutional quality.

2. The selection problem: worst-case bounds

The estimation of the effect of changes in political variables on the growth rate of GDP obtained by traditional estimation methods as well as by the approach in the first part of this section implicitly assumes that the value of the political variables is exogenously assigned. If the existence of an unknown relationship between economic growth and the selection of the level of political constraints or law and order were accepted, these estimates would be subject to selection bias. Treatment effect analysis as in Manski (1990) allows us to drop the exogenous selection assumption and solve part of the resulting identification problem by deriving bounds for the effect of changes in the levels of political indicators.

2.1 Worst case bounds on treatment effects under Z=POLCON

Since the POLCON index is a continuous treatment variable, the probability of observing any given value (other than zero) is zero. Therefore, standard worst case bounds will not be informative, since the bound will have an amplitude equal to the complete logical domain of the outcome. It is therefore necessary to map subsets of the domain of the POLCON variable into a finite set of treatments $B=\{B_1, B_2,\dots, B_n\}$. Once we do this, we define the treatment effect of changing the value of the POLCON variable from a value in the set B_i to a value in the set B_l as

$$E[\theta(B_l)]-E[\theta(B_i)] \qquad (6)$$

which we can expand as

$$\begin{aligned}&[E[\theta(B_l)|Z\in B_l]P(Z\in B_l)+E[\theta(B_l)|Z\notin B_l]P(Z\notin B_l)]-\\&-[E[\theta(B_i)|Z\in B_i]P(Z\in B_i)+E[\theta(B_i)|Z\notin B_i]P(Z\notin B_i)]\end{aligned} \qquad (7)$$

where $E[\theta(B_l)|Z\notin B_l]$ and $E[\theta(B_i)|Z\notin B_i]$ are unknown values.

To calculate upper and lower bounds for expression (7) two different problems arise: selection of the maximum and minimum values that the unknown components can take and selection of the sets B_k.

Since the unknown components could logically take any value between minus and plus infinity, thus making our bounds uninformative, we propose using the maximum sample value of $\theta(Z)$ increased by one standard deviation as the maximum possible value and the minimum sample value of $\theta(Z)$ decreased by one standard deviation as the minimum possible value. Though we have no theoretical basis for using these values, it seems unlikely that, if a country had a different political system than its own, its per-capita GDP could grow or fall at a rate superior in one standard deviation to the maximum and minimum impacts of political constraints on economic growth experienced among all the countries in the world over 25 years.

In selecting the set of treatments, one would ideally divide the domain of the POLCON index into a set of significant categories. Obviously, observations with a POLCON value equal to zero fall in a distinct category of its own; also, values of POLCON greater than 0.67 (one effective veto point) seem to have a reason to be treated as a separate category[11]. Intermediate values pose a more complicated problem, both from the theoretical and from the empirical point of view, since they exhibit the lowest density of data. We choose to consider them as a single treatment, and therefore concentrate on obtaining bounds for the effect of POLCON on three different subsets of the domain[12].

The set of treatments into which the POLCON domain is mapped is coded as follows

[11] When we look into the actual values of the POLCON index for different countries, the correlation between having one effective veto point as calculated by the index and a developed political system is not that clear. However, we prefer to let theory have its way instead of falling into subjective appreciations.

[12] When we experimented with subdividing the middle subset into more categories, the results obtained for the resulting subcategories were roughly equal, making them observationally equivalent. Though this does not imply that the range between 0 and 0.67 constitutes a single treatment, we gain nothing from the econometric point of view from subdividing it, while losing statistical accuracy.

Treatment code	POLCON value
Low	$Z = 0$
Medium	$0 < Z < 0.67$
High	$0.67 \leq Z$

Figure 7 reports the estimated worst-case bounds on $\theta(B_k)$. With no further information, these bounds convey very little insight. The narrowest bound is the one on the effect of a dictatorship, spanning over one and a half percentage points of GDP growth[13].

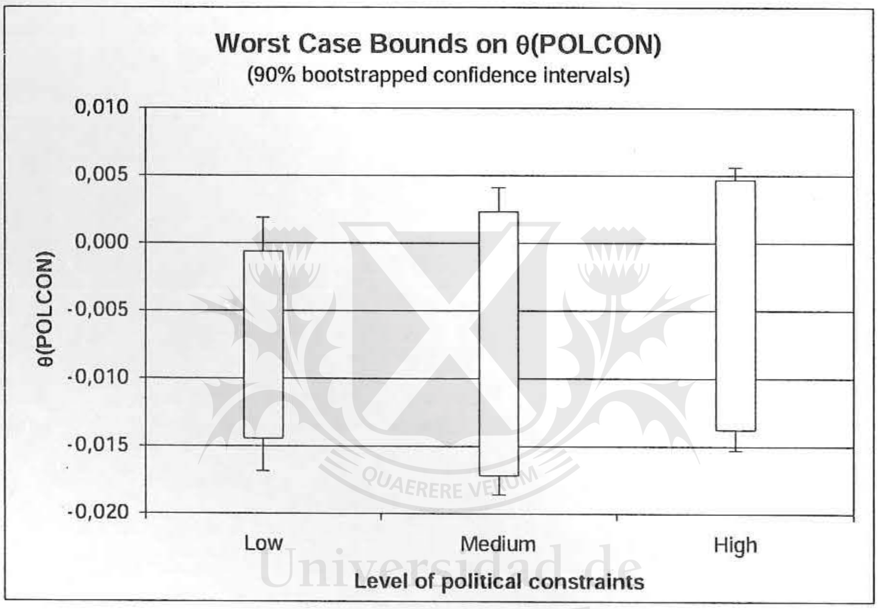

Figure 7: worst-case bounds on $\theta(B_k)$

Equation (7) allows us to answer different treatment effect questions. Figure 8 shows the worst-case bounds for the three possible pairs of treatments. The categories in the horizontal axis should be read as "moving from treatment X to treatment Y". We report only the bounds of moving upwards on the treatment scale; the bounds on moving from a higher to a lower treatment can be obtained by rotating the bound on moving from the lower to the higher treatment around zero. Values for the bounds on treatment effect are reported in Table 4 in the appendix.

[13] In considering these bounds, it must be kept in mind that they are subject to the location normalization $\theta(0.9)=0$.

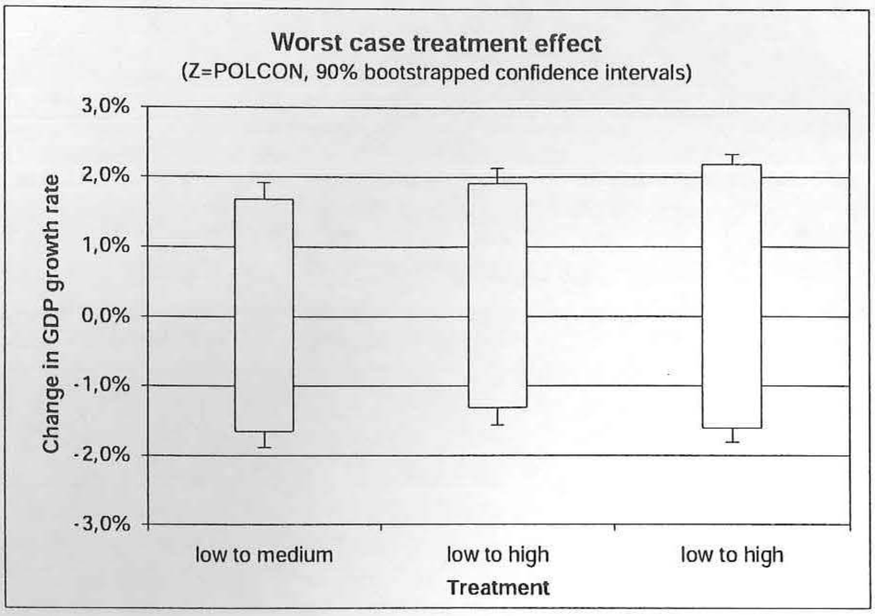

Figure 8: worst-case bounds on treatment effect

All estimated bounds span at least 3 percentage points of GDP growth and all of them include zero. Since this bounds are obtained purely from the data and under no assumptions at all (other than those embedded in the linear part of the Robinson model) an immediate insight is that any change a country can introduce in on its political constraints won't affect its per-capita rate of GDP growth by more than 2 percentage points in either direction. Uninformative as this may seem, it places a first bound on what can be expected from reforms in the political system as far as economic growth is concerned.

2.2. Worst case bounds on treatment effect under Z=Law and Order

The above analysis is easily adapted to the model using the law and order index. As a discrete variable, it already presents a natural division into several treatments. To keep a critical number of observations in each subset, we map the six categories of the law and order index into three treatments, coded as follows:

Treatment code	Law and order values
Low	1 and 2
Medium	3 and 4
High	5 and 6

Figures 9 and 10 report the corresponding worst case bounds and worst case treatment effects. Table 5 in the appendix reports the treatment effect estimates.

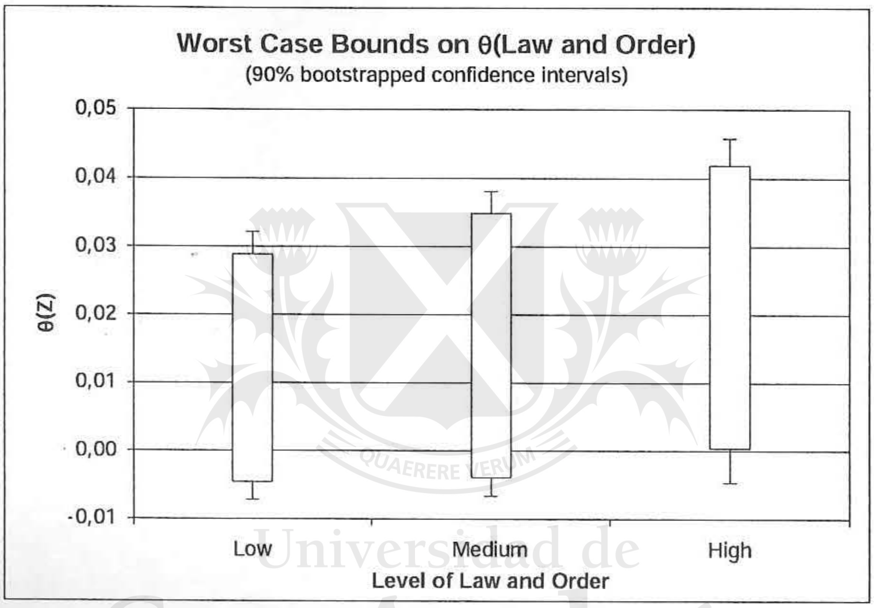

Figure 9: worst-case bounds on $\theta(B_k)$

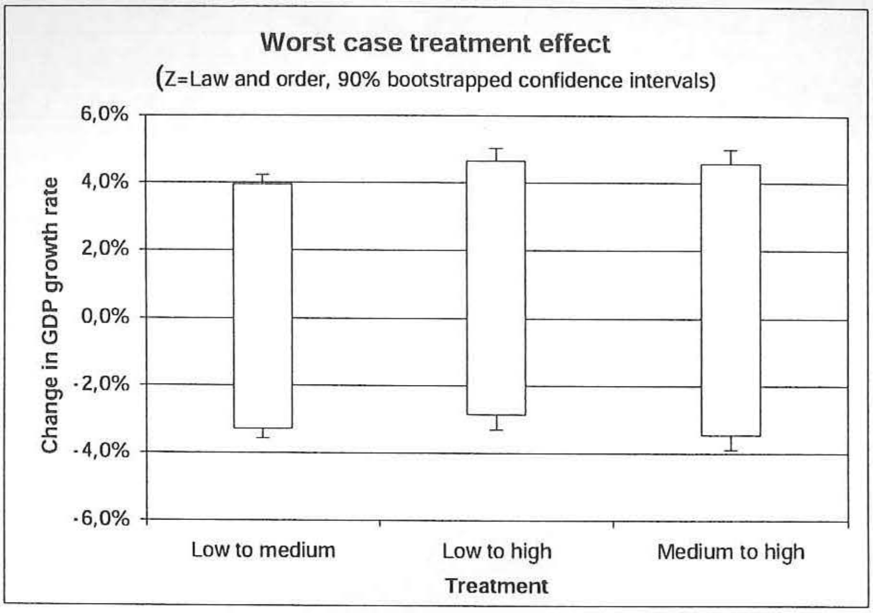

Figure 10: worst-case bounds on treatment effect

The bounds obtained using the law and order index are almost twice as wide as those resulting from the political constraints analysis, a phenomenon already observed in the exogenous selection case. The range of possibilities now spans more than seven percentage points for each possible treatment. Though these bounds are quite wide, we must bear in mind that we are in the presence of a worst-case analysis. A number of assumptions can be used to improve the accuracy of the estimates; from these, we choose an instrumental variable assumption, which does not require any restriction on the shape of the function $\theta(Z)$.

3. Bounds under an instrumental variable assumption

In section II, we argued that the polity persistence average (POLPER) is mean independent of GDP growth rates and can therefore be used as an instrumental variable. The next step is to re-estimate bounds on the treatment effect of changing the level of the POLCON variable using the methodology also introduced in Manski (1990).

3.1. IV bounds under Z=POLCON

Once again, it will be necessary to map the domain of the instrumental variable into a finite number of subsets. Let v denote our instrumental variable, and v_i, $i \in I$, $I = \{1,2,\ldots,m\}$ denote each of the subsets in which the domain is divided. We now use the fact that

$$E[\theta(B_k)|v \in v_i] = E[\theta(B_k)|v \in v_l] \qquad \forall\, i,l \in I, \quad \forall\, k = 1,2,\ldots,n \qquad (8)$$

to improve on the worst case bounds on $E[\theta(B_k)]$ derived in part 2 of this section. To do so, we estimate worst-case bounds on $E[\theta(B_k)|v \in v_i]$ for all $i \in I$. The instrumental variable assumption means that the IV bound on $E[\theta(B_k)]$ will be the intersection of the worst case bounds calculated for each subset of the domain of the instrumental variable according to expression (8). Repeating this exercise for every k=1…n, we can redo the treatment effect analysis proposed in the above section with the added identifying power of the IV assumption. This identifying power will stem from the fact that the instrumental variable, though uncorrelated with outcomes, has a positive degree of correlation with the treatment variable. In fact, though institutional history has no impact on a country's growth rate in a given year or period, it is correlated with the quality of its institutions, at least in portions of the domain of the political variables.

Figure 11 depicts the frequency distribution of the polity persistence average (POLPER).

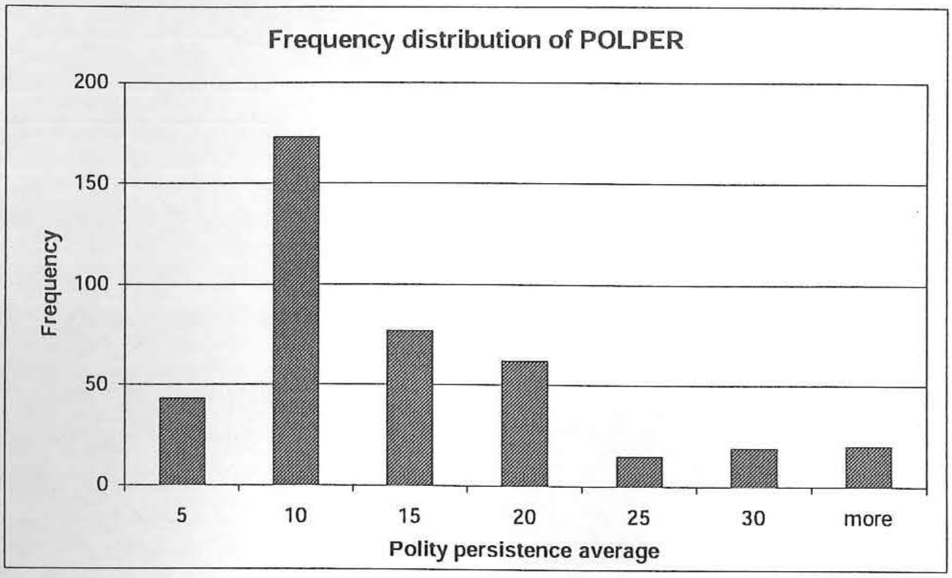

Figure 11: frequency distribution of the polity persistence average

Faced again with the partitioning problem, we now keep in mind that adding one dimension to the estimation problem will substantially reduce our freedom in terms of defining estimation sets. We therefore suggest to keep a reduced number of subsets of the POLPER domain; partitioning it for values of POLPER less than or equal to ten, between 10 and 20 and over 20 seems sensible, as it distributes evenly the number of observations each subset captures. Though by using a small number of sets we reduce the identifying power of using the instrumental variable approach, further subdividing the domain of POLPER would entail a significant risk of not having enough observations in some of the (B_k, v_i) cells on which the bounds will be calculated.

Figure 12 shows the bounds on $\theta(B_k)$ under the IV assumption when Z=POLCON.

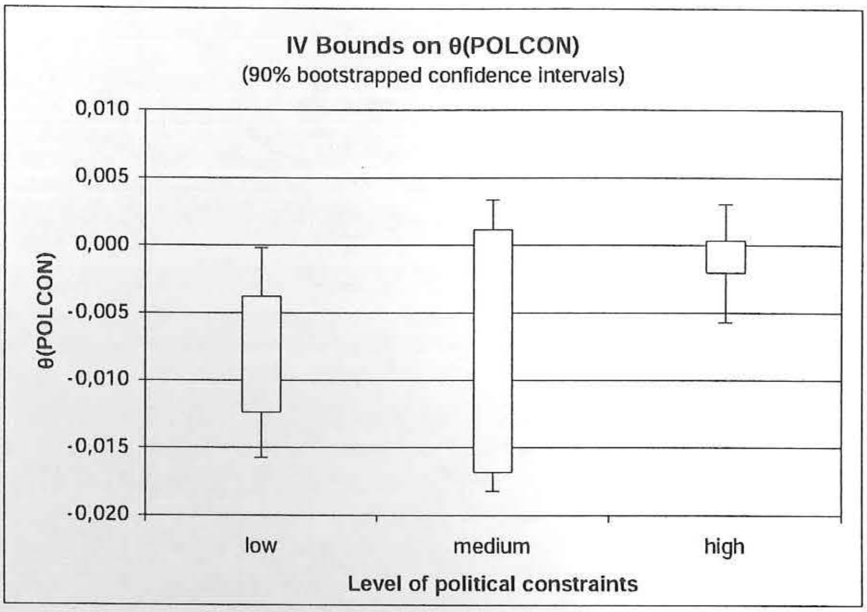

Figure 12: Bounds on $\theta(B_k)$ using an IV assumption

The scale on the vertical axis has been purposefully kept the same as in figure 7 to give the reader the opportunity to assess visually the magnitude of the identifying power added by the IV assumption. This assumption is particularly effective in narrowing the bounds for treatments 1 and 3, since it is at the extreme values of the POLCON index where the correlation with the polity persistence average is higher.

Figure 13 repeats the treatment effect analysis of Figure 8 using the new bounds. Once again, the scale on the vertical axis has been kept equal to that of figure 8 to allow for visual comparison of the added identifying power. Values for these bounds are reported in Table 6 in the appendix.

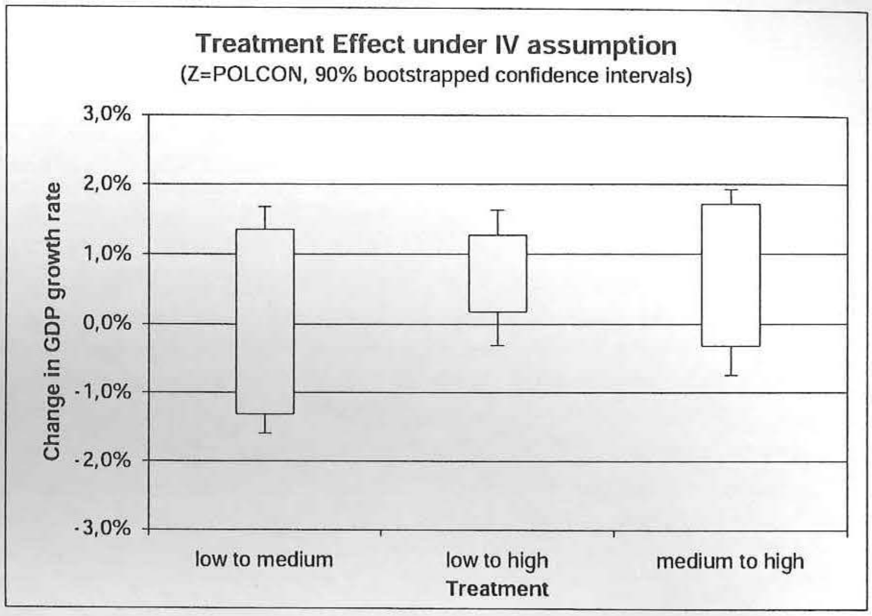

Figure 13: IV bounds on treatment effect

As the graph shows, all the bounds have been substantially narrowed from the worst-case scenario and the point estimates for the bound reflecting the treatment effect of increasing the POLCON index from zero to over 1 effective veto point (bound labeled "low to high") span only positive values. Therefore, a country under a dictatorship would stand only to gain by changing its political regime to include one or more effective veto points on the executive power. However, if the democratization process fails to include at least one effective veto point, the treatment effect again spans a wide range of possibilities, which go from a gain of 1.4 to a loss of 1.3 percentage points of per-capita GDP growth.

This approach also fails to yield an unambiguous effect on per-capita GDP growth for changes in the political system from less than one effective veto point to a more constrained institutional setup (treatment "medium to high"). However, the lower bound for this change is only slightly less than zero, meaning that countries that undertake them can't lose more than a small fraction of a percentage point (0.3%) of GDP growth, but are potentially able to gain up to 1.7% over their previous growth level.

3.2. IV bounds under Z=Law and order

We now replicate the IV bounds analysis using the law and order index as our political variable, using the same subdivision of the polity persistence average as above. Figures 14 and 15 show the IV bounds and the IV treatment effect for the law and order specification of the model. Again, we keep the scale of figures 9 and 10 for comparison. Table 7 reports the treatment effect estimates.

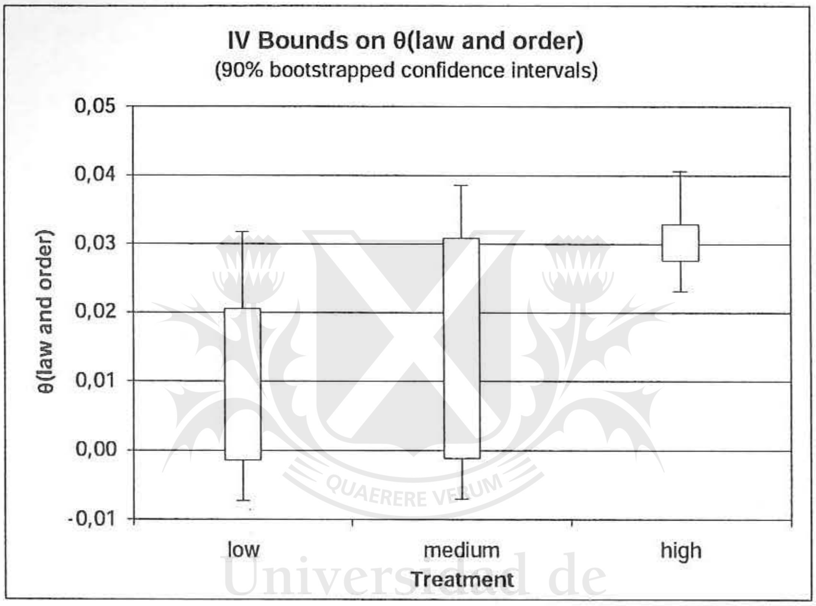

Figure 14: Bounds on $\theta(B_k)$ using an IV assumption

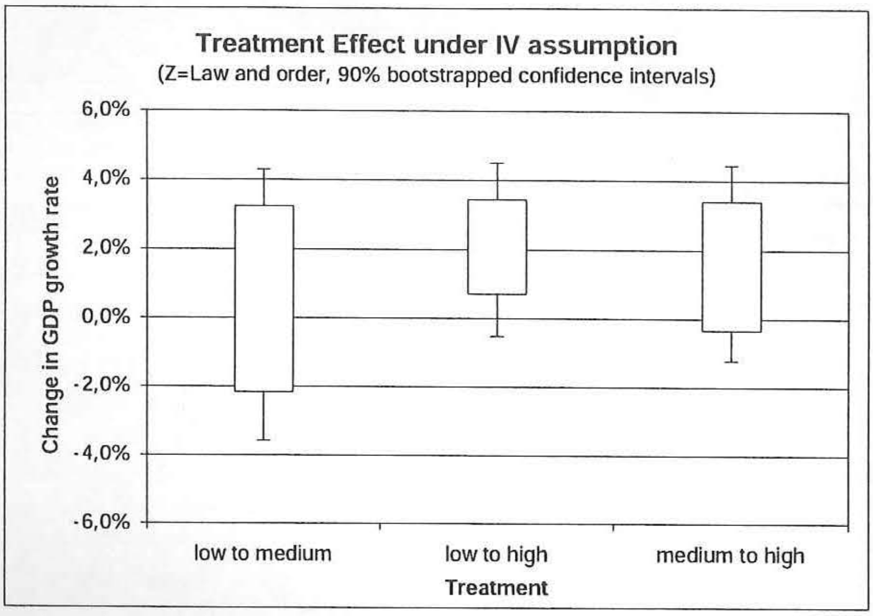

Figure 15: IV bounds on treatment effect

The treatment effect of introducing different changes in the law and order index closely replicates the results obtained with the political constraints index, except for the scale and for the fact that the "low to high" bound is not centered at zero any more, but displaced upwards. The larger magnitude of the predicted changes and the upward bias of the bounds could indicate that improvements in the rule of law would tend to have stronger and more definite effects that increased political constraints. The reasons behind these results lie in the differences between the features captured by the two political variables. While the POLCON index looks at the institutional structure, concentrating itself on the effective veto points faced by the executive, the law and order measure seeks to provide, albeit subjectively, a broader assessment of the predictability of the behavior of individuals and economic agents. To the extent that growth is linked not only to the institutional design but to the effective structure of social interaction of a country, it seems sensible that the law and order index should have a stronger effect on economic development.

V. Conclusions and further research

The previous literature on the impact of political variables on economic growth had almost exclusively focused on the estimation of linear models. By using a semi-parametric specification, we are able to provide further insight into the nature of this relationship.

If the problem of selection of the political system is ignored, our results imply that economic performance declines on average if a dictatorship is replaced by a democracy with a low level of political constraints; if the number of political constraints is further enhanced, average economic growth increases and eventually surpasses the results of dictatorships. After one full veto point is included in the political system, new increases in the level of political constraints do not seem to have any additional impact on economic growth.

If, always under exogenous selection, the rule of law is enhanced in a country registering its minimum levels, no significant effect is observed until the relatively high value of 5 is achieved (though the point estimates are always positive, except for the transition from a level of 3 to 4). This results would be consistent with those summarized for the POLCON index to the extent that an increase in political constraints, especially the transition from an autocracy to a democracy, not always results in an increase in the law and order index (especially so in its second component).

When the exogenous selection assumption is dropped, non-parametric bounds can still be estimated on the expected impact on economic growth of assigning a category of political systems or a level of respect for the rule of law to a given country. From here, it is possible to derive bounds on the average treatment effects for changes between different ranges of the political variables. From the worst-case bounds we learn that any conceivable change in the political system as reflected by the POLCON index could not increase or decrease the per-capita GDP growth rate by more than 2 percentage points, while the figure for the law and order index is almost one and a half percentage points larger. When the polity persistence average is used as an instrumental variable, it is possible to obtain some additional insight. In particular, countries under dictatorships only stand to gain by switching to a political system with over one effective veto point. Likewise, countries with less than one effective veto point can experience a change of between –0.3% and +1.7% in their per-capita rate of GDP growth if they move to an institutional scheme which places significantly more constraints on the executive. When enhancements in the rule of law are considered under the instrumental variable assumption, increases of up to 3.4% are attainable for each of the proposed treatments. Moreover, the lower bound on bringing a country with low respect for the rule of law to a medium level is –2%. Though this value is lower than the corresponding bound for the POLCON index, the bound is now biased towards positive values. Overall, the rule of law seems to be a more relevant proxy for the political features of a country that impact economic growth. However, a close comparison of the POLCON and law and order indexes and, more broadly, of the classes of political variables they represent, is still an open issue.

This study, as well as the traditional econometric approaches to economic growth, assumes that the missing data instances in the sample are exogenously determined. This is clearly not the case, since poorer and more unstable countries tend to have scantier data. However, the Robinson specification implicitly maintains the assumption that the process generating the missing data is exogenous, since it requires using only the observations with complete data on both outcome and covariates. An analysis without any assumption of the missing data generating process would require a full non-parametric approach, which is not possible with so small a sample (or so big a number of covariates). Taking into account the missing data instances would require cutting substantially the number of covariates, and therefore would make it impossible to compare the results to the previous literature. More work in this direction may be needed.

In the same fashion as above, it would be interesting to challenge the linearity assumption on the traditional covariates and study the implications for the effect of the political variable on GDP growth. Assuming a linear specification for the traditional covariates when that is not the case could result in an inconsistent estimation of the parameters, as well as contaminating the effect of the political variable with residuals from the linear regression. Further research in this direction would be desirable as well.

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Appendix

Table 1: Variables used in estimation

DGDP:	rate of growth of real per-capita GDP (dependent variable)
LIGDP:	log of initial GDP per capita
MALED:	average years of male secondary education
FEMED:	average years of female secondary education
LLIFEX:	log of life expectancy at age 0
INTER:	interaction variable between human capital and GDP
LFER:	log of fertility rate
GOV:	government consumption as a percentage of GDP
BMP:	black market premium on the exchange rate
DTOT:	percentage change in the terms of trade
INV:	investment as a percentage of GDP
POLCON:	political constraints index
LAW:	law and order index
POLPER:	polity persistence average (instrumental variable)

Table 2:

Coefficients from OLS estimation of $Y - E(Y|Z) = \beta'[X - E(X|Z)] + \varepsilon$

Z = POLCON

Regression with robust standard errors

Number of clusters (DCODE) = 91

Number of obs =	409
F(10, 90) =	16.24
Prob > F =	0.0000
R-squared =	0.2736
Root MSE =	.02828

DGDP	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
LIGDP	-.0107153	.0093445	-1.147	0.255	-.0292797	.0078491
MALED	.0126904	.0049265	2.576	0.012	.0029031	.0224777
FEMED	-.0068476	.0055575	-1.232	0.221	-.0178885	.0041932
LLIFEX	.0413106	.0191749	2.154	0.034	.0032163	.0794049
INTER	-.041119	.026086	-1.576	0.118	-.0929433	.0107054
LFER	-.0025003	.0052441	-0.477	0.635	-.0129187	.007918
GOV	-.1010307	.0331399	-3.049	0.003	-.1668689	-.0351925
BMP	-.0080023	.0025472	-3.142	0.002	-.0130627	-.0029419
DTOT	.063271	.0303412	2.085	0.040	.0029928	.1235492
INV	.1161662	.0224196	5.181	0.000	.0716258	.1607067

Table 3:

Coefficients from OLS estimation of $Y - E(Y|Z) = \beta'[X - E(X|Z)] + \varepsilon$

Z = law and order

Regression with robust standard errors

Number of clusters (DCODE) = 86

Number of obs =	388
F(10, 85) =	14.06
Prob > F =	0.0000
R-squared =	0.2604
Root MSE =	.02679

DGDP	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
LIGDP	.0028439	.0083431	0.341	0.734	-.0137443	.0194322
MALED	.0121893	.0044626	2.731	0.008	.0033165	.021062
FEMED	-.0023062	.0047765	-0.483	0.630	-.0118031	.0071907
LLIFEX	.0313096	.0172658	1.813	0.073	-.0030194	.0656387
INTER	-.0773146	.0230426	-3.355	0.001	-.1231295	-.0314997
LFER	.0063046	.0057053	1.105	0.272	-.005039	.0176482
GOV	-.1035141	.0323982	-3.195	0.002	-.1679304	-.0390979
BMP	-.0073043	.0024425	-2.990	0.004	-.0121607	-.0024478
DTOT	.0732501	.0318487	2.300	0.024	.0099264	.1365738
INV	.0934265	.0230417	4.055	0.000	.0476134	.1392395

Table 4:
worst case bounds on treatment effect and 90% bootstrapped confidence intervals
Z=POLCON

Z=POLCON	lower 90%	lower	upper	upper 90%
low to medium	-0,01881	-0,01651	0,016728	0,019148
low to high	-0,01565	-0,01314	0,019087	0,021292
low to high	-0,01812	-0,01609	0,021824	0,023286

Table 5:
worst case bounds on treatment effect and 90% bootstrapped confidence intervals
Z=LAW

Z=LAW	lower 90%	lower	upper	upper 90%
low to medium	-0,03573	-0,03285	0,039502	0,042295
low to high	-0,03298	-0,02856	0,046427	0,050373
medium to high	-0,03893	-0,03461	0,045813	0,049975

Table 6:
IV bounds on treatment effect and 90% bootstrapped confidence intervals
Z=POLCON

Z=POLCON	lower 90%	lower	upper	upper 90%
low to medium	-0,015875	-0,013089	0,0135304	0,0167641
low to high	-0,003045	0,0017148	0,0127239	0,0163031
medium to high	-0,007491	-0,0032	0,017197	0,0192621

Table 7:
IV bounds on treatment effect and 90% bootstrapped confidence intervals
Z=LAW

Z=LAW	lower 90%	lower	upper	upper 90%
low to medium	-0,035717	-0,021635	0,0323331	0,0429007
low to high	-0,005077	0,0071078	0,0343462	0,0449441
medium to high	-0,012271	-0,003259	0,0340152	0,0444963