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How Does Public Regulation Affect Growth?

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Public regulations can increase economic growth by correcting market faults and decrease growth by consuming resources and reducing incentives. A simple theoretical framework is developed to represent commonly held views on the relationship between growth and regulation. The relationship is possibly non-linear with some level of regulation being optimal. We estimate the relation by a fixed effect non-linear panel data regression model using a new semi-parametric estimator. The outcome shows that the relationship indeed may be non-linear: High levels of regulation lowers growth, but there is no effect on growth for moderate to low levels of regulation.

Jel: C14, D7, O4
Keywords: Fixed effects, growth, semi-parametric regression, panel data, public regulation

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I. Introduction

From the start of political economy a central question has been: What is the optimal level of public regulation? The question has many aspects. We consider the relation between regulation and growth, which we study under the assumption that the level of regulations is a policy decision and growth is the outcome.

Public regulations change externalities and incentives and they consume resources. From the point of view of growth the effects can be classified as reductions of market faults and increases of government faults. The interplay between these faults as a function of regulation is likely to be nonlinear, and there may exist an interior optimal level of regulation. We allow for a flexible relationship in the empirical analysis.

Regulations work through many channels of an economic system, and the relationship between regulation and growth is consequently very complex. To derive the total effect of regulation we estimate a reduced form model. The level of regulation is measured by the Fraser Institute Index of Economic Freedom. The unbalanced panel data contains 123 countries, registered every fifth year since 1970. Fixed effects for countries and years are used to control for country differences and international fluctuations. In addition, we investigate the effect of the level of economic development. A new semi-parametric panel regression technique is used to allow for both fixed effects and a flexible functional relationship.

Studies on cross-country patterns of growth (see e.g. Barro, 1997) normally searches for explanatory factors, and therefore have to deal with the problem known as coefficient *robustness*[1)]. Only a few of those studies consider the level of regulation as a possible explanatory factor. Easton and Walker (1997) show that increased regulation decreases growth. Haan and Sturm (2000) contain a thorough check of robustness. They found that while the effect of regulation is not robust, the effect of changes in regulation is robust. These studies are parametric and do not include fixed effects.[2)]

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1. Potential variables in long run cross-country studies are correlated, so the effect of one variable depends on other variables included. The problem has been approached statistically by studying the stability and significance when additional explanatory variables are included. This approach was recommended by Leamer (1983), see also Levine and Renelt (1992) and Sala-I-Martin (1997).

2. Additional results showing a connection are presented in Gwartney, Lawson and Block (1996) and Gwartney, Lawson and Holcombe (1999).

We investigate a relation of given variables and, thus, we can focus on the functional form of the relationship disregarding robustness. We find that lowering regulation from a high level to a moderate level increases growth. The effect, however, vanishes for further reduction from medium to low levels of regulation.

The theoretical framework is presented in section II. Section III describes the data, and section IV deals with the methodology and the estimation method. The results and policy implications are discussed in section V, while section VI concludes the paper.

II. Government and Market Faults

The purpose of this section is to present a theoretical framework for discussing the relation between regulation and growth that is sufficiently general to accommodate the main views of the profession.

Economic regulation affects overall economic efficiency by reducing or increasing *market faults* and *government faults*. Efficiency can improve by changing incentives of agents to reduce negative growth externalities. Many regulations are introduced for reasons unrelated to growth, e.g. to redistribute wealth, for defense, to support the rent-seeking of client groups, or to buy votes. Such policies have costs that seen from the perspective of economic growth are government faults. Many market faults have been documented, both in theory and in practice. Also, it has often been demonstrated that policies have negative side effects relative to declared purposes.

A. Two views of government

Even if economists often agree on what governments can do, disagreement tends to arise about what governments will do. It depends on the incentives governments react to. The incentives can be grouped under two views: The optimist view and the pessimist view.

The *optimist view* is that governments are either inherently good or forced to be so by the political system.[3)] A long tradition exists for treating governments as "benevolent dictators", ie.

3. This view is shaped by Tinbergen (1964), who started a long tradition for using models for maximizing economic outcomes. The tradition constitutes a positive theory of policy decisions. Wittman (1995) develops a political RE-type theory of democratic governments. The governments are forced to behave as if they were "good" by a political market, where all relevant information is disseminated to the agents.

as agents maximizing aggregate social welfare or (at least) the welfare of the median voter. In this view, the governments try to remedy market faults and to evade government faults.

The public choice school has a more *pessimistic view* of government. It claims that the optimistic view of a government is a poor description of the typical government. Politics is a complex process where the interests of the agents generate equilibrium in the short run. This does not only apply to governments and parties, but also to the bureaucracies implementing the policies. The outcome of the process does not maximize aggregate output.

B. A Formalization of the Optimistic View of Government

The optimistic view can be illustrated in a simple setup with market and government faults. The level of economic regulations is represented by an index, Λ. It is scaled so that low values correspond to much regulation and high values correspond to low regulation.[4)] The effect of regulation can be stated in terms of market faults, f_{mf}, and government faults, f_{gf}. For now, keep all the other variables that influence growth, g, constant. Then growth can be written as $g = g(f_{mf}(\Lambda), f_{gf}(\Lambda))$. This function is illustrated in figure 1 as the actual growth curve. It is drawn under the assumption that the two terms of the function are additive.

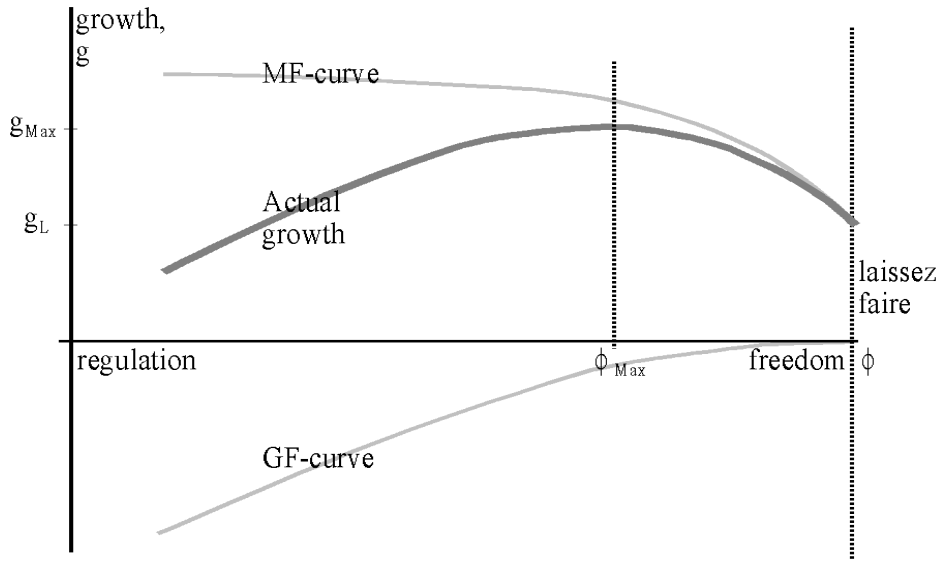


Fig. 1. — Effect of market and government faults on growth.

4. The index from the Fraser Institute measures "economic freedom" – the absence of regulation. This scaling of the index is kept throughout the paper.

The effect of changing the level of economic regulation can be decomposed into two effects. Assume all functions are differentiable. The effect on growth by changing the amount of regulation is:

$$(1) \qquad \frac{dg}{d\phi} = \frac{\partial g}{\partial f_{mf}}\frac{\partial f_{mf}}{\partial \phi} + \frac{\partial g}{\partial f_{gf}}\frac{\partial f_{gf}}{\partial \phi}.$$

The first term is the effect from reduction of market faults. In figure 1 the light gray MF-curve shows how growth increases from the laissez faire, g_L, when market faults are cured. The curve rises toward the maximum growth possible if regulations were costless, ie. do not cause government faults. Less regulation is assumed to increase market faults and more market faults decrease growth. Hence, the curve has a negative slope,

$$(2) \qquad \frac{\partial g}{\partial f_{mf}}\frac{\partial f_{mf}}{\partial \phi} < 0.$$

Unfortunately, regulations also cause government faults as shown by the second term. In figure 1 the light gray GF-curve is a cost curve in terms of loss in growth compared to laissez faire due to government faults. Less regulation is assumed to decrease government faults and, hence, to increase growth, so

$$(3) \qquad \frac{\partial g}{\partial f_{gf}}\frac{\partial f_{gf}}{\partial \phi} > 0.$$

The actual growth curve – the bold dark gray curve – is the sum of the MF-curve and the GF-curve. As they have opposite signs, more assumptions are needed to determine the curvature of the actual growth curve.

The optimistic view of government predicts that the government maximizes growth at any given level of regulation. A decrease in regulation (N increasing) is implemented to remove the largest government fault and only introducing the smallest market fault. This corresponds to the following signs on the second order derivatives:

$$(4) \qquad \frac{\partial\left(\frac{\partial g}{\partial f_{mf}}\frac{\partial f_{mf}}{\partial \phi}\right)}{\partial \phi} < 0, \qquad \text{and} \qquad \frac{\partial\left(\frac{\partial g}{\partial f_{gf}}\frac{\partial f_{gf}}{\partial \phi}\right)}{\partial \phi} < 0.$$

This implies decreasing returns to regulation due to elimination of market faults and increasing

negative return to economic regulation due to creation of government faults. It also implies that $\partial^2 g/\partial N^2 < 0$ and, thus, a unique optimum, g_{Max}, of economic regulation exists. On the figure g_{Max} is reached at the level of regulation N_{Max}.

If the effect from the smallest market faults is less than the effect from the largest government faults, and vice versa, then N_{Max} is located between no and full regulation. Hence, two necessary conditions for the optimist view of government to be correct are that the relationship between growth and economic regulation has a maximum between no and full regulation, and that the relationship is concave. In contrast, the pessimist view of government does not impose the two conditions (4).

III. Data

The data used in the paper are defined in table 1. The only non-standard variable is the index of regulation, N, which is described in detail in the following subsection. While growth is in "normal" fixed prices, the income level Y is in PPP-fixed prices. This slight inconsistency is reflected in the notation.

TABLE 1

DEFINITION OF VARIABLES

i	index for countries, $i = 1, ...,123$
t	index for time, $t = 1970, 1975, 1980, 1985, 1990, 1999$
N_{it}	regulation index, the economic freedom index from Fraser Institute
g_{it}	average real growth per capita
Y_{it}	Log GDP per capita in PPP prices
η_i	fixed effect for country i
λ_t	fixed effect for time t

Note. — If $t = 1980$, then g_{it} is the average growth for 1981, 1982, 1983, 1984 and 1985.

A. The Fraser Institute Economic Freedom Index

The regulation index is compiled by a network of 50 NGO's using about 125 individual variables characterizing the amounts of regulation in an economy. The index was planned by a group of well known researchers, and it is documented in several publications from the Fraser Institute, of which the latest is Gwartney, Lawson, Park and Skipton (2001). Haan (2003) is a conference

volume on the measurement and impacts of the index in various fields.

Both the definition and the construction of the index is controversial.[5)] Fortunately, it is a fairly robust measure for two reasons. Firstly, the index is closely correlated to the two other indices of regulation made by different methods, namely, The Heritage Foundation Index and the EBRD Transition Index for the post-communist countries. Secondly, most of the variables of the index are highly correlated so the pattern reached is fairly robust with respect to the weighting scheme used.[6)] This paper takes the index for granted.

The regulation index is constructed every five years. It starts with 57 countries for 1970 and ends in 1999 with 123 countries. A total of 721 observations is available. In the estimation, we use the average growth in the following 5 years as the measure of growth so the 123 observations for 1999 are not used. For a few observations the average growth rate is missing. Also, to do the

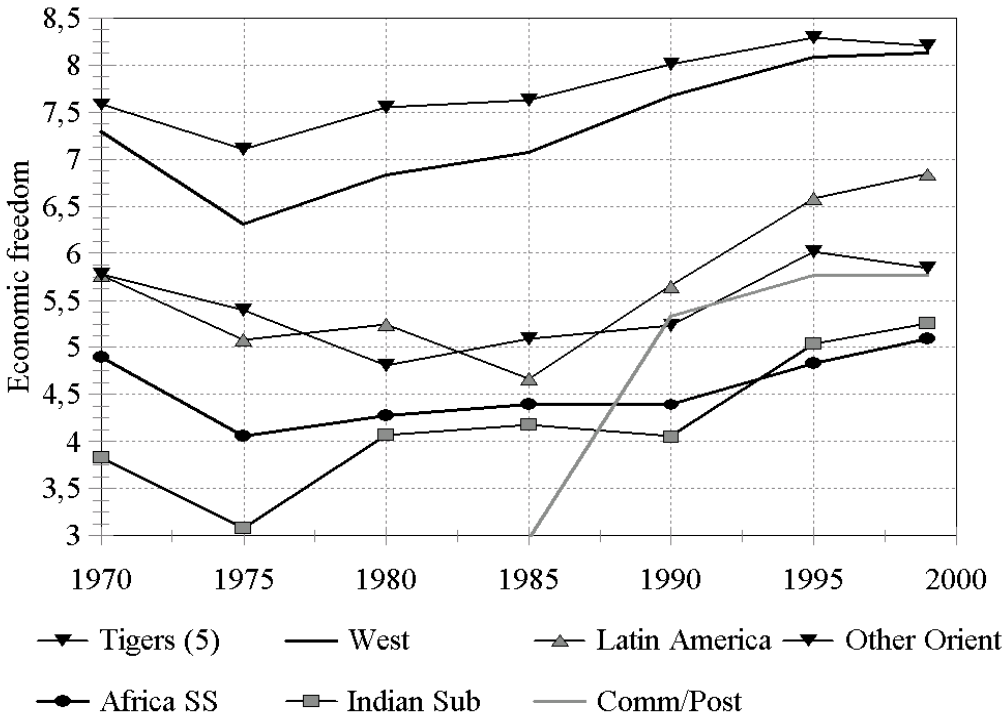


Fig. 2. — The average development of the index, *N*, 1970-99, for groups of countries

5. Most of the researchers behind the index are well known for a libertarian leaning and most of the NGO's collecting the data proclaim a liberal or business orientation. A large scale effort, however, has been made using a consistent and transparent method.

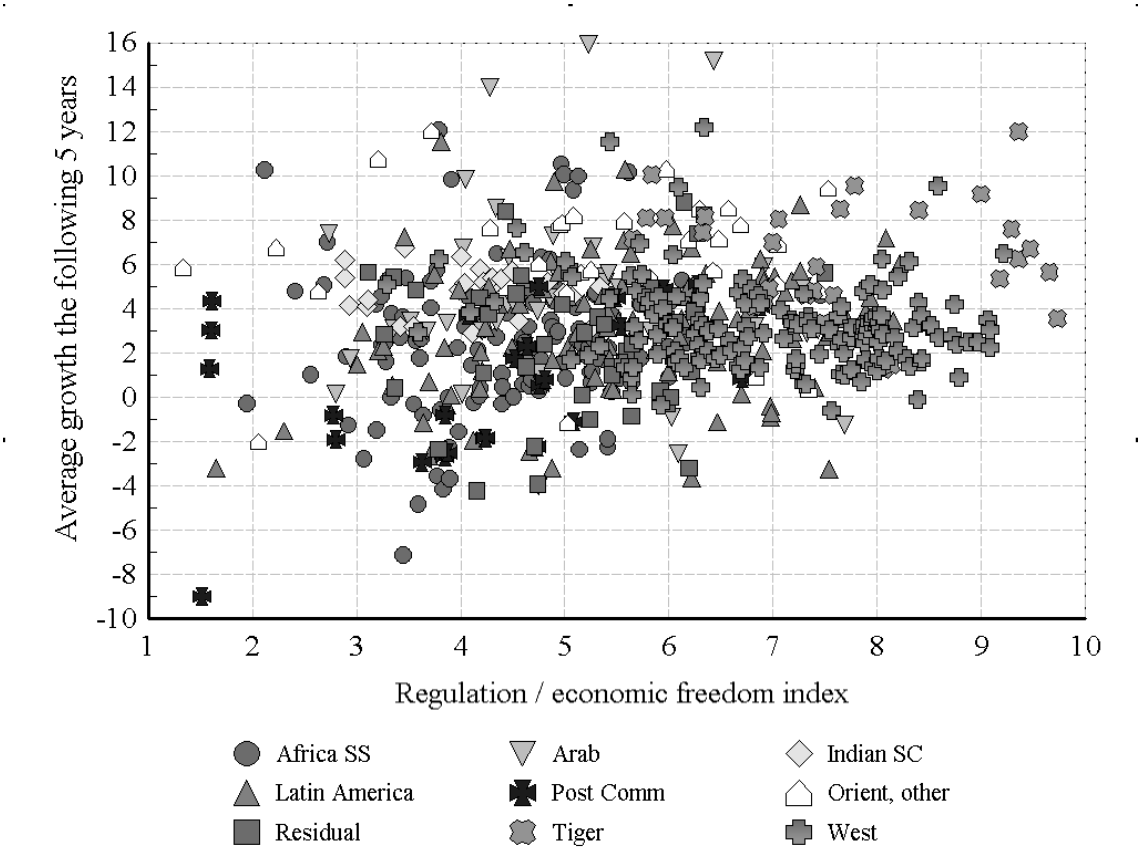
6. The robustness of the conclusions to the composition of the index is analyzed by Carlsson and Lundström (2002) and Leertouwer (2002).

panel data regression at least two observations for each country are needed, so 6 more countries with only 1 observation (before 1999) are deleted. Thus the estimates are made for an unbalanced panel of 584 observations.

The real growth rates, g_{it}, used are from the World Data CD for 2002 (from IBRD). The data for Taiwan, ROC, have been added. A few gaps in the g-data have been bridged using earlier data, from various sources. The log gdp-levels, Y_{it}, are log to GDP in PPP prices per capita.

B. A look at the Data

Figure 2 shows the development over time of the regulation index for countries divided into seven groups. The rich countries of the West and the Asian Tigers pursue moderately liberal policies giving the countries in the group regulation levels in the range from 6.5 to 8, except a few countries above 8. On the Indian Subcontinent and in Africa most countries have pursued



Note: The 590 observations are for the index N in one year against average economic growth the following 5 years. "SS" means South of Sahara, "SC" is Sub Continent, "other Orient" is East and South East Asia, excluding the Asian Tigers. The Post-communist countries were Communists before 1990. For a complete definition of the groups, see Paldam (2003).

Fig. 3. — Scatterplot of economic freedom, N_{it}, against economic growth, g_{it}

policies broadly known as *Third World Socialism* giving regulation levels in the range from 3.5 to 4.5. In the same broad way most of Latin America has pursued *Structuralist* policies, which are fairly regulatory though not as socialist as the ones of the Indian-African group. Therefore the Latin American countries had levels of regulation around 5 until a liberalization started 1985. The transition from socialism is very visible in the Post-Communist countries.

Figure 3 shows a scatterplot of growth against regulation level. Growth rates do scatter a great deal. The couple of countries with very high growth are big oil producing countries in the 1970s. The most systematic extremes are the two Asian Tigers, Hong Kong and Singapore, who grew very fast during most of the period and had very low regulations.

The plot shows that the countries in a group cluster. The only group of countries distributed throughout the range of the index is the Latin American group. This indicates that high or low growth tends to last more than five years and that most economic systems are stable for several decades in terms of regulation level. This strongly suggests that fixed effects are important to include in the model.

IV. Empirical Strategy and Model

This section presents the empirical model. The aim is to estimate the average effect of regulation without imposing strong functional assumptions. To do so and also allowing for fixed effects, we employ a new semi-parametric estimation method.

A. The Empirical Strategy

Regulations rarely influence growth directly, but they work through many channels. In the standard set of variables used by Barro for explaining growth,[7)] all the explanatory variables are either affected by public regulation, or are regulation items in themselves. Hence, these variables cannot appear in a reduced form relation without violating the very purpose of the analysis. We have not excluded the GDP-level as it is possible that the relation analyzed shifts systematically by the level of development.

Countries are different in terms of e.g. resource base, culture, size and location. These

7. The set is: (1) human capital measured by enrolment rates in the school system, (2) health measured by life expectancy, (3) public sector size measured as the ratio of collective consumption, (4) rule of law index, (5) terms of trade changes, (6) democracy index, (7) inflation (see table 1.1 in Barro, 1997).

quantities do not change over time or do so slowly. All these quantities can be controlled for by fixed effects for countries. The fixed effects also partly control for slowly changing background variables that can be affected by regulation such as the quality of the administration and the level of corruption, which are difficult to distinguish from culture at the level of aggregation used. We also control for exogenous shocks by fixed effects for years.

Finally it should be emphasized that the literature on cross-country regressions teaches some *modesty*. It is easy to find detailed analysis of the economic fluctuations in each country, but the data available on a cross-country time series basis are very crude, and they catch only some of the complexity. The literature has considered many variables, but each variable contributes little to explaining the variation.

B. Regression Model

The regression function of interest is the expected growth, $E(g_{it}|N_{it}, Y_{it}, \alpha_i, J_t)$, conditional on the choice of regulation, N_{it}, fixed effects for countries, α_i, and for years, J_t, and the log GDP level, Y_{it}.

With the number of observations available, it is necessary to impose some structure on the functional form to avoid that the curse of dimensionality leads to very imprecise estimates. We want to study the effect of the economic regulation and, thus allow for the most flexibility for this variable. The regression model for country i at time t is:

$$(5) \quad E(g_{it+5}|\alpha_i,\alpha_t,Y_{it},\phi_{it}) = h(\phi_{it}) + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \alpha_i + \tau_t$$

where $h(N)$ is an unknown function. The inclusion of Y_{it}^2 is to allow for non-linearity in the output level. By including the two effects α_i and J_t as fixed, we allow them to be arbitrarily correlated with the other explanatory variables.

In our panel, the number of countries is large, but the number of time periods small. Since we are primarily interested in the effect of regulation, we do not make unrealistic assumptions to estimate the α_i's consistently. The standard trick in linear panel data regression models to eliminate the fixed effects is to use a within estimator or a difference estimator. This does not work here since $h(N)$ is allowed to be a nonlinear function. In the following, we describe a new semi-parametric estimation method that allows for fixed effect and still provides consistent estimates of the remaining parameters and function.

C. Semi-Parametric Estimation of Fixed Effects Panel Data Regression Model

The idea of the estimation method is to approximate an unknown function by a series expansion. Doing so makes it possible to transform the variables and, thus, eliminate the country specific fixed effect. Assume the unknown function, $h(\Phi)$, is continuous. Then it can be expressed using a series expansion:

$$(6) \quad h(\phi_{it}) = \sum_{k=1}^{\infty} \gamma_k a_k(\phi_{it}),$$

where the a_k's are basis functions. The basis functions can be polynomials of increasing power, cosine functions with increasing periodicity or, as we use, splines[8]. The basis functions are known, thus leaving only the coefficients, γ_k, to be found. The approximation of the function, $h(\Phi)$, is simply a finite number, K, of the terms in the series expansion:

$$(7) \quad h(\phi_{it}) \approx \sum_{k=1}^{K} \gamma_k a_k(\phi_{it}).$$

Then the regression function (5) is approximately

$$(8) \quad E(g_{it+5}|\alpha_i,\alpha_t,Y_{it},\phi_{it}) \approx \sum_{k=1}^{K} \gamma_k a_k(\phi_{it}) + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \alpha_i + \tau_t.$$

The model can be transformed using group means. Let $g_{i\cdot}$ be the average growth of country i over the sample period. Then

$$(9) \quad E(g_{it+5}-g_{i\cdot}|\alpha_i,\alpha_t,Y_{it},\phi_{it}) = \sum_{k=1}^{K} \gamma_k(a_k(\phi_{it})-\bar{a}_{k,i}) + \tau_t + \beta_1(Y_{it}-Y_{i\cdot}) + \beta_2(Y_{it}^2-Y_{i\cdot}^2),$$

where $\bar{a}_{k,i}$ is the average over time of $a_k(\Phi_{it})$. This regression function can be estimated consistently using the OLS-estimator and, in particular, so can the coefficients, γ_k, to the basis functions. Hence, the function of main interest, $h(\Phi)$, can be estimated. Consistency of the method is established by having the number of basis functions go to infinity at an appropriate rate relative to the sample size.[9]

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8. The regression splines used are cubic splines with four equidistanced knots between 1.33 and 9.73. We also tried other basis functions and different number of knots for the splines, but obtained the same result.

9. Proofs of consistency and asymptotic normality of series estimators in different iid settings are in Andrews (1991) and Newey (1997). An extension to the case of clustering observations, of which the formulation here is a special case, is yet to be published. A working paper by Porter (1997) seems to contain the

V. Results

This section discusses the results obtained from estimating different models to assess the effect of economic regulation on GDP growth. The results demonstrate the value of a flexible functional specification.

A. Relationship Between Growth and Regulation

The estimate of the regression function (5) is shown in table 2 and figure 4. Since the specification is additive separable in functions of the regressors, the shape of the regression function for given values of Y and the fixed effects does not depend on the actual values of Y and the fixed effects; the shape is determined solely by $h(N)$. Therefore, coefficient estimates on Y and time specific fixed effects are listed in table 2 (with heteroskedastic and clustering robust standard errors) and the function $h(N)$ is graphed in figure 4 (with pointwise 0.95-confidence intervals).

Figure 4 shows the linear regression using the within estimator and the semi-parametric estimates. The main impression is that the relation between growth and regulation is positively sloped. The test for linearity is not rejected on a 5% significance level. It cannot statistically be rejected that less regulation on average leads to higher growth.

The non-linear regression curve bends at around N equal to 5. The two 95% confidence bounds[10] around the non-linear curve show that for N from 1 to 5.5 no horizontal line can be drawn within the confidence interval, whereas for N from 4.5 to 10 the confidence interval can accommodate a horizontal line. The curve hence shows that the effect of a liberalization from high regulation (N . 3) to moderate regulation (N . 6) may be as much as 2.5% extra growth. It is not clear, however, if there is an effect of a further liberalization.

In the context of the optimistic versus pessimistic view of government, a necessary condition for the optimistic view to hold is that the regression function has a maximum between full and no regulation. While the left-hand part of the curve has a significantly positive slope, the right-hand part of the curve does not have a significantly negative slope. Hence, the optimistic view of government is statistically rejected.

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extension for panel data models, but a complete copy of the paper could not be obtained. Alternatively, a proof can be obtained from the authors of this paper.

10. Note the confidence bounds are pointwise but not uniform. Thus strictly speaking they are confidence bounds for a given level of N, not for a function.

TABLE 2

RESULT OF SEMI-PARAMETRIC REGRESSION

Variable names	Coefficient	Robust se
$h(M)$	*See Fig. 4.*	
Y	-4.76	0.744
Y^2	0.355	0.144
J_{1970}	-1.10	0.602
J_{1975}	0.0624	0.434
J_{1985}	1.68	0.309
J_{1990}	2.39	0.492
J_{1995}	3.29	0.587
constant	-11.1	22.2
ACH test[11] for linearity: 0.870. Not rejected (5% critical value = 4.18)		

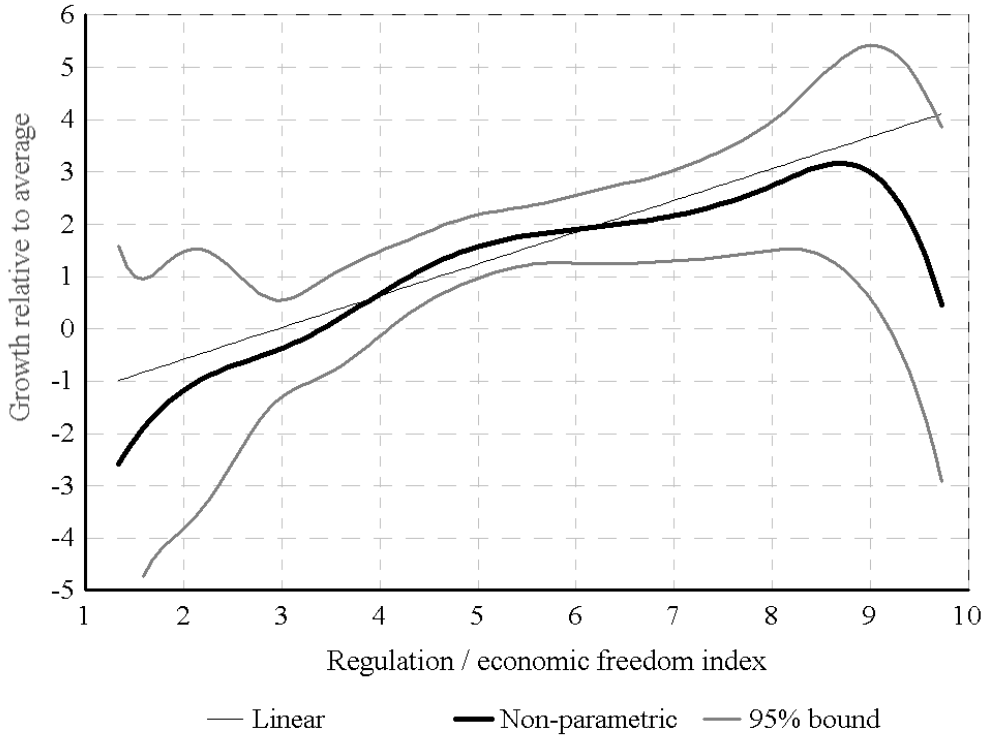

Fig. 4. — The shape of the $h(M)$ function

11. The specification test is proposed by Aerts, Claeskens and Hart (1999).

The effect of gdp on growth has an interesting implication for catching-up. The minimum average contribution to growth is for gdp equal to $815 per capita.[12] The lower gdp compared to $815, the higher growth. This is the usual catching-up effect by poor countries. It is also the case, however, that the higher gdp compared to $815, the higher growth. These results should be interpreted together with the effect of regulation. The poor countries have high levels of regulation. Hence, even though these countries have a potential higher catching-up effect, they also have the lowest effect on growth from regulation.

B. Some Consequences

Growth differences of 2-3% accumulate to gaps of 3-4 times between the gdp's of countries in just half a century. This result and the pattern of regulation found in section III.A is able to explain some of the differences in growth between countries, and hence, some of the development in the world income distribution.

The data shown in figure 2 suggest that the divergence of the West relative to Latin America, during the last 30-50 years can be explained by the differences in regulatory regime.[13] It also provides an explanation why the African countries on average grow about 3% per annum less than the rich countries of the West.

Furthermore, it explains the *twin-observation*, which appears when similar pairs of Western and Communist countries are compared.[14] It seems that the Western "twin" always develops faster by 2-3 % per year, even when the Communist "twin" always had a much higher investment ratio. This is well in accordance with the results shown in figure 4.

One of the most important facts about economic growth is that the Asian Tigers grew by about 8% per annum from an African standard of living in 1950 to become rich DC's in the early 1990s. From comparing figures 2 and 4 it appears that the relatively liberal policies of these countries on average explain half of the extra growth of these countries, see Paldam (2003) for a more detailed analysis and a survey of the amazing "Asian Miracle" controversy.

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12. The minimum is found as the $Argmin_{gdp}$ $(-4.76*Ln(gdp) + 0.355*Ln(gdp)^2)$.

13. See also Blomström and Meller (1991) for a study of the divergence of representative countries in Latin America and NW Europe, concluding that the divergence since the 1920s is due to the regulatory regimes.

14. The most obvious twin-pairs from before 1990 are East and West Germany, Estonia and Finland, and the Czech Republic and Austria. Today North and South Korea come to mind. In all these cases differences in gdp-levels of at least 3 times developed over half a century, when thay had very different regulations.

VI. Conclusion

The purpose of the study is to analyze the relation of public regulation on growth. We provided a simple theoretical framework, which suggested that the relation is nonlinear. This motivated us to a semi-parametrically estimation method of a non-linear panel data regression model with gdp and fixed effects to account for country differences and world economic fluctuations.

The substantial result is that a heavily regulated country on average grows about 2-3% less than a liberal one. The effect on growth from changing regulation occurs from high regulations to a moderate level. We find little effect of going from a moderate level of regulation to the laissez faire.

The bend of the curve is located at about 5-6 points on the scale of economic freedom used to measure regulation. Countries with high regulation, i.e. with less economic freedom than 5 points should liberalize (have a structural adjustment), while countries with a moderate level of regulation above 5 points on the scale are unlikely to gain extra growth by further liberalization.

This also demonstrates that governments on average do not make an optimal tradeoff between market faults and governments faults. This might be interpreted in several ways, but it is an interesting fact to keep in mind.

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