Politics and Productivity

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Abstract: We use a stochastic-frontier approach to study the effects of political and regulatory institutions on aggregate productivity in 39 countries from 1975 to 1990. We show that technical efficiency is positively related to policies supporting *laissez-faire* and political structures that promote policy stability. Moreover, models of technical efficiency incorporating both measures perform better than models including only one or the other. This suggests that economic performance depends not only on current policies, but also on the confidence of market participants and outside investors that these policies will remain in place.

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1. Introduction

Economic studies of long-run performance are focusing increasingly on political, legal, financial, and social factors. Development is no longer regarded as a gradual, inevitable transformation from self-sufficiency to specialization and participation in the division of labor. Instead, progress follows the creation and evolution of institutions that support social and commercial relationships. The "new institutional economics" explains that growth requires that the potential hazards of trade (shirking, opportunism, risk, and so on) be controlled by institutions like secure property rights, reliable procedures for resolving disputes, and means of enforcing contracts in the absence of close social ties. These institutions reduce information costs, encourage capital formation and capital mobility, allow risks to be priced and shared, and otherwise facilitate cooperation (North and Thomas, 1973; North, 1990; Drobak and Nye, 1997; Levine, 1997). In particular, political authorities must make credible commitments not to expropriate private resources once investments have been made.[1]

Despite widespread agreement that institutions matter, there is no consensus on how they should be incorporated into the analysis. Even the best empirical studies of productivity and growth treat institutional characteristics in an eclectic way. Barro's (1991) influential paper, for example, uses the numbers of assassinations and revolutions per capita as proxies for political instability, finding these measures negatively correlated with growth and investment. Scully (1988) regresses growth rates on dummy variables derived from Gastil's (1982) ordinal rankings of political and economic liberty. King and Levine (1993a, 1993b, 1993c) derive various measures of the quality of financial intermediaries and show that these measures are good predictors of growth.

This paper presents a different approach to analyzing the relationship between institutions and aggregate economic performance. Following the modern productivity literature (see, for example, Fried, Lovell and Schmidt, 1993), we model economic performance with a *stochastic production frontier.* Frontier analysis is a sophisticated way to "benchmark" productive units. It analyzes a group of branches, firms, nations, or other units by identifying "best practices" and evaluating each member's performance relative to the best-practice frontier. The results produce not only qualitative rankings of the group members, but also numerical efficiency scores that can be used to assess the effects of various policies and characteristics. For this reason, frontier analysis is well

[1] For general surveys of the new institutional economics see Furubotn and Richter (1997) and Klein (2000). North (1991) summarizes the literature as it applies specifically to economic development.

suited for studying the effects of legal and political institutions on the economic performance of nations.

To capture institutional factors we use two comprehensive indexes of legal, regulatory, and political conditions. Working with a broad sample of countries from 1975 to 1990, we incorporate a widely used measure of economic freedom along with a new measure of policy stability to represent a country's institutional environment. The new institutional economics suggests that countries with high levels of economic freedom (protection of private property rights, respect for the rule of law, an unhampered price system, and so on) and policy stability (commitment not to change the rules of the game ex post) will be closer to the best-practice frontier.

In our model, economic freedom and policy stability affect economic performance by enhancing technical efficiency. In other words, these institutions do not alter the state of technology, but they allow producers to squeeze more out of current technology. For instance, countries with more stable policies attract more foreign investment than countries with less stable policies, ceteris paribus; this leads to increased competition among producers, which in turn brings efficiency gains. Similarly, countries with lower taxes, milder regulatory burdens, lower inflation, fewer restrictions on foreign ownership, and so on are likely to produce output more efficiently than countries with policies that restrict production, inhibit capital formation, and reduce competition.[2]

Our results strongly support the claim that the institutional environment affects technical efficiency. Specifically, we find that both economic freedom and policy stability are highly significant determinants of a country's relationship to the best-practice frontier. Moreover, models of technical efficiency incorporating both measures perform better than models including only one or the other. This suggests that economic performance depends not only on current policies, but on the confidence of market participants and outside investors that these policies will remain in place. Economic freedom is important, but even more so when combined with policy stability, and vice versa. These results hold whether a composite measure or individual components of economic freedom are used.

The remainder of the paper is organized as follows. Section 2 outlines the stochastic-frontier model and describes the data. Section 3 presents results using the composite measure of economic freedom. Section 4 explores the effects of individual components of economic freedom. Section 5

[2]We are using the term "technical efficiency" broadly, defining it to include anything that brings a country closer to the best-practice frontier. This could include improvements in allocative as well as productive efficiency. Of course, a more general model would also explore the relationship between institutions and the state of technology.

examines our results for endogeneity, and section 6 concludes.

2. Methods and data

We model the best-practice frontier for our sample countries as a stochastic production frontier. The concept of a stochastic production frontier was proposed independently by Aigner, Lovell, and Schmidt (1977), and Meeusen and van den Broeck (1977). The original specification involved a production frontier for cross-sectional data with an error term consisting of two components, one to account for random error and another to account for technical inefficiency. The original model was later extended to incorporate time-series variation and with the prediction of technical efficiency scores by appropriate explanatory variables. We use a panel data version of Battese and Coelli (1993, 1995) that allows simultaneous estimation of technology parameters of a stochastic production frontier and the parameters of an inefficiency model.

Our specification proceeds as follows. Suppose producer i at time t uses a vector of inputs $x_{it} \in \mathbf{R}_+^N$ to produce scalar output $y_{it} \in \mathbf{R}_+$ with technology

$$y_{it} = f(x_{it}, \beta) \exp(v_{it} - u_{it}), \text{ and} \quad (1)$$

$$u_{it} = z_{it} \cdot \delta + w_{it} \geq 0, \quad (2)$$

where $i = 1, ..., I$ indexes producers, $t = 1, ..., T$ indexes time, f denotes the production frontier, and β is a vector of technology parameters to be estimated. The v_{it}s represent random errors and are assumed to be iid $N(0, \sigma_v^2)$. Technical inefficiency is captured by the u_{it}s, which are assumed to be independently distributed as $N^+(z_{it} \cdot \delta, \sigma_u^2)$. They are also assumed to be distributed independently of the v_{it}s. The parameter z_{it} is a vector of explanatory variables associated with technical inefficiency, and δ is a vector of unknown parameters to be estimated. The w_{it}s are defined by the normal distribution with mean zero and variance σ_u^2 and are truncated at $-z_{it} \cdot \delta$, which ensures that $u_{it} \geq 0$. The log-likelihood is expressed in terms of the variance parameters $\sigma^2 \equiv \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma^2$. The variance ratio γ, bounded by zero and one, can be interpreted as an inefficiency indicator. As γ goes to zero, variation in σ^2 is attributed entirely to noise. As γ goes to one, variation in σ^2 is attributed entirely to inefficiency.[3]

In this context, technical efficiency is defined as the ratio of observed to maximum feasible

[3] See Battese and Coelli (1993) for the derivation of the log-likelihood.

output. Formally,

$$TE_{it} = \frac{y_{it}}{f(x_{it}, \beta)\exp(v_{it})} = \exp(-u_{it}) = \exp(-z_{it} \cdot \delta - w_{it}) \tag{3}$$

where TE_{it} denotes technical efficiency of producer i in period t. Battese and Coelli (1993) show that the minimum-mean-squared error predictor of technical efficiency is given by

$$E[\exp(-u_{it})|v_{it} - u_{it}] \ .$$

Maximum-likelihood estimates for the parameters of both the stochastic production frontier and the technical inefficiency model can be obtained from the computer program FRONTIER 4.1 (Coelli, 1996).[4]

Our data on inputs and outputs are taken from the Penn World Table (Summers and Heston, 1991), which provides income and expenditure data for about 150 countries from 1950 to the present. The expenditure entries are denominated in common prices in a common currency to permit real comparisons across countries and over time.

A key advantage of our approach over others typically used in the growth literature is that we use output levels, rather than growth rates, to estimate our stochastic frontiers. The Penn World Table was designed to compare income levels using "international prices" to adjust for differences in the purchasing power of currencies. It turns out that these "international prices" most closely resemble those of Hungary. Nuxoll (1994, p. 1423) notes that use of these prices tends to overstate growth rates for countries wealthier than Hungary and to understate growth rates for countries less wealthy than Hungary. He writes (p. 1434) that "probably the ideal is to use Penn World Table numbers for levels and the usual national-accounts data for growth rates." Our stochastic-frontier approach avoids such bias by focusing on input and output levels, not growth rates.[5]

To capture the role of institutions, we begin with the composite measure of economic freedom (EF) provided by Gwartney, Lawson, and Samida (2000). In their definition, "[i]ndividuals have

[4]Scully (1988) also uses a frontier approach to examine the effects of social institutions. He shows that ordinal rankings of political, civil, and economic liberty positively affect a country's ability to convert capital per worker into output per worker. However, Scully's two-stage approach poses problems. In the first stage he estimates a deterministic production frontier and predicts technical efficiency scores for each country under the assumption that the technical efficiency scores are identically distributed. The second stage involves a regression of the predicted technical efficiency scores on three measures of liberty. But this is inconsistent with the initial assumption of identically distributed technical efficiency scores. Our formulation avoids this problem with a one-stage approach that estimates the technology parameters of the stochastic production frontier and the parameters of the inefficiency model together.

[5]Temple (1999, p. 119) also discusses problems caused by confusing income levels with growth rates. Reliance on data from the Penn World Table may explain why so many studies have failed to find convergence in growth rates among countries.

economic freedom when: (a) their property acquired without the use of force, fraud, or theft is protected from physical invasions by others and (b) they are free to use, exchange, or give their property to another as long as their actions do not violate the identical rights of others." Working with this definition, Gwartney, Lawson, and Samida construct an index measuring how strongly these rights are protected across a broad sample of countries over time. The composite EF measure consists of twenty-three components allocated to four major areas: (1) money and inflation, (2) government operations and regulations, (3) takings and discriminatory taxation, and (4) international trade. The composite measure represents the degree to which government policy fosters savings, foreign investment, and commercial and industrial development.[6] The data are provided in a series of five-year cross-sections from 1970 to 2000.[7]

We interpret EF_t as characterizing the policy "status quo" in year t. Economic development clearly requires desirable policies, but it also requires policy stability; investors must believe that desirable policies are likely to remain in place. We therefore add to our model a new measure of policy constraints (PC) developed by Henisz (2000a).[8] This measure, derived from a spatial model of political interaction, describes how easily the status quo can be changed. It comprises two elements: the number of potential veto points in the political system and the current alignment of political interests, defined as the degree to which political actors agree on the desired policy, whatever that policy may be.[9] Veto points make it difficult to change the status quo by administrative or executive fiat; alignment of interests makes it unlikely that political actors will want to change the status quo.

Henisz suggests two channels through which policy constraints affect economic performance. First, by reducing the risk of wealth expropriation through arbitrary changes in tax, regulatory, or other policy areas, stable policies encourage foreign investment, especially where relationship-specific investments are at stake. Second, under stable policy regimes, fewer resources tend to be

[6]A value of ten represents very high economic freedom and a value of zero very low economic freedom. While the aggregate country ranking is given on this ten-point scale, the individual components are derived from quantitative measurements, not subjective, qualitative assessments. For this reason, the data are unlikely to be biased in favor of a positive relationship between economic freedom and economic performance (as would be the case if researchers tended to assign high EF rankings to more prosperous countries). See also our discussion of the individual components in section 4 below.

[7]Other papers on institutions and growth using the Gwartney, Lawson, and Samida data include Easton and Walker (1997), Dawson (1998, 2002), Gwartney, Holcombe, and Lawson (1998, 1999), Norton (1998), Ayal ad Karras (1998), La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1999), Ali and Crain (2002), and Carlsson and Lundström.

[8]The PC measure is also used in Henisz (2000b) and Henisz and Zelner (2001).

[9]A value of one represents very high policy stability and a value of zero very low policy stability.

spent in rent-seeking activities, freeing those resources to create wealth. We consider the effects of EF and PC both separately and together, presuming that economic freedom should be more valuable in the presence of policy constraints, and policy constraints should be more valuable in the presence of economic freedom.[10]

Drawing from these sources, and eliminating observations with missing data, we construct a balanced panel of 39 countries for the years 1975, 1980, 1985 and 1990 with a total of 156 observations.[11] (The list of countries is included as Appendix A.) Real GDP per worker and capital stock per worker in 1985 international prices are taken from Summers and Heston (1991). Summary statistics for all variables are provided in Table 1.

[Table 1 about here]

Are high levels of EF associated with high levels of PC? In our sample the correlation between EF and PC is 0.538, smaller than we initially expected. Some countries, like the United States, Canada, and Switzerland, score high on both measures, while others, like Turkey, Iran, and Syria, score low on both. However, economic freedom and policy constraints do not necessarily go together. Israel, Portugal, and Spain rank high on PC but low on EF; these countries have very stable policies, but the content of those policies inhibits efficient resource allocation through markets. Guatemala, by contrast, scores high on EF but low on PC. Guatemala has relatively laissez-faire policies, but provides investors and entrepreneurs little assurance that those policies will remain in place.

[10]Policy stability should not be confused with political stability. Political stability refers to the likelihood that the current regime will remain in power. Zaire under Mobutu Sese Seko was an example of a country with a highly stable political regime but increasingly arbitrary policies. Similarly, policy stability does not measure "political freedom"—an extended franchise, the right to form political parties, an independent press, and so on. In our framework, such political rights affect productivity only to the extent that they affect economic freedom. For more on the relationship between political and economic freedom, see the classic treatments by Mises (1927), Hayek (1944), and Friedman (1962).

[11]The Penn World Table contains data on 152 countries, but not all variables are available in all four years. Henisz's dataset on political constraints includes the same 152 countries, while the Gwartney, Lawson, and Samida data include from 83 to 123 countries, depending on the year, though some individual components of EF are missing in particular years. Our panel includes the 39 countries for which all necessary variables were available in all four years.

3. Basic results

We employ a Cobb-Douglas stochastic production frontier in logarithmic form:

$$\ln y_{it} = \beta_0 + \beta_1 \ln x_{it} + \sum_{t=2}^{4} \eta_t D_t + \sum_{i=2}^{39} \lambda_i D_i + v_{it} - u_{it} \tag{4}$$

where $\ln y_{it}$ is the natural log of real GDP per worker for country i in period t, $\ln x_{it}$ is the natural log of capital stock per worker for country i in period t, D_t is a time dummy for period t intended to capture technical change (see Baltagi and Griffin, 1988), D_i is a country dummy for country i to control for unobserved heterogeneity, and v_{it} and u_{it} are defined as above.[12]

To explore the effects of EF and PC on productivity we use four specifications of the technical inefficiency component:

$$u_{it} = \delta_0 + \delta_1 EF_{it} + w_{it} \tag{5}$$

$$u_{it} = \delta_0 + \delta_1 PC_{it} + w_{it} \tag{6}$$

$$u_{it} = \delta_0 + \delta_1 EF_{it} + \delta_2 PC_{it} + w_{it} \tag{7}$$

$$u_{it} = \delta_0 + \delta_1 EF_{it} + \delta_2 PC_{it} + \delta_3 EF \cdot PC + w_{it} \tag{8}$$

The first specification includes only EF as a source of inefficiency, the second includes only PC, the third includes both, and the fourth adds an interaction term. Table 2 provides parameter estimates for all four specifications.

[Table 2 about here]

The results strongly support the idea that EF and PC are important determinants of technical efficiency. The elasticity of RGDP per worker with respect to capital per worker, β_1, ranges from 0.599 to 0.712. The inefficiency indicator, γ, is very close to one and highly significant, implying that nearly all the variation in σ^2 can be attributed to inefficiency. In the technical inefficiency component of the model, the key parameters δ_1 and δ_2 (the coefficients on EF and PC, respectively) have the expected signs and are highly significant: the higher the EF and the higher the PC, the

[12] We chose this functional form because scale effects are unlikely to matter at this level of aggregation and because our focus lies on the inefficiency component of the model. As a robustness check, we also regressed the natural log of real GDP on the natural log of labor and the natural log of capital stock to allow for variable returns to scale. The corresponding results (not reported here) are similar to the results reported in this section.

less inefficient the country in converting capital per worker into RGDP per worker. The coefficient on the interaction term also has the expected sign, though it is not significant.[13]

Likelihood ratio tests suggest focusing on specification (7). The estimated coefficient on PC in this specification is -0.333. Mean technical efficiency for the sample is 0.8904, which implies that mean u_{it} is 0.116. If the mean PC score were one-third of a standard deviation (0.11 units or 21 percent) above its current level, ceteris paribus, the mean u_{it} would fall by $-0.333 \cdot 0.11 = -0.0337$ to -0.0794. In turn, mean technical efficiency would rise to 0.9237. Similarly, if mean EF were one-third of a standard deviation (0.473 units or 10 percent) above its current level, ceteris paribus, mean u_{it} would fall by $-0.198 \cdot 0.473 = -0.0937$ to -0.0223. Mean technical efficiency would then rise substantially to 0.9780, eliminating almost all waste! Of course, these quantitative statements should be interpreted with caution, since it is unclear what constitutes a "unit" of EF or PC. Nonetheless, the results strongly support the proposition that EF and PC enhance economic growth through technical efficiency gains.

This exercise also sheds light on the debate about the rise of the "East Asian Tigers." A 1993 World Bank study attributed the impressive growth rates of Taiwan, South Korea, and Thailand from 1960 to 1990 to high rates of productivity growth, dubbing their strong economic performance the "East Asian miracle." Young (1994), by contrast, suggested that the major source of their economic growth was increased utilization of capital and labor, not productivity growth. Krugman (1994) popularized the idea that East Asian growth was no miracle, claiming that higher output was driven merely by an increase in inputs. Without productivity growth, of course, output growth cannot be sustained for long.

Table 3 provides the raw data and technical efficiency scores for South Korea, Taiwan, Thailand, and eight other countries in the sample. South Korea, Taiwan, and Thailand all show significant improvement in technical efficiency from 1975 to 1990. South Korea and Thailand had technical efficiency growth rates of 2.15 and 1.86 percent per year, respectively, the highest efficiency growth rates in our sample. Taiwan ranked 9th with average annual efficiency growth of 1.17 percent over

[13] As discussed in footnote 10 above, PC is a measure of policy stability, not political stability. However, to check the robustness of our results we experimented with an additional set of specifications including an additional control variable, the average annual number of revolutions and coups during the previous five years (the most common proxy for political stability used in the growth literature). The data were obtained from Arthur Banks's Cross National Time-Series Data Archive.

The results (not reported here) were virtually identical to those reported in Table 2. PC and EF retain the expected signs and significance levels, their point estimates are about the same as before, and the new variable is not statistically significant. This suggests that dramatic regime changes are important only to the extent they affect policy stability and economic freedom (the content of current policies), not independent of them.

the same period.

[Table 3 about here]

Moreover, the raw data reveal that during this period these three countries experienced substantial improvements in EF, PC, or both. For the entire sample, the mean increase in PC between 1975 and 1990 was 0.09 units, and the mean increase in EF over the same period was 0.95 units. South Korea had the highest increase in PC, 0.48 units, along with an above-average increase in EF of 1.1 units (19th best). Similarly, Thailand had an increase in PC of 0.07 units (13th highest) and an increase in EF of 1.6 units (10th highest). Taiwan appears less impressive, with a 0.01-unit decrease in PC (35th best) and a 1.2-unit increase in EF (12th best). However, Taiwan started with a high 1975 PC score of 0.72, which leaves little room for improvement. In short, our results suggest that the South Korean, Taiwanese, and Thai economies expanded not only through capital accumulation, but also through productivity growth fostered by policies and institutions that increased economic freedom and improved policy stability.

This result is not exclusive to the East Asian Tigers. Other countries with substantial increases in EF and PC leading to improvements in technical efficiency include India, Chile, and Portugal. Like South Korea, India achieved substantial improvements in PC (0.25 units, 7th best in the sample) and EF (0.7 units, 21st best), and witnessed a corresponding increase in technical efficiency of 1.54 percent per year (6th best). Like Taiwan, Chile and Portugal maintained high levels of PC during the 1975–90 period, while also increasing EF, by 3.3 units (best in the sample) and 1.7 units (9th best), respectively. They simultaneously experienced annual technical efficiency growth rates of 0.73 (12th best) and 1.61 (4th best), respectively.

By contrast, consider Iran, Nigeria and Syria. These countries experienced technical efficiency declines of 7.59, 3.37, and 1.26 percent, respectively. Our analysis suggests that these productivity losses were due to reductions in EF. All three countries rank at the bottom in EF change (Iran is worst at −1.70, Syria third worst at −0.70, and Nigeria fifth worst at 0.10). All three countries are also effectively dictatorships, with PC scores of 0.00 in 1975 and 1990. These EF changes and PC levels largely explain their inability to attract foreign investment. For further illustration, suppose that Iran, Nigeria, and Syria had the same 1975–90 increases in EF and PC as South Korea (1.1 and 0.48 units, respectively). According to the estimated coefficients from model (7), Iran would have more than doubled technical efficiency from 0.330 to 0.675, Nigeria would have increased technical efficiency from 0.615 to 0.88, and Syria would have almost doubled technical efficiency from 0.671 to 1.127. (Syria would have an output-input ratio beyond what is feasible for any members of the current sample!)

Another example illustrates our point that both PC and EF are necessary for productivity growth. Both Argentina and Peru experienced substantial increases in PC over the sample period, 0.41 units for Argentina (third best in the sample) and 0.38 units for Peru (fourth best). However, both had below-average increases in EF of 0.3 units. Despite these increases in PC, Argentina and Peru experienced technical efficiency declines of 1.61% (fifth worst) and 2.51% (third worst), respectively. Policy constraints are important, but only if current policies leave markets relatively free of government intervention.

4. Individual components of economic freedom

The composite measure of economic freedom provided by Gwartney, Lawson, and Samida (2000) is derived from individual rankings of all countries in twenty-three specific areas. To be sure our results using the composite measure were not driven by Gwartney, Lawson, and Samida's particular aggregation method, we reestimated our results using individual components of EF in place of the composite measure. Besides constituting a robustness check for the results presented above, this approach helps shed light on those specific policies most conducive to economic development.[14]

Of the twenty-three individual components provided by Gwartney, Lawson, and Samida, ten were available for all our sample countries in all four years.[15] We thus reestimated the technical inefficiency component of our production frontier as

$$u_{it} = \delta_0 + \delta_1 PC_{it} + \sum_{j=2}^{12} \delta_j z_{jit} + w_{it} \ , \tag{9}$$

where z_{jit} represents country i's score in year t on the following j components z_j:

1. z_2, the difference between the annual growth rate of the money supply (M1) and the annual growth rate of potential real GDP;

[14] Other papers focusing on the individual components of the Gwartney, Lawson, and Samida index include Ayal and Karras (1998), Carlsson and Lundström (2002), and Dawson (2002).

[15] Gwartney, Lawson, and Samida (2000) use alternative weights to construct the composite measure of EF for country-years in which one or more of the individual components of EF is missing. First, they try to construct a rating in each of the four major areas (money and inflation, government operations and regulations, takings and discriminatory taxation, and international exchange). For example, suppose an area consists of three components. They calculate an area rating if at least two of the three components exist by allocating the missing component's weight to the two available components. Next, they use a similar process to construct the composite rating from the area ratings.

2. z_3, government consumption as a percent of total consumption;
3. z_4, government-consumption-to-total-consumption squared (used for reasons explained below);
4. z_5, the presence and role of state-operated enterprises (SOEs) (a higher rating means that government enterprises play a less significant role);
5. z_6, the right to own foreign currency domestically (zero or ten);
6. z_7, the freedom to engage in capital (investment) transactions with foreigners (zero, two, five, eight or ten);
7. z_8, the right to own a bank account abroad (zero or ten);
8. z_9, the use of conscripts to obtain military personnel (zero or ten);
9. z_{10}, the average tax rate on international trade;
10. z_{11}, actual size of trade sector (imports and exports as a percentage of GDP) compared to the expected size; and
11. z_{12}, the difference between the official exchange rate and the black-market rate.[16]

Results are presented in Table 4. As in the model with the composite measure of EF, the coefficient on PC is negative and significant, indicating that countries with strong policy constraints are less inefficient than countries with weak policy constraints. All components of EF except the two international trade proxies are statistically significant, and most have the expected signs.

[Table 4 about here]

The coefficient on z_2, inflation, is positive and significant, consistent with a substantial empirical literature showing that high inflation rates inhibit trade and capital formation by distorting relative prices (Aarstol, 1996; Kaul and Seyhun, 1990; see also Scully, 1992). The coefficient on z_3, government expenditures, is significant but negative, indicating that countries with high government expenditures are less inefficient than countries with low government expenditures. This is surprising, given that most of the empirical growth literature finds a negative correlation between the size of the public sector and economic growth (Kormendi and Meguire, 1985; and Landau, 1983), and it seems inconsistent with our *laissez-faire* argument. Some authors suggest that government expenditures on certain "core functions"—protection of property rights, enforcement of contracts,

[16]Gwartney, Lawson, and Samida (2000) express all rankings on ordinal scales. For greater precision, we have substituted for z_2, z_6, z_9, z_{10}, and z_{11} the actual numbers.

and a legal system to resolve disputes, and possibly some goods like public infrastructure and education—stimulate economic growth (Gwartney, Holcombe, and Lawson, 1998, pp. 165–66).[17] Barro (1990) develops a growth model in which the level of government expenditures contributes positively to economic growth up to a certain level (for example, 25 percent of GDP), but reduces growth beyond that level. Branson and Lovell (2000), following similar reasoning, estimate an optimal level of government spending for New Zealand of 22 percent.

An alternative explanation for our coefficient on z_3, however, is that the level of government expenditures is likely to be a poor proxy for the role of government intervention in the economy. It is increasingly recognized that government activities such as statutes, administrative regulation, and the judicial interpretation of legal rules redirect resources as much as, or more than, taxes and spending (Peltzman, 1980; Lindbeck, 1985; Borcherding, 1985; Block, 1991). For this reason, recent research on the U.S. has used alternative measures of government intervention such as the number of pages in the *Federal Register* (Westley, 1998; see also Goff, 1996). More generally, as Higgs (1987, p. 29) points out, "all quantitative indexes of the size of government share a common defect: their changes may indicate either changes in the scope of effective governmental authority or merely changes in the level at which government operates within a constant scope of authority."

Nonetheless, to allow comparison of our results to those of similar studies, we follow Branson and Lovell (2000) and include a second-order term to solve for the level of government expenditures (GOV) associated with minimum technical inefficiency. We model the inefficiency component as

$$u = \delta_0 + \delta_3 GOV + \frac{1}{2}\delta_4 GOV^2 \tag{10}$$

(abstracting from the other independent variables and omitting time and country subscripts). This implies that

$$\frac{\partial u}{\partial GOV} = \delta_3 + \delta_4 GOV \ . \tag{11}$$

The theory that government spending up to a certain level is beneficial implies that δ_3 should be negative and δ_4 positive. Setting that expression equal to zero yields the "optimal" GOV equal to $-\delta_3/\delta_4$. As Table 2 shows, δ_4 is positive and significant, suggesting an optimal GOV of about 30 percent, somewhat higher than Branson and Lovell's figure.[18]

[17] However, as emphasized by Rothbard (1970), Friedman (1973), Benson (1990, 1998), and others, even the "protective" functions of government such as securing law and order are also provided by markets.

[18] Our GOV measures government consumption relative to total consumption, not government expenditures relative to GDP, so our measure is not directly comparable to theirs.

Consistent with our overall position, the coefficient on z_5, the presence and role of state-owned enterprises, is negative and significant. (Recall that a higher score on z_5 indicates a smaller role for SOEs.) The empirical literature on privatization strongly suggests that SOEs are less efficient than private-sector benchmarks (Boardman and Vining, 1989; Ehrlich, Gallais-Hamonno, Liu, and Lutter, 1994; Majumdar, 1996; Dewenter and Malatesta, 2001; see also Megginson and Netter, 2001). Like this literature, we find that aggregate economic performance is lower when SOEs play a more important role.

The results on the remaining variables are mixed. The negative coefficients on z_6, the right to own foreign currency domestically, and z_7, the freedom to engage in capital transactions with foreigners, support the claim that these liberties enhance productivity by encouraging foreign trade. On the other hand, the positive coefficient on z_8, the right to own foreign bank accounts, does not appear to support our argument, unless foreign accounts are regarded as repositories of illegal gains that would have otherwise been invested domestically. The coefficient on z_9, conscription, is positive and significant at the 10 percent level, suggesting that forced military service is less efficient than voluntary arrangements.

Finally, the coefficients on z_{10} and z_{11}, the two variables that relate directly to international trade, are not statistically significant. Despite arguments that trade barriers can increase productivity by correcting factor-market distortions, protecting "infant industries," and so on, it is generally agreed that free trade should produce efficiency gains from improved resource allocation due to specialization according to comparative advantage. Most empirical studies find that openness to trade, usually proxied by the ratio of exports or imports to RGDP, has a significant positive (but small) impact on growth (see, for example, Feder, 1983; Kormendi and Meguire, 1985). However, our model fails to pick up a significant effect. Possibly, neither variable is a good measure of a country's openness to trade; Ayal and Karras (1998) also find that the average tax rate on international trade is not a significant determinant of economic growth in a neoclassical framework.[19] An ideal measure of trade liberalization would be an aggregate, weighted index of the divergence between world and domestic prices; unfortunately, such a measure has not yet been constructed. We do find that the coefficient on z_{12}, the black-market exchange premium, is positive and significant

[19] One potential problem with z_{10}, the average tax on international trade, is that it is strongly correlated with per-capita GDP (Easterly and Rebelo, 1993). Less developed countries tend to rely heavily on tariffs because they lack the administrative ability to collect other types of taxes. To see if the inclusion of z_{10} had biased the coefficients on the remaining right-hand-side variables, we reestimated the regression reported in Table 4 without z_{10}. The point estimates and significance levels for the remaining variables were essentially the same as those reported in Table 4.

(countries with high premiums are less efficient). The black-market premium is usually used as a measure of distortions on foreign trade, but may also be interpreted more generally as a proxy for other distortionary policies and for macroeconomic instability.

In general, these results in this section support our hypothesis that EF and PC raise technical efficiency even if we employ components of EF instead of a composite measure of EF. Our basic conclusion is thus robust to the precise measurement of EF.

5. Endogeneity

Clearly, then, the institutional environment, as captured by EF and PC, is highly correlated with technical efficiency. However, we have not yet established a causal relation between institutions and efficiency. So far we have treated EF and PC as determinants of productivity. Conceivably, the relationship could go the other way: countries that are more productive are wealthier, and wealthy countries can *afford* to have stable, *laissez-faire* policies. This could be the underlying causal explanation for our results.

In a historical context, this argument makes little sense. Countries with interventionist, unstable policies did not become rich and then suddenly reduce the sizes of their public sectors and stick to established rules of the game. Rather, it was the stable, laissez-faire economies that became wealthy in the first place (Rosenberg and Birdzell, 1986, Landes, 1998). Nonetheless, to explore the possibility that our results reflect a causal relationship from wealth to EF and PC, we estimated panel regressions of EF and PC on RGDP per worker and RGDP per worker lagged one period. Results from both random-effects and fixed-effects regressions are presented in Panel A of Table 5. As seen in the table, the coefficients on RGDP per worker are positive and highly significant in both EF regressions and positive in both PC regressions (though significant only in the random-effects model). This means that income is contemporaneously correlated with both dependent variables. However, lagged RGDP per worker is not significant in any regression. Controlling for current income, then, past values of income are not good predictors of EF or PC.

[Table 5 about here]

By contrast, as seen in Panel B of Table 5, lagged values of EF and PC are generally good predictors of RGDP per worker, controlling for current values of EF and PC. These findings suggest that EF and PC are best understood as drivers of productivity, not simply consequences of economic well-being. Gwartney, Lawson, and Holcombe (1999) also look at whether growth causes EF. They find that the value of the composite measure of EF in a year, and the change in EF over time, affects growth over a period of decades. However, they find no correlation between economic growth and future changes in EF. In other words, higher growth in the present is not correlated with higher levels of EF in the future. Dawson (2002) applies Granger causality testing to individual components of EF and finds that strong property rights and relatively unfettered markets are primary drivers of growth, while other components of EF, such as the size of government and controls on international finance, are more likely the result of growth. (Yet other components, such as those related to monetary and price stability, appear to be jointly determined with growth.) Along with these results, our findings reported in Table 5 support the idea that the institutional environment is an important determinant of economic performance, not merely its consequence.

6. Conclusions

Economists have become increasingly aware that technology, and not resource endowment, is usually the most important driver of economic performance over time. Our analysis shows that cross-country differences in technical efficiency need not be treated as exogenous—indeed, these differences can themselves be explained largely by differences in institutional environments. Countries with legal and regulatory frameworks that promote trade and competition, and relatively stable political systems, tend to be closest to the best-practice frontier.

More generally, our findings for the 1975–90 period complement the modern literature on long-term economic performance. Recent work in economic history argues that the emergence of long-distance trade, and later industrialization, were dependent on political and social institutions. In early societies, agency problems were typically solved through kinship or other close social ties. Greif (1989), for example, shows how eleventh-century Jewish traders in the Mediterranean area enforced codes of conduct by maintaining close social relationships, using the threat of ostracism as a disciplinary device. Later, standardized weights and measures, units of account, media of exchange, and procedures to resolve disputes (such as merchant law courts) supported the expansion of trade by lowering information costs. Capital markets could flourish only in societies where rulers could credibly commit not to expropriate private wealth; North and Weingast (1989) show how capital markets emerged in Britain after the Glorious Revolution of 1688 placed parliamentary limits on the authority of the Crown. The growth of product and factor markets depends similarly on establishing secure property rights. Furthermore, as an economy industrializes, more and more commercial activity involves "transacting": trade, finance, banking, insurance, and management (Wallis and North, 1986). Industrialization requires institutions to mitigate the costs associated with these transactions.

A key to understanding economic development, then, is institutional development. "The central issue of economic history and of economic development is to account for the evolution of political and economic institutions that create an economic environment that induces increasing productivity" (North, 1991, p. 98). In future work we hope to study the evolution of institutions that promote technical efficiency, rather than taking institutions as exogenous as we do in the present paper. We also hope to incorporate measures of financial-market development, though this raises potential endogeneity problems. A further issue concerns the relationship between changes in PC and changes in EF over time. Is the change in one of these variables a necessary precondition to a change in the other? Our sample includes countries that experienced increases in PC without corresponding increases in EF, and failed to enjoy efficiency gains as a result. However, there are no similar examples of countries that experienced an increase in EF without corresponding increases in PC, suggesting that a change in PC tends to precede a change in EF. Further work on the co-movement of these variables over time may provide valuable guidance for economic reform in the developing and post-Communist world.

In short, we are convinced that productivity analysis can benefit from closer study of political and regulatory institutions, and that the new institutional economics can benefit from more explicit theorizing about the channels through which institutional factors affect aggregate economic performance. We look forward to future research that combines these two strands of literature.

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Appendix A: List of Countries

Argentina
Australia
Austria
Belgium
Bolivia
Canada
Chile
Denmark
Finland
France
Germany
Greece
Guatemala
India
Iran
Israel
Italy
Japan
Kenya
Korea
Mauritius
Mexico
Netherlands
New Zealand
Nigeria
Norway
Peru
Philippines
Portugal
Spain
Sweden
Switzerland
Syria
Taiwan
Thailand
Turkey
United Kingdom
United States
Venezuela

Table 1: Summary Statistics

Pooled data from 1975, 1980, 1985, and 1990. $N = 156$.

Variable	Description	Source	Min.	Max.	Mean	Median	St. dev.
RGDP/worker	Real gross domestic product per worker in 1985 international prices	Summers and Heston, 1991	1863	36771	17718	18615	9391
Capital/worker	Capital per worker in 1985 international prices	Summers and Heston, 1991	553	73459	19860	18733	14419
Economic freedom	Degree to which government respects property rights and promotes free trade. Ten represents a high level of economic freedom; zero represents a low level.	Gwartney, Lawson, and Samida, 2000	2.00	7.80	4.84	4.70	1.42
Policy constraints	Ease of changing current policy regime. One represents highly stable government; zero represents highly unstable government.	Henisz, 2000	0.00	0.89	0.52	0.73	0.33
Individual components of economic freedom (from Gwartney, Lawson, and Samida, 2000):							
Inflation	Difference between annual growth of M1 and potential RGDP	Table I-A	−2.90	690.20	30.54	10.80	86.88
Government spending	Government consumption as percent of total consumption	Table II-A	5.60	40.20	15.87	15.55	5.83
SOEs	Role and presence of state-owned enterprises	Table II-B	0	8	4.55	4.00	2.06
Foreign money	Right to own foreign currency domestically	Table I-C	0	10	6.15	10.00	4.88
Foreign capital transactions	Freedom to engage in capital transactions with foreigners	Table IV-D	0	10	3.78	2.00	3.19
Foreign account	Right to own bank account abroad	Table I-D	0	10	4.49	0.00	4.99
Conscription	Use of conscripts to obtain military personnel	Table III-C	0	10	2.55	0.00	4.37
Taxes on IT	Average tax rate on international trade	Table IV-A	0.00	24.19	4.11	2.83	4.48
Trade sector	Actual size of trade sector minus expected size (percent)	Table IV-C	−69.97	116.93	8.00	5.48	33.39
Black-market premium	Difference between official and black-market exchange rates (percent)	Table IV-B	0.00	2197.00	32.04	2.00	184.34

Table 2: Effects of Economic Freedom and Policy Constraints on Technical Efficiency

Maximum-likelihood estimates for stochastic production frontier with inefficiency component. Pooled data from 1975, 1980, 1985, and 1990. $N = 156$. Country- and year-fixed effects not reported. Standard errors given in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Parameter	Variable				
β_0	Constant	2.974^{***}	4.206^{***}	3.357^{***}	3.361^{***}
		(0.5640)	(0.5614)	(0.4436)	(0.1295)
β_1	Capital/worker	0.756^{***}	0.599^{***}	0.712^{***}	0.720^{***}
		(0.0609)	(0.0613)	(0.0484)	(0.0130)
δ_0	Constant	0.790^{***}	0.120^{***}	0.925^{***}	0.887^{***}
		(0.0510)	(0.0460)	(0.0544)	(0.0974)
δ_1	EF	-0.159^{***}	—	-0.198^{***}	-0.150^{***}
		(0.0109)		(0.0154)	(0.0214)
δ_2	PC	—	-0.571^{***}	-0.333^{***}	-0.360^{**}
			(0.0985)	(0.0596)	(0.2160)
δ_3	EF $\cdot$ PC	—	—	—	-0.001
					(0.0446)
σ^2		0.016^{***}	0.034^{***}	0.031^{***}	0.022^{***}
		(0.0011)	(0.0035)	(0.0024)	(0.0011)
γ	Inefficiency indicator	0.999^{***}	0.999^{***}	0.999^{***}	0.999^{***}
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Log-likelihood		177.161	196.202	208.476	191.280

Table 3: The "Asian Tigers" and Selected Benchmarks

Technical efficiency scores and raw data for South Korea, Taiwan, Thailand, and eight other countries in the sample.

Country	Year	RGDP per worker	Capital per worker	Technical efficiency	Change (rank)	EF	Change (rank)	PC	Change (rank)
South Korea	1975	6245	6533	0.742		4.00		0.00	
South Korea	1990	16022	17995	1.000	2.15% (1)	5.10	1.10 (19)	0.48	0.48 (1)
Taiwan	1975	7657	8451	0.849		4.90		0.72	
Taiwan	1990	18409	25722	0.999	1.17% (9)	6.10	1.20 (15)	0.71	−0.01 (35)
Thailand	1975	3371	2385	0.772		4.60		0.28	
Thailand	1990	6754	4912	0.999	1.86% (2)	6.20	1.60 (10)	0.35	0.07 (13)
Chile	1975	9173	6907	0.766		2.80		0.67	
Chile	1990	11854	9543	0.849	0.73% (12)	6.10	3.30 (1)	0.71	0.04 (15)
India	1975	2069	1259	0.747		3.00		0.20	
India	1990	3235	1946	0.926	1.54% (6)	3.70	0.70 (23)	0.45	0.25 (7)
Portugal	1975	10354	7461	0.777		2.40		0.67	
Portugal	1990	16637	11819	0.972	1.61% (4)	4.10	1.70 (9)	0.75	0.08 (12)
Iran	1975	20388	6696	0.996		4.90		0.00	
Iran	1990	11400	15548	0.330	−7.59% (39)	3.20	−1.70 (39)	0.00	0.00 (20)
Nigeria	1975	3067	553	0.993		3.20		0.00	
Nigeria	1990	2082	702	0.615	−3.37% (38)	3.30	0.10 (35)	0.00	0.00 (20)
Syria	1975	14804	9512	0.802		3.90		0.00	
Syria	1990	15871	14994	0.671	−1.26% (34)	3.20	−0.70 (37)	0.00	0.00 (20)
Argentina	1975	16043	9445	0.826		3.10		0.00	
Argentina	1990	13406	11244	0.658	−1.61% (35)	3.40	0.30 (32)	0.41	0.41 (3)
Peru	1975	10486	8710	0.952		3.10		0.00	
Peru	1990	6847	8796	0.667	−2.51% (37)	3.40	0.30 (32)	0.38	0.38 (4)

Table 4: Effects of Individual Components of Economic Freedom

Maximum-likelihood estimates for stochastic production frontier with inefficiency component. Pooled data from 1975, 1980, 1985, and 1990. $N = 156$. Country- and year-fixed effects not reported. Standard errors given in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Parameter	Variable	
β_0	Constant	4.7220*** (0.4980)
β_1	Capital/worker	0.5980*** (0.0540)
δ_0	Constant	0.9796*** (0.1262)
δ_1	PC	-0.3237^{***} (0.0639)
δ_2	Inflation	0.0006*** (0.0001)
δ_3	Government spending	-0.0383^{***} (0.0103)
δ_4	(Government spending) squared	0.0013*** (0.0005)
δ_5	SOEs	-0.0544^{***} (0.0108)
δ_6	Foreign money	-0.0082^{**} (0.0039)
δ_7	Foreign capital transactions	-0.0238^{***} (0.0094)
δ_8	Foreign account	0.0185*** (0.0047)
δ_9	Conscription	0.0082* (0.0052)
δ_{10}	Taxes on IT	0.0032 (0.0037)
δ_{11}	Trade sector	0.0110 (0.0508)
δ_{12}	Black-market premium	0.0002*** (0.0001)
σ^2		0.0073*** (0.0009)
γ	Inefficiency indicator	0.9718*** (0.0407)
Log-likelihood		228.425

Table 5: Endogeneity

Panel A: Regressions of economic freedom and policy constraints on income (RGDP per worker), lagged income, and a constant for the random-effects models. Pooled data from 1975, 1980, 1985, and 1990. $N = 117$. Standard errors given in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Dependent variable:	EF	EF	PC	PC
Constant	3.267870*** (0.359108)	—	0.116441** (0.058716)	—
RGDP/worker	0.000114*** (0.000036)	0.000132*** (0.000040)	0.000021*** (0.000007)	0.000006 (0.000008)
Lagged RGDP/worker	−0.000023 (0.000039)	0.000046 (0.000046)	0.000002 (0.000008)	−0.000001 (0.000009)
Fixed effects?	no	yes	no	yes
$\bar{R}^2$	0.734	0.832	0.783	0.865

Panel B: Regressions of income (RGDP/worker) on economic freedom, policy constraints, their lagged values, and a constant for the random-effects models. Pooled data from 1975, 1980, 1985, and 1990. $N = 117$. Standard errors given in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Dependent variable:	RGDP/worker	RGDP/worker	RGDP/worker	RGDP/worker
Constant	5001.6*** (2077.2)	—	10731.4*** (1422.4)	—
EF	1221.0*** (266.8)	1146.3*** (272.9)	—	—
Lagged EF	1545.4*** (290.3)	1468.0*** (298.0)	—	—
PC	—	—	6268.8*** (1760.4)	1560.6 (1978.0)
Lagged PC	—	—	8228.1*** (1975.4)	−142.4 (2537.5)
Fixed effects?	no	yes	no	yes
$\bar{R}^2$	0.959	0.973	0.858	0.912