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AGRICULTURAL DEVELOPMENT, STATE EFFECTIVENESS AND LONG-RUN ECONOMIC DEVELOPMENT

SHARMISTHA SELF AND RICHARD GRABOWSKI*

Missouri State University and Southern Illinois University

This paper begins with the presumption that rapid economic development requires an effective state. An effective state is able to act independently of powerful interest groups with the aim of allocating resources so as to maximize long-term economic growth. It will be argued that such states are more likely to arise in situations within which the state must earn its income. That is, it must construct an institutional apparatus to extract the revenue that it needs and it is dependent upon the bulk of its agricultural producers to produce this revenue. The higher agricultural productivity within a region, the more dependent the state will be on revenues from the bulk of its agricultural producers. This dependency will lead, through a dialectical process, to a state whose activities will be constrained, a state which will be able to effectively commit itself to long-run development. This proposition is tested using time series/cross-sectional data for a sample of diverse countries from the 1960's through 1990's.

Keywords: Agricultural Productivity, State Effectiveness, Institutional Quality
JEL classification: O10, O13, O17

1. INTRODUCTION

Agriculture's role in the overall process of economic development has been a much discussed topic. In closed models of economic development agriculture is seen as providing certain necessary things for the expansion of the modern industrial sector; food, savings, etc. From an open economy perspective the role of agriculture is much more ambiguous. In an open setting many of the necessary things discussed above can be brought in from the outside through foreign investment, imports, etc. Thus agriculture's role is much more ambiguous. It will be argued in this paper that agriculture's role in the process of economic development is much more subtle than has previously been perceived in the literature. Specifically, there is a link between agriculture and institutional

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effectiveness, especially the institutional effectiveness of the state.

There is now a consensus that an effective state is essential to long-run economic development and growth. Developmental state theorists and neoclassical economists may differ about what the state should do and how it should do it, but they both agree that an institutionally effective state is crucial. The real question, the most important question, concerns how effective state institutions can be established. Institutions are important, but how are effective ones established? There is a limited literature on this that emphasizes the role of geography, openness, and inequality (the existence of a sizeable middle class). This paper proposes that broadly based rural development, in particular broadly based agricultural productivity, plays a key role in the development of the institutional effectiveness of the state. The argument in its simplest form is as follows. All states and their ruling elites face a commitment problem. That is, a state powerful and independent enough to establish property rights, etc. is also a state powerful enough to take them away. The question is how can a state's behavior be constrained so as to solve the commitment problem?

This paper hypothesizes that the answer lies in states and their ruling elite having the power to raise revenue in order to do the things necessary to survive politically. Thus, a state that is significantly dependent on a productive agricultural sector for its revenue will become involved in a political process by which an agreement evolves as to how much revenue can be extracted and what mechanisms are acceptable. This is a process fraught with conflict, but eventually resulting in an institutional and social compact that solves the state's commitment problem.

Alternatively, a state and ruling elite dependent on an agricultural sector that is subsistence oriented, with low productivity, will have to look elsewhere for the revenues necessary to survive. These other sources may stem from the taxing of trade, the extraction of revenues from mineral or illegal drug production, and/or the extraction of revenue from a small rural elite among other sources. In this context the political process is likely to unfold in a way that fails to solve the commitment problem or solves it for only a small subset of the population.

This hypothesis will be tested empirically in this paper. In order to measure state effectiveness, a number of different measures of institutional quality are used as dependent variables (the data spans the late 1980s and 1990s). The primary independent variable needs to be a measure of agricultural structure and productivity. In order to avoid problems in interpretation and estimation from concerns relating to whether institutional quality affects agricultural productivity or whether agricultural productivity has an impact on institutional quality or both, the variable measuring agricultural productivity relates to 1965. A number of additional control variables are also used to test for the robustness of the results. A longer run test of the hypothesis is also conducted using a measure for agricultural potential (biological/geographical characteristics) in existence prior to organized human society as the independent variable in place of the measure of agricultural productivity.

The outline of the paper is as follows. Section two of the paper will review the

literature on the role of the state in economic development and on those factors that are influential in determining institutional quality. Section three will discuss the conventional views of the role of agriculture in the development process. In addition, the notion that agriculture's role may be more subtle and yet more powerful is developed. Section four will discuss the empirical methodology and the data used and present the results. Finally, section five will summarize the paper.

2. PREVIOUS LITERATURE

The state's role in economic development is characterized by what Weingast (1995) has called "the commitment problem". That is, a state which is strong enough to protect property rights is a state that is strong enough to take them away at a moments notice. A state that promises investors that it will not confiscate their profits has every incentive to do so once the investment is made and the profits are generated. Investors recognize this and thus are unwilling to make the investment. Thus economic development would seem to be dependent upon whether or not the state can commit itself to productive development policies and eschew the temptation to cheat and confiscate.

In this paper it will be argued that political development is a process by which the state gains the ability to credibly commit to development policies, whether these policies are providing environments conducive to investment or governing the market so as to quickly move up the technological ladder. Political development involves the development of institutions, both formal and informal, that constrain or direct the state to pursue productivity enhancing rather than productivity reducing policies. Economists now recognize the fact that institutions are a key factor in long-run growth and development.

This perspective is bolstered with a large amount of empirical research concerning the role of institutions in economic growth and development. Almost all of these studies use measures of institutional quality which are linked either directly or indirectly with the quality of the state. In other words, they are measures of the extent to which rules, directly or indirectly, influence the productiveness of state decision-making. Many of these empirical studies are cross-country analyses that focus on indicators reflecting perceptions of how well governments protect property rights, bureaucratic quality, the power of the rule of law, and the level of corruption (Knack and Keefer (1995), Mauro (1995)). These studies and many others seem to find a strong relationship between institutional quality and economic growth (as measured by GDP growth).

However, these early studies only identify an association between institutional quality and economic performance, not really touching on the issue of causality between these variables. Hall and Jones (1999) also use institutional quality as one component of their institutional social infrastructure variable and use distance from the equator as an instrument. The reasoning is that Western Europe has historically been identified with good institutions and thus latitude serves as a good instrument. They also used percent of the population speaking a European language as another instrument. They find a strong

causal connection between institutional quality and economic growth. Acemoglu, Johnson, and Robinson (2001) develop another creative way to test for causality from institutional (governmental) quality to economic growth using concepts of good institutions, extractive institutions and settler mortality rates.[1] Engerman and Sokoloff (1997) and Sokoloff and Engerman (2000) use, in an informal way, types of crops as an instrument for good institutions (government).[2] These institutional structures persisted over long periods of time and thus explain the different development trajectories followed by these different regions.

Most of the above discussion relates to determining whether institutional quality is causal with respect to growth. However, if true, as it seems, the next question concerns the source of these institutions. Specifically, how is a quality institutional structure established? This issue is not clearly developed theoretically or empirically. Easterly and Levine (2003) provide some insight as to variables or factors which influence the quality of institutions, with the latter mainly representing measurements of the quality of state decision making. They use settler mortality, latitude, the dependence of the particular economy on highly concentrated crops and minerals, origin of legal institutions, religious composition, and ethnic diversity. They find that settler mortality, latitude, and crops/minerals variables are always strongly related to institutional quality, the first negatively, the second positively, and the third negatively.

Islam and Montenegro (2002) have also empirically analyzed the determinants of institutional quality and have included measures of openness in trade. They find that measures of openness in trade are significantly and consistently correlated with measures of institutional quality (such as rule of law, corruption, and government effectiveness measures). They find little evidence that ethnic diversity has a negative influence on institutional quality. Neither do they find any negative relationship between inequality

[1] They argue that Europeans adopted two basic strategies in the colonization process. Certain colonies were actually settled by Europeans and they brought "good institutions with them". Other colonies were not characterized by significant European settlement, with extractive institutions being the result. The second part of the analysis presumes that the type of colonization strategy chosen was dependent on settler mortality rates. Those areas where such rates were low, better institutions were established while in those regions where these rates were high were those regions characterized by bad (extractive) institutions. Finally, it is assumed that institutional structures persist through time. There is indeed a strong relationship between economic development and settlement patterns which in turn supports the notion of the importance of good institutions in economic growth.

[2] According to these papers, Latin American endowments were such as to lead to the production of crops characterized by economies of scale (plantation production). In these cases landownership was highly unequal and the distribution of power was very unequal. Alternatively, North American endowments led to the production of crops on small, family farms leading to the development of a large middle class. In the former situation, institutions inimical to long-run growth developed whereas in the latter better institutions promoted development.

and institutional effectiveness.

The theoretical literature on what factors influence institutional quality is even less well developed than the empirical literature discussed above. However, there has been some work on this issue. Easterly (2001) has argued that highly polarized and conflicted societies are less likely to develop an effective institutional structure. Thus the development of consensus, in particular a middle class consensus, is found to be a key factor. In addition to this idea, there is a large literature that argues that societies that are highly dependent on natural resource rents are also unlikely to develop an effective structure for institutional quality.

Economists have, in the past, argued that the discovery of natural resource rent sources often pose a threat to an economy's well-being. Specifically, the term "Dutch Disease" refers to the situation in which rents from natural resources drive an appreciation of a country's exchange which renders the manufacturing sector less competitive, resulting in de-industrialization. In particular, this argument has been applied to countries that have experienced an oil boom.

There is a political version of the above analysis that argues that nations that are heavily dependent upon natural resources in terms of generating revenue are also more likely to be subject to violence and civil war, a general situation in which defective institutional structures persist. There are two mechanisms by which this process is thought to work. The first is the looting mechanism developed in the work of Collier (1998).[3] The second mechanism is that conflicts over the distribution of rents often lead to civil war. There is some empirical evidence to support these ideas. The work of Collier (1998) and Collier Hoeffler (2000) indicates that controlling for income per capita, ethnic fragmentation, and income inequality, dependence on oil and/or minerals dramatically increases the likelihood of civil war.

This literature, it will be argued below, ignores the role of agriculture in influencing the quality of institutions. Thus the next section of the paper expands the analysis by examining how productivity in agriculture would influence political development.

3. METHODOLOGY

The role of agriculture in economic development may be more subtle and sophisticated than what has previously been thought. Specifically, there may be a causal relationship running from broad based agricultural growth to the development of an effective institutional structure. The causal relationship, in all probability is likely to run both ways, agricultural development to institutional quality and institutional quality to

[3] Rebel organizations are likely to find a ready source of revenue that can be used to fund violent activities if they can control regions where natural resources are located. Looting and the extortion of funds from manufacturing firms is less likely since such firms are more mobile.

agricultural development. However, this paper will concentrate on the former rather than the latter.

Moore (1998, 2001) provides some help in clearly thinking about this issue. He argues that political and institutional development is a dialectical process whose characteristics are influenced by how the state raises its revenue. More specifically, he argues that one should make a distinction between earned and unearned state income. States earn their income if they have to work closely with their citizens in order to generate revenue. The effort that Moore is talking about is of two types. The first is organizational effort and by that he means the extent to which the state has to construct a bureaucratic apparatus for the collection of revenue and the proportion of its citizens that are reached in these revenue collection activities. The second aspect involves the extent of reciprocity between citizens and the state. That is, the extent to which there is the provision of services in return for revenue. Alternatively, unearned income derives from a few sources, requires little organizational and political effort to collect, and involves little interaction between the state (ruling elite) and the mass of citizens.[4]

This distinction is important because it tells something about the political development process. States (ruling elite) that rely upon earned income are more likely to become politically and institutionally developed, able to solve the commitment problem. This occurs as a result of the struggle between the ruling elite and the bulk of society over taxation and revenue. The elite, because they are dependent upon the bulk of their society, have an interest in the prosperity of their society while the bulk of society have a common interest in constraining the states behavior. However, the ruling elite must learn to behave in ways which are viewed as legitimate by the bulk of its citizens.

There is a learning process involved for the ruling elite. Initially, they are likely to be tempted to extract as much revenue as possible by promising to provide an appropriate investment atmosphere and then confiscating the profits of any investments made, utilizing a patron-client form of politics to remain in power. However, resistance to confiscation and excessive taxation within the society is likely to act as a punishment mechanism aimed at curbing such “cheating” upon the part of the ruling elite. This resistance may be direct and active or it may be indirect. The latter occurs as producers hide output, understate income, reduce market trading, etc. It is out of this struggle that constraints to cheating behavior become binding. The state learns that its revenue suffers when commitments are broken and rises when they are kept. Because the ruling elite are dependent upon the bulk of society for its revenue, through this conflicting, dialectical process it learns to foster the wealth of the bulk of its citizens.

Contrast this process with one in which the government or ruling elite rely mainly on unearned income. In this context the revenue supporting the ruling elite comes from

[4] The most extreme examples of sources of unearned income are mineral revenues (oil) and foreign aid. However, a broader view would include timber, diamonds, narcotics, and certain types of primary commodity exports (coffee, cotton, sugar, etc.).

outside (say foreign aid) or from a small segment of society (oil production). The fact that the elite are relatively autonomous from their populations implies that they are unlikely to have much interest in the economic needs and capabilities of the bulk of the population. There is likely to be little interaction between the state and its citizens with the latter incapable of articulating issues of concern. In addition, the state would have little interest in creating and developing an effective civil service bureaucracy.

In utilizing this approach, one must consider that for most developing countries agricultural production is likely to be the main potential source of earned income, at least initially. This is due to the fact that much of the population is employed in agriculture and a large share of GDP originates from this sector. If a ruling elite is to extract revenue from agriculture it would most certainly have to create a bureaucratic structure to penetrate the countryside. In addition, in order to successfully extract revenue from the countryside services will likely have to be provided in return such as transportation, roads, credit, etc. Thus the agricultural sector would likely be the source of earned income for most developing countries.

The extent to which agriculture can serve as a source of income is certainly dependent on its productivity. Thus one would expect that highly productive agriculture sectors are more likely to provide the ruling elite with opportunities to earn their income. Attempts to extract such revenue will, according to Moore's analysis, result in political development. In order to maintain its revenue flow, the state will have to create an institutional infrastructure that both enhances future productivity growth while at the same time providing an effective and efficient mechanism for extracting revenue.

Alternatively, those countries characterized by an agricultural sector with low productivity will have little incentive to earn their revenue or income. Instead, the incentive is likely to be to behave in a predatory fashion. These countries are likely to have primary product export sectors earning revenue from foreign sales. Thus taxing this trade is likely to represent the main source of revenue. As a result, there is no incentive to foster productivity growth for the bulk of the subsistence oriented farmers. Political and institutional development is not likely to occur.

The main hypothesis to be tested then concerns the relationship between agricultural productivity and political and social development. Specifically, higher agricultural productivity provides sources of earned income for the ruling elite and the process of earning that income is likely to result in improvements in institutional quality. Alternatively, those nations in which agricultural productivity is low are likely to be situations in which the ruling elite are dependent on unearned income and, as a result, little improvement in institutional quality is likely to occur.

One must, of course, recognize that while high agricultural productivity is hypothesized to lead to improvement in institutional quality, it is also very likely that the reverse also holds. That is, improvements in institutional quality will result in increases in agricultural productivity. Thus care must be taken in specifying the empirical model such that only the causal influence from agricultural productivity to institutional quality is measured. This is done in three ways. First, measures of the productivity in agriculture are

developed for the 1960s while the measures of institutional quality are taken from the 1990s. The argument here is that in this context it is possible for agricultural productivity in the 1960s to have a causal impact on institutional quality in the 1990s, but it is not possible for institutional quality in the 1990s to influence agricultural productivity in the 1960s. Thus any significant statistical relationship between agricultural productivity and institutional quality likely runs from the former to the latter. The second approach to determining the direction of causality is to make use of an instrumental variables approach in the analysis. Finally, to ensure that any reverse causal influence from institutional quality to agricultural productivity is excluded, measures of bioconditions which reflect agricultural potential are also used as an independent variable. These are truly exogenous biological conditions that could not possibly have been influenced by institutional quality.

4. EMPIRICAL RESULTS

In order to test the hypothesis presented above, data on institutional quality is utilized. Indicators of institutional quality are drawn from the International Country Risk Guide (ICRG) and include: repudiation of contracts by the government (*REPGOV*), bureaucratic quality (*BQLTY*), rule of law (*RLAW*), expropriation risk (*EXPRSK*), and corruption (*CORR*). Expropriation risk, rule of law, and repudiation of contracts by the government are interpreted on measures of security of property rights and contracts. The higher the score (ranging from 0 to 10), the more protective of property rights the state is. Corruption in government and quality of bureaucracy are taken as measures for the general efficiency with which government services are provided. The higher the score the more efficiently government services are provided. The scores for each of these variables cover the period from the 1980s to the late 1990s. The values for the 1990s were averaged for each country for each of the five indicators. Thus there are five different measures of institutional quality used as dependent variables for each country.[5]

In order to test the hypothesis outlined in the previous section some measure of agricultural productivity at the beginning of the postwar period is needed. Agricultural productivity data might be used, but that is also not readily available. In its place a measure of the degree of usage of modern inputs was used, specifically, the intensity of

[5] Additionally, aggregate variables of institutional quality such as the one used by Hall and Jones (1999), Bockstatte, Chanda, and Putterman (2002) and Olsson and Hibbs (forthcoming) were also estimated and results were very similar to the ones presented with the individual institutional quality measures. These results are available upon request. Moreover, a quantitative measure of institutional quality is constructed by considering the average tax paid as a percentage of GDP, which is the state's income. Regressions similar to the once presented here are conducted using the average tax measure as a dependent variable and the results remain unchanged in terms of interpretational significance. These are available upon request.

the use of fertilizer as measured by kilograms per hectare (*LFERT*(*65*)). The year for which the data is utilized is 1965 and the data is taken from the FAO. It is hypothesized that an increase in the intensity of fertilizer use in 1965 indicates a more broadly modernized agriculture sector and this will have a positive causal effect on institutional quality in the 1990s. One can alternatively assume the fertilizer measure signaling the importance of improving agricultural productivity for the country. In other words, it is a measure of initial *effort* made by a country to maintain and improve the agriculture sector which, in turn, would lead to better institutional quality in the future.

A possible criticism of the agricultural productivity measure being used in this paper could be that while it is acceptable to both Latin America and Africa, where the proportion of agriculture out of the economy is very high, it may be a poor proxy variable in both Western Europe and East Asia. In order to address this issue a second measure of agricultural productivity was also utilized. It represents a much broader measure of technology (*MODERNIZATION*). Specifically, it is an interaction term in which fertilizer intensity is multiplied by tractor intensity (1965) which is in turn multiplied by secondary education enrollment rates (1960). The tractor intensity variable is taken from the FAO while secondary enrollments come from Bockstatte, Chanda, and Putterman (2002). The correlation between *LFERT(65)* and *MODERNIZATION* is statistically significant and high (0.78). This broader measure of agricultural productivity is likely to be as relevant for East Asia and Europe as well as for other regions of the world.

In addition to the above, a number of other control variables were also added. One is the average growth rate of GDP per capita from 1960 to 1980 (*GR6080*) which is included because some scholars have argued that rapidly growing countries are better able to afford better quality institutions. In addition, since a more educated population may be better able to construct good quality institutions, the secondary school enrollment rate for 1960 is included (*SCHOOL*(*60*)) in the estimation using fertilizer intensity. However, this variable is not used when the broader measure of technology (*MODERNIZATION*) is used. Since some theoretical work indicates that ethnically divided societies are less likely to construct effective states, an ethnolinguistic fractionalization (*ELF*(*60*)), originally computed by Taylor and Hudson (1972) for 1960 is added. Previous theoretical work also indicates that the degree of openness of a nation may influence the quality of its institutions. To measure this, the instrumental variable constructed by Frankel and Roemer (1996) is utilized. It is the (log) predicted trade share of an economy, based on a gravity model of international trade that only uses a country's population and geographical features (*LOGFRANKROM*). Also a series of regional dummy variables were added (East Asia-Pacific (*EAP*), Latin America-Carribbean (*LAC*), Sub-Saharan Africa (*SSA*), South Asia (*SA*), Western Europe (*WE*), Middle East-North Africa (*MEN*)).[6]

[6] We wish to thank Valerie Bockstatte, Areendam Chanda, and Louis Putterman for making much of this data

In addition to the above variables, a measure of state antiquity constructed by Bockstatte, Chanda, and Putterman (2002) is included as a control variable (*STATEHIST*). In the paper the authors find the state antiquity variable to be statistically significant in explaining average long-run economic growth in a cross-section of countries.[7] In this paper the question will be to test to what extent state antiquity can explain the quality of institutions in the 1990s. The relationship between the quality of institutions and agricultural technology is the main focus of this paper. In order to test this relationship multivariate regression analysis is utilized incorporating these two variables and the control variables discussed above. The model can be written as

$$\begin{aligned} &INSTITUTIONAL\ \ QUALITY\ (\text{five measures}) \\ &= a_0 + a_1 LFERT(65) + a_2 ELF(60) + a_3 GR6080 + a_4 STATEHIST \\ &+ a_5 SCHOOL(60) + a_6 LOGFRANKROM + a_7 EAP + a_8 LAC \\ &+ a_9 SSA + a_{10} SA + a_{11} WE + a_{12} MEN + \varepsilon, \end{aligned} \tag{1}$$

where *STATEHIST* is the measure of state antiquity, *SCHOOL*(*60*) is the secondary school enrollment rate in 1960, *LOGFRANKROM* is the log of the Frankel and Roemer openness variable, *EAP* is a dummy variable for Latin America and the Caribbean, *SSA* a dummy variable for Sub-Saharan Africa, *WE* a dummy variable for Western Europe, and *MEN* a dummy variable for the Middle East and North Africa. As mentioned earlier the equation is also estimated using the alternative and broader measure of agricultural productivity, *MODERNIZATION*.

A number of interesting things can be seen. Most importantly, the measure of agrarian structure in 1965 has a statistically significant influence on four of the five measures of institutional quality and the signs are positive. This implies that productive agrarian structures in 1965 are related to effective institutions in the 1990s.

Other than the significant and positive impact of agricultural productivity in 1965, according to the results, secondary enrollment rates in 1960 had a significant positive effect on all five measures of institutional quality in the 1990s. The average growth of GDP per capita from1960 to 1980 would seem to also be positively related to the quality of institutions in the 1990s, at least for four of the measures of quality. Finally, of all the dummy variables utilized, that for Latin America consistently seems to have a negative effect on institutional quality. The Middle Eastern variable is significantly negative for

available to us.

[7] Bockstatte, Chanda, and Putterman (2002) argue that the older the state is the more likely that it will have developed an effective institutional structure and thus the more capable it would be of carrying out a long-run growth process. In order to test this proposition the authors develop a measure of state antiquity which is an index based upon the extent to which a non-tribal government existed, whether it was locally based or foreign, and the extent to which the territory of the modern country was ruled by this government.

three of the measures and the Sub-Saharan dummy for one measure.

Table 1. Empirical Result

dependent variable →	*REPGOV*	*BQLTY*	*RLAW*	*EXPRSK*	*CORR*
LFERT(65)	0.26	0.22	0.09	0.23	0.21
	(2.75)***	(2.73)***	(1.34)	(3.19)***	(2.75)***
ELF(60)	-0.25	-0.85	-0.93	-0.42	-0.81
	(-0.37)	(-1.77)*	(-1.96)	(-0.82)	(-1.83)*
GR6080	0.77	0.59	0.84	1.05	0.05
	(1.98)*	(1.92)*	(2.43)**	(2.98)***	(0.14)
STATEHIST	0.33	-0.60	-0.49	-0.53	-0.09
	(0.49)	(-0.85)	(-0.69)	(-0.83)	(-0.15)
SCHOOL(60)	0.18	0.17	0.20	0.14	0.20
	(2.67)***	(2.62)***	(3.04)***	(2.19)***	(3.26)***
EAP	0.09	-0.52	-0.67	-0.51	-0.59
	(0.18)	(-1.02)	(-1.31)	(-1.19)	(-0.95)
LAC	-1.10	-1.82	-1.66	-1.71	-1.24
	(-2.25)**	(-4.45)***	(-3.44)***	(-4.34)***	(-2.19)**
SSF	-0.91	-0.37	-0.65	-1.00	0.19
	(-1.50)	(-0.67)	(-1.21)	(-2.03)**	(0.30)
SA	-0.94	-0.44	-1.43	-0.77	-0.79
	(-1.61)	(-0.79)	(-2.02)**	(-1.09)	(-1.26)
WE	0.64	0.32	0.11	0.27	-0.10
	(1.09)	(0.58)	(0.17)	(0.48)	(-0.16)
MEN	-0.69	-1.08	-1.38	-1.18	-0.65
	(-1.27)	(-2.29)**	(-2.39)**	(-2.25)	(-0.97)
LOGFRANKROM	-0.29	-0.35	-0.11	-0.26	-0.01
	(-1.68)*	(-1.86)*	(-0.56)	(-1.36)	(-0.04)
Observations	80	80	80	80	80
R^2	0.79	0.75	0.72	0.77	0.70

Note: Numbers in parentheses are t-statistics with *** significance at 1%, ** at 5%, and * at 10%; all estimations include a constant term not reported here.

The equations were re-estimated utilizing the broader measure of agricultural productivity (*MODERNIZATION*). The results for all five measures of institutional quality are presented in Table 2. As can be seen, the modernization variable has a significant positive effect for all five measures. Moreover, as expected, the results using *MODERNIZATION* instead of *LFERT*(*65*) find some differences in terms of the impact of the regional dummies. In Table 2 it can be seen that along with Latin America and Sub-Saharan Africa, there are additionally several instances of a statistically significant

negative impact of South Asia (in three cases), East Asia pacific (one case), Western Europe (one case, positive) and the Middle East and North Africa (two cases).

Table 2. Using *MODERNIZATION* to Measure Agricultural Productivity

dependent variable →	*CORR*	*BQLTY*	*REPGOV*	*EXPRSK*	*RLAW*
MODERNIZATION	0.14	0.15	0.18	0.13	0.09
	(3.78)***	(4.02)***	(4.87)***	(4.85)***	(2.85)***
ELF(60)	-0.69	-0.72	-0.04	-0.36	-0.9
	(1.27)	(1.41)	(0.06)	(0.65)**	(1.64)
GR6080	-0.04	0.55	0.72	0.99	0.78
	(0.09)	(1.52)	(1.48)	(2.18)**	(1.67)
STATEHIST	-0.39	-0.95	-0.005	-0.83	-0.93
	(0.54)	(1.24)	(0.006)	(1.19)	(1.09)
EAP	-1.02	-0.94	-0.37	-0.86	-1.05
	(1.25)	(1.46)	(0.65)	(1.7)*	(1.53)
LAC	-1.44	-1.9	-1.09	-1.76	-2.03
	(1.85)*	(3.61)***	(1.89)*	(3.77)***	(3.04)***
SSF	-0.54	-0.89	-1.39	-1.49	-1.45
	(0.26)	(1.41)	(2.12)**	(2.72)**	(2.09)**
SA	-1.37	-0.84	-1.33	-1.07	-2.06
	(1.72)*	(1.41)	(2.27)**	(1.57)	(2.75)***
WE	0.45	0.88	1.29	0.85	0.49
	(0.52)	(1.3)	(1.83)*	(1.3)	(0.59)
MEN	-0.67	-1.01	-0.53	-1.08	-1.54
	(0.77)	(1.68)	(0.82)	(1.85)*	(1.99)**
LOGFRANKROM	-0.07	-0.39	-0.33	-0.28	-0.2
	(0.4)	(2.26)**	(1.95)**	(1.47)	(1.11)
Observations	77	77	77	77	77
R^2	0.58	0.71	0.75	0.72	0.65

Note: Numbers in parentheses are t-statistics with *** significance at 1%, ** at 5%, and * at 10%; all estimations include a constant term not reported here.

To further test the robustness of the fertilizer intensity variable as a predictor of institutional quality, it is included as an additional instrumental variable in the Hall and Jones (1999) estimation using social infrastructure (*SOCINF*) as the dependent variable. *SOCINF* is an aggregate variable which is constructed using a weighted average of the five different aspects of institutional quality measures. In Bockstatte, Chandra, and Putterman (2002), the *STATEHIST* variable is included in a similar specification to show the importance of the state antiquity variable as a possible instrument for the Hall and

Jones (1999) estimation of social infrastructure. The results show that *LFERT*(*65*) is also a strong candidate as an instrument for social infrastructure as presented in Hall and Jones (1999). The analysis was re-estimated utilizing the broader measure of agricultural productivity (*MODERNIZATION*). The results presented in Table 3 indicate that the *MODERNIZATION* variable is still statistically significant.

Table 3. A Comparison with H/J and B/C/P

	H/J	Including *STATEHIST*	Including *LFERT(65)*	Including *MODERNIZATION*
ENGFRAC	0.009	0.03	0.001	-0.03
	(0.13)	(0.66)	(0.05)	(0.61)
EURFRAC	0.07	0.1	0.05	0.11
	(1.3)	(2.4)**	(1.22)	(2.68)**
LOGFRANKROM	0.08	0.11	0.07	0.09
	(2.4)***	(3.44)***	(2.74)***	(3.28)***
LATITUDE	0.72	0.29	0.09	0.06
	(5.82)***	(1.6)	(0.53)	(0.35)
STATEHIST		0.49	0.39	0.43
		(4.41)***	(3.53)***	(3.19)***
LFERT(65)			0.04	
			(3.56)***	
MODERNIZATION				0.02
				(3.06)***
Observations	76	76	76	67
R square	0.42	0.58	0.66	0.66

Notes: Numbers in parentheses are t-statistics with *** significance at 1%, ** at 5%, and * at 10%; All data except STATEHIST and LFERT(65) come from Hall and Jones (1999); SATEHIST comes from B/C/P (2002). ENGFRAC is fraction of a country's population speaking English; EURFRAC is the fraction of a country's population speaking one of western Europe's five main languages, LATITUDE is the distance from the equator in absolute degrees.

In order to eliminate any questions one might have towards the exogeneity of the relationship between the institutional quality and the measure of agricultural productivity some measure of agricultural potential which is truly exogenous is necessary. The work of Olsson and Hibbs (forthcoming) provides just such a measure of agricultural potential, a bio-conditions measure. It is composed of two variables. The first is called *plants* and measures the number of annual or perennial wild grasses with a kernel weight exceeding 10 mg that is known to have existed in prehistory. The variable *animals* is the number of domesticable mammals weighing more than 45 kg that is known to have existed in

prehistory. The bio-conditions measure is the first principal component of these variables. This variable is available for most of the countries in the cross-sectional sample used in the above analysis.

The prehistory bio-conditions variable is used here as a measure of the potential for agrarian productivity growth, a potential to develop an agrarian structure supportive of institutional development. It is truly exogenous since these conditions existed prior to the development of human institutions, or social structure. The difficulty with using this variable is that most of the other explanatory (right-hand side) variables are likely to be highly correlated. For example, the measure of state antiquity is likely to be strongly related to agrarian potential. In fact, most of the right-hand variables used previously would be highly correlated with the bio-conditions variable. Thus the control variables used in previous estimations will be excluded. Given the above, the model can be written as

$$\begin{aligned} &INSTITUTIONAL\ \ QUALITY\ (\text{five measures}) \\ &\qquad = b_0 + b_1 BIOCOND + b_2 ELF(60) + \varepsilon, \end{aligned} \tag{2}$$

where *BIOCOND* represents the bio-condition variable and *ELF*(*60*) is the ethnolinguistic fragmentation variable. The results of this analysis are presented in Table 4.

Table 4. Regression Results Using Bio-Condition and Ethnicity

dependent variable ↓	BIOCOND	ELF(60)	Observations	R^2
Rule of Law	0.64	-1.11	74	0.36
	(3.62)***	(2.21)**		
Bureaucratic Quality	0.76	-0.73	74	0.34
	(4.37)***	(1.25)		
Expropriation Risk	0.81	-1.01	74	0.39
	(4.28)***	(1.72)*		
Repudiation of Contents	0.94	-1.48	74	0.42
	(4.24)***	(2.04)**		
Corruption	0.55	-0.91	74	0.29
	(3.17)***	(1.66)*		

Note: Numbers in parentheses are t-statistics with *** significance at 1%, ** at 5%, and * at 10%; all estimations include a constant term not reported here.

As can be seen, the bio-conditions variable has a significant positive influence on institutional quality in the 1990s. It is truly exogenous in this specification of the model. This is further support for the notion that the agricultural sector and its structure have an important positive influence on the quality of institutions and the effectiveness of the state. The multivariate regressions results presented above make a strong case for considering

initial agricultural productivity as having a significant and positive impact on future institutional quality of a country. In order to further test for a causal relationship between agricultural productivity and institutional quality the next table presents the results of using an instrumental variable (IV) analysis. The instruments used are taken from Olsson and Hibbs (2005) and relate to key geographic and bio-geographic variables. These are major axis of continent, climate, number of animal and plant candidates for domestication, distance from equator, and schooling in 1960. The animal and plant candidates for domestication, distance from the equator, and schooling in 1960 variables have all been discussed above. The major axis of continent variable seeks to provide a rough measure of the East-West orientation of a major landmass, believed to be a major determinant of the ease of transmitting agricultural innovation. It is obtained by dividing a continent's distance in longitudinal degrees between its eastern and western most points by its north-south distance in latitudinal degrees. The climate variable classifies climate into four types with the number three denoting the best climate for agriculture and zero denoting the worst. All these variables are satisfactory candidates as instruments because all of these variables can be related to the agriculture sector and its productivity, but cannot be related to the institutional quality variables in the 1990's. The control variables between the OLS and IV estimates are left unchanged except for the regional dummies, which are excluded from the IV analyses.

Table 5. Instrumental Variables Estimates

dependent variable →	*BQLTY*	*CORR*	*EXPRSK*	*REPGOV*	*RLAW*
LFERT(65)	0.52	0.55	0.46	0.59	0.55
	(1.8)*	(3.98)***	(1.92)*	(2.18)**	(1.78)*
ELF(60)	0.17	0.22	-0.5	-0.93	0.61
	(0.7)	(0.27)	(-0.27)	(-0.43)	(0.23)
GR6080	-1.3	-0.54	0.47	1.82	-2.27
	(-0.47)	(-1.46)	(0.22)	(0.81)	(-0.71)
STATEHIST	2.83	0.51	1.84	0.96	2.91
	(1.25)	(0.63)	(1.1)	(0.51)	(1.18)
LOGFRANKROM	-0.25	0.36	-0.14	-0.14	0.18
	(-0.55)	(1.03)	(-0.33)	(-0.29)	(0.25)
Observations	68	68	68	68	68

Note: Numbers in parentheses are t-statistics with *** significance at 1%, ** at 5%, and * at 10%; all estimations include a constant tern not reported here.

The results make it very clear that the agriculture sector and its productivity in 1965 did not just have a positive impact on institutional quality and state effectiveness in the 1990's, but that it was actually a causal force for a better institutional quality. The IV

estimates were also carried out for the aggregate measures of institutional quality and the results remained unchanged indicating the robustness of the above results.

Finally, the IV analysis was repeated utilizing the *MODERNIZATION* variable. The results in Table 6 indicate that this broader measure of agricultural productivity has a statistically significant positive causal effect on four of the five measures of institutional quality.

Table 6. Instrumental Variables Estimates

dependent variable →	*BQLTY*	*CORR*	*EXPRSK*	*REPGOV*	*RLAW*
MODERNIZATION	0.26	0.34	0.24	0.31	0.29
t stats	(1.9)**	(2.2)**	(1.9)**	(2.33)**	(1.55)
ELF(60)	0.52	1.64	-0.15	-0.79	1.22
t stats	(1.18)	(0.55)	(0.06)	(0.32)	(0.33)
GR6080	-2.95	-4.31	-1.44	-0.45	-4.45
t stats	(0.79)	(1.07)	(0.43)	(0.15)	(0.86)
STATEHIST	3.76	2.71	2.91	2.05	4.14
t stats	(1.34)	(0.92)	(1.2)	(0.87)	(1.15)
LOGFRANKROM	0.53	1.27	0.48	0.59	0.98
t stats	(0.91)	(1.84)*	(0.81)	(0.87)	(1.15)
Observations	65	65	65	65	65

Note: Numbers in parentheses are t-statistics with *** significance at 1%, ** at 5%, and * at 10%; all estimations include a constant tern not reported here.

5. CONCLUSION

The theoretical analysis of this paper proposed that a state and its ruling elite which is dependent on unearned income for its survival is unlikely to develop politically. That is, such a state will be unlikely to solve Weingast's political commitment problem. This is due to the fact that in this type of situation the ruling elite are autonomous to society and are thus likely to act as predators. Alternatively, a state that must earn its income through dependence upon society is more likely to develop politically, solve Weingast's political commitment problem.

It was hypothesized that agriculture, for most developing nations, is likely to be a significant source of earned income. Thus if agricultural productivity is high, large sources of earned income exist, and political and social development is more likely to occur. Alternatively, if agricultural productivity is low, few sources of earned income will exist and it is unlikely that political and institutional improvement will occur.

The above hypothesis was tested three ways. First, agricultural productivity in the 1960s was used as the independent variable and various measures of institutional quality in the 1990s as the dependent variable in various regression analyses. Second, biological conditions

conducive to high agricultural productivity were used as the independent variable with various measures of institutional quality as the dependent variable. Finally, instruments for agricultural productivity were utilized for regressions with institutional quality as the dependent variable. All of the results strongly support the conclusion that agricultural productivity has a significant positive influence on the quality of institutions.

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Mailing Address: Sharmistha Self; Department of Economics Missouri State University Springfield, Missouri 65804.
Richard Grabowski; Department of Economics Southern Illinois University Carbondale, IL 62901. E-mail: ricardo@siu.edu

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