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"Everybody knows now that the 'hardware' dimension of development--the physical infrastructure, for example--is a lot easier to put in place than the 'software' to keep it operable, which depends on local skills and institutions." -- UNDP 1993, pp. 59-60.

Pre-Industrial and Post-War Economic Development: Is There a Link?

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Abstract

What became the post-War era's "less developed countries" (LDCs) varied enormously in their pre- modern or pre-industrial economic conditions. We hypothesize that if these countries are arrayed on a continuum of pre-industrial development such as that of the demographer Ester Boserup, countries positioned closer to the "modern" end of that continuum will be found to have achieved more rapid post-War growth, due to more favorable pre-conditions. A cross-country data analysis supports this hypothesis. This suggests to us the importance of societies' stocks of human capital, conceived of more broadly than is measurable on the basis of formal education only.

Keywords: Economic growth, development, evolution, pre-modern development, anthropology, Africa, Asia, Boserup.

JEL numbers: O10 (Economic Development, General), O57 (Comparative Studies of Countries), O29 (Development Planning and Policy, Other).

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Pre-Industrial and Post-War Economic Development: Is There a Link?

Since the end of the Second World War, former colonies and other less developed countries in Africa, Asia, and Latin America have been viewed as taking part in a race towards modern economic development, with widely varying results. During the past decade, the question of why some countries' economies have grown rapidly and others slowly or not at all has helped to motivate a new body of research using a variety of neoclassical growth models and cross-country regression techniques. Such studies have generally supported the hypothesis that growth rates are a positive function of investment rates and that they are a negative function of initial income--that is, that poorer countries tend to grow faster, all else being equal. In some cases, they have also supported additional hypotheses, such as those linking growth to education and to government policies influencing prices or other variables. However, an important part of the variation in growth rates typically remains unexplained, and this unexplained variation is strongly correlated with the regions in which countries are situated, a seemingly noneconomic variable.

In this paper, we suggest, and provide evidence for, the hypothesis that a substantial portion of the conventionally unexplained variation in performance among LDCs is due to differences in economic and social preconditions to modern economic growth that have not heretofore received systematic attention in the economics literature. The new growth literature treats all countries as being on a par in the growth race, but for

the types of economic variables mentioned above. The old post-War literature on economic development itself typically recognizes two basic states or stages of development: the traditional, pre-industrial, or underdeveloped and the modern, industrial, or developed.[1] The departure of this paper is to provide evidence that conceptualizing long-run social and economic development--most of it preceding the modern era--as a *multi-stage* process (Boserup, 1965, 1981; Service, 1971; Johnson and Earl, 1987), sheds light on the differential performances of countries in the growth race of recent decades.[2] In particular, we propose that the initial position of the society or societies comprising a present-day nation, with respect to a *production system intensity* continuum stretching from low-population-density hunter-gatherer societies, on the one extreme, to high-population-density agriculture-based societies marked by large states, taxation, and specialized commerce, on the other, is an important predictor of that nation's growth performance in recent decades, even after controlling for the determinants of growth treated in the standard literature. (Although hunter-gatherers were already of marginal significance on the eve of the world-wide spread of industry, a good part of that continuum continued to be represented.) This link between pre-industrial economies and recent growth performance suggests to us that pre-modern economies left their traces on societies' stocks of human and perhaps physical capital in ways that are not adequately measured by flows or stocks of formal schooling, initial

[1] Even W. W. Rostow's well-known *Stages of Economic Growth* dealt only with steps in the transition from a basically undifferentiated "traditional" economy, and thus bears no similarity to the multi-stage conceptions discussed below.

[2] Goodfriend and McDermott (1995) make a similar departure from past economic literature by modeling development as a series of stages, in their case a pre-market period, a period of pre-industrial market development, and modern industrial growth. Human capital and population density also play crucial roles in their approach, as in this paper. However, theirs is largely a theoretical exercise, does not posit a

income, or investment. Our hypothesis is that societies located closer to the high-intensity end of the continuum of pre-modern economic formations required a less dramatic transformation, in terms of economic practices and behaviors, and are thus tending to make the shift to industrialization more rapidly than are those located nearer to the opposite end of this continuum.[3]

Our approach has an obvious application to the widening**,** over recent decades, of the economic gap between many of the countries of east, southeast, and south Asia, on the one hand, and those of sub-Saharan Africa (SSA), on the other. While it is striking that both groups of countries manifested similar per capita income levels in the early post-War period, these similarities may have masked differences in economic legacies that play an important role in explaining the large differences in their performances in recent decades. Our hypothesis is that while some of the latter differences can be linked to government policies and to other factors treated in the standard literature, others cannot be so linked, but could have been predicted using a multi-stage framework of the type proposed by us. The differences between these countries widened, within a few years of the granting of independence to SSA's countries, partly because marketable output in the SSA countries at independence was, more than in Asian counterparts, a reflection of colonial infrastructures rather than domestic human resources. The more densely populated Asian countries with long traditions of intensive, irrigated agriculture, taxation, and state bureaucracies, were by hypothesis better positioned to launch into industrialization in the post-War economic and political environment. While the

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continuum of developmental stages, and does not predict a link between stage of pre-industrial growth and post-War economic performance.

[3] An earlier exposition of these ideas is found in Putterman (1995).

framework's interpretation is more complicated for many Latin American countries, whose societies are more heterogeneous in terms of the production system continuum treated in our discussion, our hypothesis nonetheless performs well also for these countries using the proxies available to reflect position on that continuum, since as a group they register intermediate levels both of those indicators of pre-modern development and of rates of economic growth.

To some, our analysis may appear to provide yet another reason for pessimism regarding the economic prospects of sub-Saharan Africa and other low-growth regions. We believe that a more hopeful interpretation is possible. If, e.g., Africa's poor growth record can be attributed not simply to some unknown "African" factor (perhaps related to soils, climates, tribal conflicts, or genes), but rather to specific consequences of its economic and social history, then there may be a basis for hope regarding its longer-term economic prospects. In particular, the analysis suggests to us that the accumulation of modern attitudes and skills may be as important as are conventionally recognized aspects of economic policies, including formal education, in preparing a country for success in the game of modern economic growth. In fact, our hypothesis is consistent with the possibility that African countries may already have made much progress in this more subtle modernization process, even during decades of poor performance with respect to measurable economic growth. Greater emphasis on the development of the continent's human capital stock, not only in terms of formal education but also in some of the broader senses touched upon below, may therefore bear as much fruit, in the long run, as will "getting prices right" and other such prescriptions. The implications of our analysis

are quite consonant with the recent emphasis placed by the World Bank, the UNDP, and the U.N.'s Economic Commission for Africa, on "capacity building" as a *sine qua non* of the continent's future economic progress. [4]

1. Pre-Modern Economies and Modern Development Capacity

With its focus on modern market economies or in some instances on the transition to industrialization, neoclassical economics has generally been content to view economies as fundamentally similar, or to distinguish, at most, between "traditional" and "modern" ones. In the longer view of human development taken by many anthropologists, archeologists, and demographers**,** however, human society has passed through numerous stages between the primitive era of hunting and gathering and the industrial societies of today's more developed countries. The thesis of this paper is that the type of economy that characterized today's nation-states before they began their transitions to industrialization is likely to impact upon the speed with which they make that transition. Economies starting from "less developed" positions in terms of the developmental hierarchy of Boserup and others will initially experience slower growth, as it takes longer for them achieve those preconditions of modern development that must be embodied in the broad human and perhaps also physical capital of their societies. Under "broad human capital" we include attitudes and capabilities that may fall outside the scope of

[4] See for example UNDP (1993). The World Bank's long-term perspective study similarly states: "Africa's lack of technical skills and strong public and private institutions accounts more than anything else for its current predicament." (1989, p. 190)

formal education, as well as a stock of ideas and knowledge that will be held *collectively* by a population, through a complex division of cognitive labor, and which it may not be sufficient to impart to a few individuals alone.[5] Relevant pre-modern physical capital may include canal and irrigation systems, which may have low or nonexistent market valuations and which will be little reflected in initial income because their effects on output tend to be roughly offset by corresponding effects on population.

In long period evolutionary schemes, hunter-gatherer societies, presumed to be the basic form in which humans lived for most of their existence, are the most "primitive" in several senses. Their productive activity consisted mainly of acquiring foodstuffs which were more or less immediately consumed. They are believed to have subsisted on relatively low energy intakes and to have economized on energy use, correspondingly, by spending a relatively small proportion of their time on acquiring food. Their technology and resource base could sustain only sparse population densities, and they lived in small bands, without large integrating political structures. While there was some division of labor by age, gender, and other characteristics within a band, social and economic stratification was limited.[6]

With the advent of agriculture, it became possible for humans to live in more concentrated populations, generating enough surplus food to support some individuals not

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[5] Collective knowledge or capability, including tacit elements maintained and transmitted by active use, is discussed by Nelson and Winter, 1982.

[6] In addition to the works already cited, see the classic work by Sahlins, 1972, and the recent collection edited by Plattner, 1989.

directly engaging in production. The increase in energy availability is, however, offset by the increase in work required to obtain it. Some anthropologists speculate that work-avoiding human beings shifted to more labor-intensive modes of production only when forced to do so by the pressure of necessity, for instance when a random population surge or decline in the availability of certain prey or flora forced greater reliance on cultivation.[7] Once more labor-demanding cultivation was in use, denser populations could not revert to hunting and gathering, and cultivation became the more or less permanent norm. By such means, movement from systems of slash-and-burn or swidden cultivation, in which plots were prepared with minimal labor and abandoned after one or two seasons, towards those of annual cultivation, and on to multiple cropping, multiple cropping with irrigation, mixed farming with animal manure application, and so on, took place in slow although sometimes step-like progressions (and sometimes reversions) and in a number of distinct locations over the relevant centuries and millennia.[8] With each movement along this path of "development," population densities grew, and along with them the scale and complexity of social and political organization. Larger areas and populations were integrated into political units, segments of these populations became specialized to administration, tax collection, and religious and military roles, written records became more elaborate, internal and external trade grew.

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[7] This speculation is partly based on evidence that knowledge of basic techniques of food cultivation has existed over long periods in societies that did not rely heavily upon agriculture; the "agricultural revolution" may, then, be modelled as a very gradual process of knowledge accumulation followed by surges of adoption of this knowledge triggered by causes other than the discoveries themselves. See, for instance, Rosenberg (1990).

[8] Economic anthropologists identify as "horticultural" societies intermediate between the hunter-gatherer (or "forager") and agrarian types, typically organized in tribal groupings. "Horticultural" societies probably spanned a transition of two thousand years or more between foragers and agricultural states in both Mesopotamia and Mesoamerica, and they remained predominant in the humid tropics until recent times. See Johnson and Earle (*op. cit.*) and Johnson (1989).

Anthropologists believe that similar developmental progressions occurred independently in numerous instances. For instance, Sanders and Marino (1970) provide evidence that intensification of cultivation and large scale state formation, social differentiation, and taxation developed independently in at least three indigenous civilizations of pre-Columbian Mesoamerica and Peru, more than two thousand years after similar developments in ancient Egypt, Mesopotamia, India, and China. These authors find large correlations between social system and mode of production in cross-sectional comparisons of the various indigenous societies inhabiting the Americas on the eve of their conquest by European colonizers. [9]

Over the course of history, population growth and the search for resources has frequently led societies at more intensive positions on the continuum of production intensity, economic complexity, and state scale, to expand into territories previously occupied by those using more extensive technologies, causing the latter to adopt the new techniques or to move to more marginal environments. Until the 15th century, however, a significant degree of isolation existed between such macro-regions as the Americas and the Eurasian land mass. While the age of colonization and the industrial revolution eventually caused economic and social change to become linked on a world-wide scale**,** the densities of indigenous populations prior to Europe's colonization drive continue to

[9] Complex kingdoms also existed in Dahomey (Benin), the eastern rim of Lake Victoria, and elsewhere (perhaps including the civilization associated with the Zimbabwe ruins) in Africa. The linked growth of production and socio-political systems in these cases may have followed the same basic patterns documented by Sanders and Marino for the Americas. (We have already mentioned the Egyptian case,

be reflected in ethnic compositions and other social features not only of the nations of the Americas, but also of other parts of the world that were colonized by Europeans between the 16th and 19th centuries. In particular, the areas of the present-day United States, Canada, and Australia were inhabited mainly by societies practicing various mixes of agriculture, gathering, fishing and hunting activities, with low population densities and relatively small sociopolitical units. Such low-density indigenous populations were to a large degree replaced by populations from Europe and elsewhere, and the nations that have taken their places have gone on to participate, in effect, in the mainstream of European economic growth. British and Dutch conquest of more densely populated India and Indonesia, by contrast, failed to overturn the ethnic dominance of pre-colonial inhabitants. This was also the case in most of sub-Saharan Africa, a region with a pre-colonial population density intermediate between these extremes, despite protracted struggle over what Europeans saw as zones of opportunity in South Africa, Rhodesia, and elsewhere.[10] In Central and much of South America, both indigenous and immigrant populations are fairly large, and ethnic and social mixes are complex.

How might the characteristics of the pre-modern societies contributing populations and cultural legacies to modern nations have helped to determine the growth performances of those nations in recent decades, when all faced similar conditions of national independence, of exposure to world trade and technology, and of at least nominal

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which may have influenced both the Mesopotamian and subsequent early Mediterranean civilizations, and which is the earliest known instance of this evolutionary progression in Africa.)

[10] In a more careful study, one might also want to investigate the impact of the pre-colonial African slave trade on that continent's population densities both on the eve of colonialism and in the post-War period that is our ultimate focus.

bi- and multi-lateral support for development? One way they could have done so is through their impact on conceptions and practices of productive activity. If Boserup and others are right that human beings are generally averse to work, that they submit to more intensive labor only under the pressure of necessity, and that average amounts of work done have increased, along with energy consumption, during the progression from hunting and gathering to the most intensive forms of agriculture (and on into early industrial society), then it may also be the case that norms and expectations regarding work become embedded in cultures and differ among societies having substantially different modes of production.[11] The peoples of agrarian societies that had adapted to the drudgery of intensive farming may have become more conditioned to (and, in the language of economics, more willing to supply) long, arduous hours of work than would less intensive farmers or pastoralists.[12] They may more sharply distinguish between work and leisure**,** may be more acclimated to specialized and hierarchical economic interactions, and may separate their economic and noneconomic social interactions in ways more closely resembling those of people in industrial societies. Surviving counterparts in hunting-and-gathering systems may have been at the opposite extreme on these characteristics, with the more numerous practitioners of less intensive agriculture and pastoralists occupying a middle ground. Although hunter-gatherers *per se* were no longer demographically important in the vast majority of today's nations by the late nineteenth century, animal herders and low-intensity agriculturalists continued to

[11] The potentially lasting effect of environmental factors on preferences with respect to work effort fits into a framework positing sensitivity of preferences to experience within limits determined by genetic predisposition (see Ben-Ner and Putterman, forthcoming).

dominate many of today's developing countries well this century. We hypothesize that, *ceteris paribus*, proximity to the modern end of the broader continuum of social evolutionary development would be positively correlated with rapid adaptation to the rhythms of modern economic life and production.

Something similar may apply with respect to technology. It is unquestionable that in, say, the 16th century, technological toolkits and the associated stocks of skills differed markedly between the countries of northern Europe, Japan or China, on the one hand, and most of present-day Brazil, central Africa, or Australia, on the other. Presumably, societies at intermediate levels of technological development could also be identified. It seems likely that the skills useful to societies "on the eve of industrialization" can be more quickly adapted to use in industrial society than can those found in less technologically "advanced" settings. Dearth of relevant skills plays an important part in explaining, for instance, why a large share of projects to bring potable water to African villages in recent decades have been found to be nonfunctional within a few years of installation.[13] By contrast, stocks of pre-modern mechanical knowledge (such as those applied to farming, construction, or navigation of waterways in pre-modern China or Japan) may have aided receptivity to industrial methods in East Asia.

Other reasons why societies closer to the industrial pole on the social evolutionary scale may industrialize more rapidly, once exposed to an enabling international

[12] The idea that hunter-gatherers worked fewer hours than agriculturalists, which became popular in the 1960s, is still debated (see Cashdan, 1989). However, qualitative differences in the nature of work along the evolutionary continuum may have similar implications.

environment, include greater economic independence of households, greater experience with hierarchical state forms, and higher degrees of commercialization and trade. In less developed societies, access to resources tends to be more dependent upon position within a band, clan, or tribe, and resources are transferred between individuals as much by redistribution under the aegis of such a structure as by trading among autonomous individuals or households. Among hunter-gatherers, to take the extreme case, sharing is pervasive, perhaps due to the absence of other forms of insurance and of storable wealth. With development, families become more independent economic and social units, interacting increasingly through trade. Some economists and economic anthropologists have speculated that norms of sharing within communities, clans, or extended families, may have slowed modern economic growth in societies where they are especially strong because they act like a tax on the returns to the efforts of individuals and small family units.[14]

While weakening of social bonds within extended families and clans may be one hall-mark of modernization, strengthening of social organizations on larger scales is another. Differences in state capacity and political stability appear likely to give rise to some of the most important ways in which pre-modern development experience may have affected recent economic growth. Strong states have played notable roles in the development of East Asia's NICs,[15] and weak states and/or political instability have

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[13] See Therkilsen (1988), Smith (1994).

[14] This idea appears in Albert Hirschman's 1958 book and in many other souces given in a recent paper by Jean-Philippe Platteau, 1996.

[15] See the Symposium on the State and Economic Development in *Journal of Economic Perspectives* 4 (3) (1990) and the papers in Putterman and Rueschemeyer, eds., 1992.

probably done as much as anything to thwart the economic aspirations of much of sub-Saharan Africa, Central America, and other slow-growing regions. While traditions of bureaucratic and state-level organization pre-date colonial encounters in such countries as India, China, or Japan, they were typically absent or present only on smaller social scales in most parts of Africa, which were carved up into multi-ethnic nations by foreign powers. It seems noteworthy in this connection that while China was able to follow the Soviet Union in making some strides towards basic industrialization under a state-centered Communist regime,[16] similar attempts at state control in African nations, with their weaker state bureaucracies, brought only economic decline. Some of the numerous civil conflicts in Africa and elsewhere, in which the antagonists fractured along ethnic lines, can be viewed as direct manifestations of the difficulties of transition from pre-colonial social structures to those of the colonially-fashioned state.[17]

Social evolutionary development could also be conducive to modern economic growth because greater population density tends to lower the cost of local trade, thus spurring the division of labor following the famous formulation of Adam Smith (1985 [1776]). While the Smithian hypothesis may take the static form that a given degree of division of labor, and thus of productivity, will be associated with a given extent of markets, dynamic interpretations are also eminently sensible. In particular, as modern

[16] See, for instance, Yusuf (1994), as well as Putterman (1992).

[17] In this respect, Easterly and Levine's (1997) recent explanation of "Africa's Growth Tragedy" as a consequence of ethnic heterogeneity may be related to our own approach. The unfavorable performance of countries such as Peru, Guatemala, and the Philippines may also be related to the non-"digestion" of indigenous peoples, with less modern economic and social systems, by immigrant populations imposing alien state forms. However, we see what Easterly and Levine take as a key independent variable as being only one aspect of a more general complex of pre-modern social and economic characteristics. We

methods of trade and communications, specialized technologies, etc., spread around the globe, regions with denser populations and thus greater natural "extent of (local) markets" would have been positioned to more rapidly converge towards those benefits already being enjoyed by the most developed nations.

Hypotheses such as that advanced here are likely to strike some as old-fashioned or offensive. Indeed, we suspect that one reason why they are not frequently advanced in contemporary social science discourse is their seeming inconsistency with values of cultural relativism and ethnic equality. We wish to be clear, therefore, that our framework implies nothing about the superiority of some ethnic or racial groups, or the members thereof, over others. Societies reflect their particular environments and histories, individuals the cultures to which they are exposed. There is no anthropological evidence of genetic differences in capacity for culture. Even with respect to social formations such as hunting and gathering or irrigated agriculture, we use terms like "advanced" and "developed" to reflect only general historical directionality, not a normative judgment. Nor do we need to become engaged in debates about the linearity of human history, since our broad-brush hypothesis can accommodate multiple development paths, occasional cross-societal incomparabilities, and local "reversals."[18] All that is necessary to our framework is that historical social and economic formations be understood as roughly orderable, in terms of complexity of social organization, intensity

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investigate the relationship between the effects of ethnic heterogeneity and those of pre-industrial development stage, *per se*, in a subsidiary exercise reported briefly below.

[18] It is striking, for instance, that no early irrigation-based civilization went directly on to industrialization. That the location of the first industrial revolution does not coincide with maximum pre-industrial

of production system, and scale of political integration, so that one can talk of relative proximity to the modern industrial form of organization. Our paper deals narrowly with the impact of pre-modern economic adaptations upon recent performance with respect to conventionally measured economic growth, not with broader questions such as the desirability or undesirability of the industrial way of life (or for that matter the agricultural one).

2. Testing the Hypothesis

There are a variety of ways in which one might investigate linkages between the types of pre-modern economies contemporary nations had, and their recent economic performance. In-depth comparisons of individual countries and of regions or subpopulations within countries are one possibility. In this paper, we pursue the alternative approach of testing the hypothesis on cross-country data, as in the recent growth literature mentioned in the introduction. Our approach is to adopt a growth equation that matches closely those used in other studies, into which we introduce additional independent variables proxying for the pre-industrial development (PID) stage of each included country. While we have no argument with the view that this methodology has reached a point of diminishing returns in many applications, the long-view approach pursued here is unlike any in the extant growth literature, and we adopt the standard cross-country format only to control for other variables and facilitate

development, as measured by a Boserup-type development schema, is another reason why a simple approach of the type proposed here must be treated with caution (see also footnote 22, below).

comparability with other studies. A key question remains how pre-industrial development is to be measured.

We considered a number of possible measures of PID. One approach would be to devise an indicator of the proportion of time spent in productive labor, and the intensity of that labor, at an appropriately early point in history. While a few anthropologists have done careful time-use studies with related issues in mind, however, these have focused on a handful of societies, only, and mainly at the sub-national level, so that no relevant cross-country series of this sort is available or possible to construct from existing data. Another possible measure of developmental stage might be obtained by classifying populations into such categories as hunter-gatherers, pastoralists, shifting cultivators, and so forth, assigning a point value to each one, ordered in conformity with Boserup's, Service's, or some other such scale, and then assigning to each country a score equal to the average of these point values, weighted according to the shares of the relevant types in its population, again at an appropriately early point in time. Once again, though, data of the sort that would be needed for such an exercise do not appear to be available.

There do exist data for a reasonably large number of countries on three relevant indicators of social evolutionary development. First, information on population density prior to the recent push for development should be indicative of developmental stage, according to our framework. Second, widely available information on the amount of land cultivated per farmer can be treated as a proxy for cultivation intensity, another indicator of the proposed evolutionary continuum. Third, information on the proportion of the

cultivated land that is irrigated may serve as another measure of production-system intensity, since irrigation systems both directly require additional labor to construct and manage, and they make possible the use of additional labor through such methods as the sowing of multiple crops on a given parcel. They are therefore historically associated with higher population densities, as well as with state level organization, taxes, and social stratification.

The three indicators are not necessarily without drawbacks. The farmer-land ratio is imperfect, for instance, because of its lack of controls for the prevalence of noncultivating modes like hunting-and-gathering or pastoralism, or for mechanization, which gives rise to lower man-land ratios at the industrializing end of the continuum. Failure to control for soil quality may also be a problem, although the need to do so is unclear, with Boserup and others arguing that soil quality is to a significant degree an endogenous outcome of cultivation intensity, including mixed husbandry/agriculture practices. Recourse to irrigation is arguably an outcome of unfavorably timed rainfall.[19]

Perhaps the most serious problem with the measures that are available, however, is the lack of broad cross-country data for dates much earlier than the Second World War. To be sure, were perfect time-series reaching back as far in time as one might want available, it is unclear exactly what dates the "right" data would be taken from. We

[19] Thus Robert Wade argued in personal communication that not irrigating may simply reflect not needing to irrigate.

might like data for most of Africa prior to its late 19th century colonization, for instance, but at what point should Latin America's pre-industrial economic formation be gauged?[20] Whatever the answer to this question, we were able to obtain only limited data for dates before 1960.[21] We were led to ask, then, whether data on population densities, cultivation intensities (land per farmer), and irrigation rates (share of that land irrigated) in the early 1960s, when these are available for a broad sample of countries, could be treated as proxies for the pre-industrial economic orders of today's developing countries. We concluded that this *is* an acceptable approach, until such time as better data can be assembled, because it is likely that while at least two of the measures (population density and cultivation intensity) have changed appreciably in most countries over the past 100 years and more, such change has probably left them highly correlated with earlier values. The one case in which we were able to test this conjecture directly involves population density, for which information was obtained for 1911 for a total of 76 countries of which 66 also provide data for 1960. In that case, the simple correlation between the two sets of measures is .8199, and the Pearsson rank correlation is .8960, which has a p-value of .0001. Tests of our hypothesis using the 1911 values themselves for the subsample providing them will be reported below. However, the main part of our analysis is done with 1960 values, which are available for a much larger sample of countries and for all three of our PID measures.

[20] Neither their pre-Columbian antecedents, nor the societies from which their immigrant populations hailed, would seem to constitute the relevant pre-modern society for Latin American countries, but rather the various mixes of these that we find in them on the eve of industrialization proper--or in some cases, perhaps, of post-War efforts to restart it.

[21] Some of the little data that we did find for the early 20th century are problematic, as in many cases territories covered do not correspond to present-day nations. Although a territorial average for, say, French West Africa, could be used as a common datum for all contemporary nations once part of that territory, it is

The rest of our growth equation follows the format suggested by Levine and Renelt (1992, hereafter LR), who survey a number of cross-country growth studies, including those of Barro (1991) and Kormendi and Meguire (1985). Like LR, we regress four principal independent variables--initial GDP per capita, the average investment share in GDP, the population growth rate, and a measure or measures of formal education--on the rate of growth of GDP per capita for a cross-section of countries. Including initial GDP per capita controls for the possibility that poorer countries will grow faster as a result of forces towards convergence of development levels. Investment and education are expected to be positively associated with growth, while high population growth might slow economic growth due to higher per capita costs for education and social services, among other factors.[22] We add one more variable, aside from our PID measures, to the basic LR data set. Measures of price distortion used in several recent growth studies including Barro and Lee (1994), Barro (1996), and Perotti (1996), are excellent predictors of growth performance. There are good economic grounds for expecting this to be the case, since distorted prices can lead to misallocation of resources and thus to lower returns on given levels of investment and of resource endowments. We use the black market premium measure, which seems most satisfactory from a conceptual standpoint.[23]

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unclear whether using such averaged data would be superior to the use of more recent data that is specific to the individual present-day units.

[22] As will be noted again below, we do not posit any particular relationship between *formal* education and the types of human capital that would be expected to derive from the nature of the pre-industrial economy. Thus, findings about the effects of formal education on growth have no direct bearing upon the hypothesis that pre-industrial development has affected growth through broad characteristics of the human capital stock.

[23] Development economists have long argued that many economies operate with greatly reduced economic efficiency because government interventions, e.g. in banking, import controls, and foreign-exchange management, led to artificially reduced capital and import costs, higher labor costs, and lower profitability

Finally, like the papers cited, we check for the explanatory adequacy of the included economic variables by including dummy variables for the sub-Saharan African and Latin American regions in some estimates.

Our data on population density, cultivation intensity and irrigation are drawn mainly from the F.A.O. Production Yearbooks.[24] The data on the conventional growth equation variables, including the black market premium, are drawn from the data set assembled by Barro and Lee (1994). Growth rates of real GDP, GDP per capita, and the investment ratio in the latter data set are from Summers and Heston (1991).

One more issue should be addressed before we turn to our results. This concerns the generality of our analysis across historical periods. The hypothesis of this paper is that pre-industrial development has affected rates of economic growth in the post-War era. We do not assert that pre-industrial growth affected industrialization similarly in all periods before 1945, or that it will do so into the indefinite future. It is entirely consistent with our hypothesis for pre-modern developmental status to have influenced recent economic performance without precluding a tendency for initially poorer countries to have grown more rapidly than initially richer ones, after controlling for it. Although complete convergence in levels of development would not have occurred in the period of

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of exports. The black market premium should be an accurate measure of one of these distortions, the degree of currency overvaluation, which is likely to be highly correlated with others. The purchasing power parity of investment goods, the variable favored by Perotti, seems less satisfactory because PPPs tend to be systematically associated with levels of development for reasons that may have little to do with the kinds of price-distortion in question here.

[24] Data on total land area, arable land, and irrigated land in 1960 were taken from the 1978 yearbook, that on agricultural population in 1960 was taken from the 1970 yearbook. The total population data for 1960 was taken from the data used by Barro and Lee (1994).

study, should our hypothesis be correct, it does not rule out such convergence at some time in the future. This is because PID may in recent decades bear a relationship to characteristics of the human capital stock, broadly conceived, that will not hold in the very long run. Since we do not suppose that the relationship between PID and growth will be stable over the very long run, it is important to test for its stability over time, and to be cautious about extrapolating the results for any period to other periods, for which they may not apply.

3. Estimation and results

To assess the influence of pre-industrial development (PID) variables on growth we apply regression analysis to data on a cross-section of nations. Our most general specification of the regression model is as follows:

$$y_i = a' x_i + e_i$$
$$Var(e_i) = \exp(b_0 + b_1 q_i)$$
$$i = 1, \ldots, n$$

where y_i is the average annual growth rate (in decimal form) of per capita GDP for country i for 1960-90, a is 12x1 vector of unknown coefficients, and x_i is a 12x1 vector of regressors for country i, whose first element is one and whose other elements are the following:

2. GDP60: GDP per capita in 1960

3. Inv6090: Investment divided by GDP, averaged over 1960-90

4. GPop6090: Growth rate of population (in decimal form), 1960-90

5. Sec60: Share of children of secondary school age attending secondary schools (in percentage form) in 1960

6. BMP6090: Black market premium, averaged over 1960-90

7. Popden60: Population per hectare of land surface in 1960

8. Manland60: Agricultural population per cultivated hectare in 1960

9. Irrig60: Fraction of cultivated land that was irrigated in 1960

10. PC1: First principal component of the previous three variables

11. SAfrica: Dummy variable for sub-Saharan Africa

12. LaAm: Dummy variable for Latin America.

e_i is a stochastic disturbance--including measurement error for the dependent variable--whose distribution may exhibit heteroskedasticity of the form indicated by the second equation above. b_0 and b_1 are unknown parameters while q_i is a quality rating for the GDP data of country i. This quality rating ranges from 1 for countries with the lowest quality data (a rating of D-) to 11 for those with the highest quality data (a rating of A) according to Heston and Summers (1991). We report weighted least squares estimates of

a whenever an ordinary least squares (ols) estimate of b_1 is negative and otherwise report ols estimates of a.[25]

Conventional economic theory and previous empirical work suggest that the coefficients of GDP60, GPop6090, and BMP6090 should be negative and those of Inv6090 and Sec60 should be positive. We expect any one of our four proxies for pre-industrial development (Popden60, Landman60, Irrig60, and PC1) to have a positive estimated coefficient if the other proxies are omitted. Thus, the same should be the case for their first principal component. However, recognizing that the four proxies are positively correlated, we cannot be confident of the signs of the estimated coefficients when more than one proxy is included. Previous empirical work suggests that the estimated coefficients of the regional dummies are likely to be negative.

Before turning to our statistical results, it is interesting to look at Table 1, which shows the means of GDP per capita in 1960, of the growth rate of real GDP per capita from 1960 to 1990, and of our three measures of pre-industrial development, for the sample countries located in sub-Saharan Africa, in Asia excluding the Middle East, and in Latin America, which together account for 85% of the sample of countries included in the exercises of Tables 2 - 4.[26] The table provides some intuition for the results to emerge here, as we see that the Asian countries exhibit the highest average population density,

[25] Most of the estimates of b_1 are both negative and statistically significant, suggesting that the expected variance in data quality may in fact exist. However, checks of alternative estimates suggest that the qualitative nature of the results is affected little by whether or not the weights are used.

[26] Computations cover all countries within these regions which provide data on enough variables to permit their inclusion in one or more of the regression estimates of the three tables that follow.

number of farmers per acre cultivated, and irrigated share of cultivated area, and the highest rates of growth during 1960-90, that the sub-Saharan African countries exhibit the lowest average levels of all of these variables except farmers per acre, and that the Latin American countries occupy middle positions except with regard to the latter variable, on which its average is slightly smaller than SSA's. Growth rates are not obviously correlated with initial GDP per capita across these groups.

The number of countries providing sufficient data for inclusion in our estimates varies depending upon which if any proxies for PID are used. For ease of comparison, in Table 2 we report estimates of the vector a for the common sample for which all three PID measures as well as the standard growth regression variables are available, but we shall also refer in our discussion to the results obtained for the sample of maximum size for the specification of a given column. In our main analysis, we include all non-OECD countries providing sufficient data in the sources listed, which yields a sample of 48 countries when no PID variables enter, 46 countries when only population density is used, 44 countries using only land per farmer, 42 countries using only irrigation intensity, and 41 countries when all three PID variables, or their first principal component, are used, and thus in all of the results shown in Table 2. (See Table A1, in the Appendix, for a list of included countries.) Constraining the last six elements of a to equal zero, we obtain the estimates in the first column: these have the expected signs and for three of the five explanatory variables, are significant at the .05 level or better. This column indicates that

our sample of countries is similar to those analyzed in previous studies with regard to the relationship between the dependent variable and the conventional regressors.[27]

In columns two through five we add the three basic PID variables and their first principal component to the regression, one at a time. The estimated coefficients are in each case positive and significant at the .01 level. In column six we report the results of including the regional dummy variables in the regression. Their estimated coefficients are negative and significant, as they have been in several previous studies. Finally, in column seven are the results of including PC1 as well as the two regional dummies. Their estimated coefficients have the expected signs and are significant at the .01 level or better.

To investigate the stability of the coefficient estimates, we split the 1960-90 period into two halves: 1960-75 and 1975-90. Table 3 displays the results for the former

[27] Results for the larger sample of 48 countries are qualitatively similar, but the coefficient on GDP60 becomes significant at the .01 level, and that on BMP not significant at .05 level. The insignificant negative coefficients on population growth for the 1960-90 period as a whole, both in this and the other columns of the table, are consistent with the positive coefficients for the 1960-75 and negative coefficients for the 1975-90 subperiods, shown in tables 2 and 3. Note that while our hypothesis stipulates that high population density at the outset of the industrial era would be associated with conditions favorable to modern economic growth, it involves no prediction regarding the effects of population growth after the commencement of the drive for industrialization. The absence of a positive partial correlation between population growth and output growth, despite the positive partial correlation of the latter with population density (see below), is consistent with our interpretation of the latter correlation as being due to long-run impacts on broadly conceived human capital, as we remark in section 4. Turning to the schooling variable, we note that other studies have found similarly weak correlations. Some recent studies, such as Perotti (1996), substitute "stock of education" measures which are available for female and male subpopulations, separately, although for a smaller sample of countries than is Sec60. Experimentation with substituting the two stock measures for Sec60 while retaining the rest of our specification generated a pattern of significant positive coefficients on the male education stock variable and significant coefficients, typically similar in absolute value but *negative*, on the female education stock variable. Conceivably, the mixed signs could reflect the fact that the gap between the male and female education stocks in 1960 was a good indicator of growth *potential* (for similar reasons as is GDP60). Since further investigation of this issue would lead us

subperiod, for which the dependent variable is the average annual growth rate of per capita GDP for 1960-75 and the period-specific regressors are, in an obvious notation, Inv6075, GPop6075, and BMP6075. Table 4 presents the results for the latter subperiod, for which the dependent variable is the average annual growth rate of per capita GDP for 1975-90 and the period-specific regressors are, analogously, Inv7590, GPop7590, and BMP7590. We retain PID measures based on 1960 data, since these proxy PID at earlier dates, and are not meant to track "initial PID" for the specific sub-period.[28] For both subperiods, all estimated coefficients have the same signs as for the full period. In many cases the adjusted R^2 statistics and absolute values of t-statistics are a bit lower for both subperiods than for the full period, perhaps due to the greater influence of cyclical and random influences on growth rates over shorter periods. Nonetheless, when the PID variables enter the regressions, their estimated coefficients are always positive at the .05 level, with the exception of the coefficient of irrigation share in the estimation for 1960-75 which is significant at .10 level.

Based on the common sample results shown in Tables 2-4, both the familiar criterion of the adjusted R^2 statistic and the theoretically better justified Schwarz criterion always favor the model which includes PC1 and the regional dummies--i.e., the model whose estimates are reported in the last column of each table. It may also be of interest to compare proportions of the total variance that are explained by the different models by

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away from this paper's focus, and to maintain maximum sample size, we focus on the more easily interpreted results for Sec60.

[28] Recall that 1960 data were used because these were the earliest we could obtain for a broad subsample of countries. The common use of data for the year 1960 both for the PID measures and for the initial GDP and education variables in the 1960-90 and 1960-75 estimates is strictly coincidental.

reference to the R-squared statistics**.** In the results for the minimal common sample of 41 countries for 1960-90, we find that the R-squared statistics for models 1-7 (1960-90) are .52, .69, .69, .65, .69, .74, and .82. Thus we can say that when a PID variable is added to model 1, the increment to R-sq. is at least .13 and typically .17, an addition to explained variance similar to the .19 increment when only region dummies are added. Comparing the results for columns 1 and 7, we can say that the full model explains almost 30% more of the variance in growth rates than does the unaugmented model. The relative contribution of the PID variables to this extra explanatory power is comparable to that of the region dummies, since (a) moving from 1 to 5 to 7 suggests that the PID variables provide 57% of the additional explanatory power, the region dummies the remaining 43%, while (b) moving from 1 to 6 to 7 suggests that the region dummies provide 63% of the additional explanatory power, the PID variables the remaining 37%. Put differently, either of the first two PID variables or PC1 alone explain 35% of the variance unexplained by the base model, the region dummies (alone) explain 40% of that variance, and the addition of both explains the better part, or 62.5%, of the otherwise unexplained variance.[29]

Considering the units in which our variables are expressed, we can see that models 2, 3, and 4, estimated for 1960-90, imply respectively that a country's growth rate would have been increased one percentage point if in 1960 its population density had

[29] We also estimated, but do not show, a model in which all three individual PID variables appear simultaneously with the other variables. The R-square for this model if .74, suggesting that it explains more of the total variance, as well as of the variance unexplained by model 1, than does the model adding the region dummies only. As mentioned earlier, however, it is difficult to interpret the individual PID

been 10 persons per hectare larger, if it had had 5 more farmers per cultivated hectare, or if its irrigation share had been 25 percentage points higher. An alternative way of expressing the economic importance of the PID variables is to compute "beta-coefficients," which indicate by how many standard deviations the dependent variable increases when an independent variable rises by one standard deviation. The beta coefficients for the PID variables, based on estimates for 1960-90, are .46 in model 2, .45 in model 3, .38 in model 4, .42 in model 5, and .38 in model 7. Only the investment ratio and the black market premium appear to have comparable impacts, among the standard variables.[30] Thus, the PID effects appear to have been substantial: having had the "right history" was as important as having "gotten prices right." Although history, unlike prices, cannot itself be changed, there may nonetheless be policy implications of this finding, as argued in the next section.

As mentioned earlier, we were unable to obtain data on most of the PID variables for dates earlier than 1960, but we were able to find data on population density in 1911 for a subset of countries in our sample. To check the sensitivity of our results to demographic changes between 1911 and 1960, which could conceivably reflect "contaminating" influences of early industrialization efforts, we re-estimated equations of the types shown in Tables 2-4 using population density in 1911, rather than 1960. Since we do not have data on the other PID variables for a comparable date, we entered Popden11 as the only PID variable in these runs. Data for the Popden11 was obtained for

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coefficients, since the three variables are correlated. Although they pass an F test for joint significance at the .001 level, only one of them, irrigation, shows a significant coefficient.

76 countries, of which 50 are covered by data for the conventional variables as well, although only 31 provide complete coverage for 1960-90. Table 5 shows the results of re-estimating the equations corresponding to columns 1, 2, and a modified version of column 7 of Table 2, for the 31 country subsample available for that period. The other results are roughly the same as those shown inTable 2, and the 1911 and 1960 values of population density are found to perform almost identically when the same subsample of countries is examined, although the absolute value of the coefficient on Popden11 is as much as an order of magnitude larger than that on Popden60. Qualitatively identical results are obtained for the 50 country sample for which parallel estimates can be performed for 1960-75, and for the 32 country sample for which this can be done for 1975-90. This provides evidence that the PID variables used in the runs reported in the tables, which are measured in 1960, are indeed good proxies for pre-industrial development at a considerably earlier point in time, or at least do not lead to exaggerated estimates of the importance of pre-industrial conditions to modern growth. Indeed, judging from these estimates, the estimates of Table 2 - 4 which use 1960 measures for PID, could significantly understate the magnitudes of the economic impact of PID, more accurately measured.

4. Further tests and extensions

While certainly impressive, the tests just reported are by no means conclusive. Among other things, we would like to know how sensitive the results are to equation specification (for instance, the possibility of missing variables), sample, and the precise

[30] To provide points of comparison, we note that the beta coefficients for GDP60, Sec60, GPOP6090,

period analyzed. We have been able to conduct a few further explorations, which we report here, with further work remaining for the future.

First, we conducted some checks of the robustness of our conclusions to the composition of the developing country sample. That sample includes all non-OECD countries providing data for the variables under study, and it appears to be broadly representative of Africa, Asia, and Latin America.[31] Checking the values of the PID variables, we found two countries, Hong Kong and Singapore, to have been substantial outliers, especially for population density and cultivation intensity.[32] Hong Kong and Pakistan are also found to be outliers when irrigation share is the only PID variable. Re-estimating the models without Hong Kong and Singapore, we find that the coefficients of the PID variables retain their expected positive signs and are usually little changed in magnitude, although their significance levels are often lower.[33] Neither the coefficient estimates nor their significance levels are significantly affected by dropping any other country from the 41 country sample of the Table 2 estimates.

INV6090, and BMP6090 in model 7 are -.18, -.09, -.06, .32, -.19 .

[31] A major gap in coverage is that of the former Communist countries. Also China and Korea are not included in the main set of estimates reported since some of the data on them were collected from sources other than the ones used for the other countries.

[32] Hong Kong, a British colony absorbed by China in 1997, is treated as a country in World Bank data up to this writing, by Summers and Heston, and in most of the cross-section growth studies referred to above.

[33] The potential influence of relatively arbitrary boundary issues might be put in perspective by noting that while ethnically Chinese, fast-growing and populous Hong Kong has full country weight (or better where data weights are used) in the main results reported, neither mainland China nor South Korea, appear there (nor, of course, do numerous rapidly growing Chinese provinces, which are not countries, yet often surpass in population many developing areas that are). Also, sub-Saharan African countries with combined populations less than a quarter of China's are represented by as many as 29 observations. As an exploratory exercise, we added data missing from our primary sources to assemble observations for mainland China and South Korea, and we re-estimated the regressions of Tables 2 - 4 both with these two countries added to their full samples, and with the two countries included "as substitutes" for Hong Kong and Singapore. The results are qualitatively similar to those shown and discussed above, except that with China and South

The possibilities for investigating the impact of excluding relevant variables are virtually endless. We confined our initial investigations to three sets of variables. First, we were impressed with the impact of ethnic heterogeneity in explaining in particular Africa's relative performance, as shown by Easterly and Levine (1997), and we wanted to investigate the degree to which their ethnic heterogeneity variables might capture the same influences reflected by our PID measures. We therefore re-estimated models 5 and 7 for the three periods of Tables 2- 4 adding in turn the two main measures of ethnic heterogeneity used by those authors.[34] In the resulting estimates, the coefficient on PC1 remains significant at the .01 level (usually with slightly increased significance) with almost no change in its point estimate. Ethnic heterogeneity has the expected sign but is significant only at the .05 level only for the 1960-90 period, when PC1 is included.[35]

Second, a reader raised the possibility that the PID variables might be serving as imperfect proxies for "initial health capital," and that the estimates of their effects might be biased by exclusion of more direct measures of that variable from our equations. We accordingly carried out a set of estimates in which life expectancy at birth in 1960 was

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Korea in the sample, the PID variables, which are always of the predicted sign, remain statistically significant in all estimates for 1960-90 and for 1975-90 even when the outlyers are dropped.

[34] These are an ethnic heterogeneity index constructed by scholars in the then Soviet Union, and the average of several non-Soviet indices of ethnic heterogeneity.

[35] Only the average non-Soviet ethnic heterogeneity index is significant. Both indices have significant coefficients of the predicted sign for 1960-90, but not for the subperiods, when PC1 is not included, for these samples. Sample sizes are 40, 55, and 46 for 1960-90, '60-'75, and '75-'90, respectively. Results for the 1960-90 period are included in Burkett et al., 1997. Results are similar when China and South Korea are substituted for Hong Kong and Singapore, as in the tests reported in footnote 32.

added to the explanatory variable set of model 7.[36] The results showed that the coefficient on life expectancy is indeed positive and significant in this setting, but that addition of this variable does not change the sign or significance level of PC1 in the equation.[37]

Third, we were intrigued by Sachs and Warner's (1997, hereafter SW) apparent success in explaining differences between African and non-African economic growth using a number of different policy and resource variables. Unlike other studies, SW show the dummy for sub-Saharan Africa becoming insignificant when variables including life expectancy, the natural resource export fraction of GDP, central government saving, tropical climate, access to the sea, and indicators of openness to trade are controlled for. They also provide evidence that ethnic heterogeneity and the growth rates of neighboring countries are of no effect when the latter factors are controlled for. SW's specification differs from that of Barro *et al*. in a variety of ways (for instance, they use log of initial GDP per economically active person, rather than initial GDP, and they use a savings ratio

[36] While life expectancy is a possible proxy for human health capital, it is also viewed by many as an important measure of well-being, and in that respect an outcome of economic performance. To what extent life expectancy or other physical quality of life or human development measures might be determined by such underlying factors as initial income and legacies of pre-modern development, versus government policies or other factors, is an interesting question that we are unable to explore here. (We did some exploratory regressions on our sample and found that about 57% of the variance of life expectancy in 1960 within our sample appears to be explained by a constant term, GDP per capita in 1960, and the three PID measures.) For an exploration of the determinants of the physical quality of life, see Burkett (1985).

[37] The significance level of the coefficient on PC1 is higher than that of the coefficient on life expectancy when the latter is added to model 5, and the point estimate of PC1changes only slightly. Results are included in Burkett et al., 1997. The reader mentioned earlier reported a trial result in which addition of life expectancy to a version of our equation in which popden is substituted for PC1 caused the coefficient on popden to become statistically insignificant. For further assurance, we therefore repeated this test substituting each individual PID variable for PC1. All of the PID variables remain statistically significant and positive in their respective equations. We do not know whether the difference of our result using popden from that reported by the reader is due to our larger sample size (46, versus 39), to the period covered (1960-90 versus 1960-85), or to some other factor.

rather than an investment ratio), and questions can be raised about the variables which are used, including issues of endogeneity and of relationship to PID.[38] To keep our investigation manageable, we tested whether the effects of PID remain significant even after controlling for the variables used by them both (a) by adding their distinctive variable set to the set of explanatory variables in model 7, and (b) by adding our PID variables to the explanatory variables in their most comprehensive model, shown in Table 2 of their paper.[39] When we use approach (a) adding first only the four additional variables included in an earlier version of SW's study, the coefficient on PC1 remains positive and significant.[40] Using the same approach but adding all ten new variables in SW (1997),[41] PC1 is positive but statistically insignificant (although, interestingly, it is significant when Hong Kong and Singapore are excluded).[42] PC1 has an insignificant coefficient when added to SW's own specification, i.e. following approach (b). While

[38] To mention but a few issues, (a) their openness variable is constructed from binary observations in which a country qualifies as open if it falls within certain limits on, *inter alia*, tariff rates, introducing a degree of arbitrariness; (b) openness and government saving are policy variables which may be endogenous to other economic factors, including PID (to be sure, the same might be said of, e.g., BMP); (c) the primary product export share of GDP strikes us as being more of a structural indicator of level of development than one of the abundance of natural resources, the interpretation they propose.

[39] With approach (a), we retain initial GDP per capita, the investment ratio, BMP, the secondary school ratio, and the population growth rate, and leave out their parallel variables (GDP per economically active person, the difference between total and economically active population growth rates, and the savings ratio). For simplicity, we do not include the interaction between openness and log GDP per economically active person, nor the square of life expectancy. With approach (b), we add one PID variable at a time to the regression for 1965-90 shown in their Table 2, including simultaneously all variables shown there except the savings ratio and the inflation rate, which were insignificant in their estimates and for which we lacked sufficient data.

[40] These are their measures of sea access, primary product share, openness, and institutional quality. The version of their study circulated in 1996 used these except that it included a "freedom rating" for which the institutional quality index was subsequently substituted. The results are shown in Burkett et al., 1997.

[41] That is, in addition to the four variables mentioned in the previous note, we add life expectancy circa 1970, central government saving, a dummy for tropical climate, their measure of the growth rates of neighboring countries, and one of the ethnic heterogeneity measures used by Easterly and Levine. As indicated in footnote 35, approach (a) retains the investment share rather than the savings share, and so forth.

[42] That is, PC1 retains a coefficient of about the same sign, magnitude, and significance level as in model 7, Table 2, when these ten variables from SW are added, and we drop the outlyers Hong Kong and Singapore,

comparability of our results with theirs is hindered by a decline in sample size due to added data requirements, it is interesting to note that dummy variables for sub-Saharan Africa and Latin America remain significant and negative in the bulk of these experiments.[43] While there is room for further investigation, then, in some settings, at least, the PID variables appear to explain some of the growth variance left unexplained by the variables used by Sachs and Warner, just as it explains otherwise unexplained variance in the models of Levine and Renelt, Barro, and others.

Finally, while our hypothesis is meant to apply mainly to countries at an early stage of industrialization during the post-War period--we do not expect the PID measures to explain much of the differences in the performances of, say, France and Germany in the post-War era--we found it interesting to investigate whether it holds at some broad level when all countries for which the relevant data are available, including those of Western Europe and other OECD member states, are included. The population densities and intensities of cultivation in most European countries were relatively high, although probably not the highest in the world, when their industrialization processes began. During the post-War era, the population densities, cultivation intensities, and irrigation ratios of European countries were on average intermediate between those of Asia and of Latin America, as were their growth performances.[44] We re-estimated the equations of Tables 2 - 4 adding European and other OECD countries, and found that our hypothesis

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including instead South Korea (there is insufficient data for China), as in the exercise mentioned in footnote 32. See Burkett et al., 1997.

[43] It is possible to include only 39 countries, as compared to the 77 to 79 for their estimates, when we add their first four variables, and only 36 countries when we add all ten variables. Substituting popden for PC1 increases sample size only slightly and gives the same qualitative result.

appears to hold as well or better for this larger sample. As might be expected, the improvement is less noticeable when all of the OECD countries are added, primarily because the U.S., Canada, Australia and New Zealand have European-like economies (attributed to broad human capital transfer in earlier remarks) but lower population densities and more land per farmer. By contrast, inclusion of Japan, a high density and high growth country, strengthens the qualitative result of the tables with respect to the PID variables. These results suggest that the linkage between pre-industrial development and modern economic growth that is hypothesized in this paper has been a worldwide phenomenon, and not one that holds for the less developed countries only. [45]

5. Policy Implications

We have seen that any one of our three indicators of pre-industrial development typically contributes as much to the explanation of recent economic growth as do the more standard variables analyzed by Barro, Levine and Renelt, and others, and that the addition of these variables to their equations explains roughly the same fraction of the growth residual otherwise picked up by region dummies, and the better part (57%) of that majority of the growth residual that is explained when both PID indicators and region

[44] These statements apply mainly to Western Europe. Comparable data for formerly Communist east and central Europe are not provided in our sources.

[45] The basic result for the sample including both OECD and non-OECD countries is included in Burkett et al., 1997. The fact that northwest Europe industrialized before East Asia suggests that factors other than position on the type of pre-industrial development scale used in this paper--factors the identification of which would take us beyond the scope of this paper--became more decisive once threshold levels of PID were achieved, as may have occurred many centuries ago for both groups of countries. The results just reported suggest that the pre-industrial legacy of both groups of countries may nevertheless still help to explain their overall growth performance relative to that of other countries in the late 20th century.

dummies are added.[46] The results are somewhat sensitive to sample composition and period, and constructing a data set that allows testing with larger samples would thus be desirable. Likewise, while the results are robust with respect to inclusion of several other candidate variables, this is not uniformly the case, so that further investigation is warranted. .

If the trends highlighted by this initial exploration were to be confirmed, what would be their implication for economic policy? Since the PID variables are givens to each country from the present standpoint, what does their inclusion in our study contribute beyond what we already know from the significance of regional dummy variables or of those for such exogenous factors as SW's tropical climate dummy? The most obvious response to this question is that our analysis provides evidence that a country's economic history matters, a finding that might serve as a point of departure for arguing that it too must be understood in order to develop more useful policy prescriptions. But we also wish to suggest a more specific answer. While our analysis literally shows only that three demographic and resource variables have influenced recent economic growth, we suggest that these variables are indicators of stages along a developmental continuum. We argue that the reason why the distance between the industrial stage of development and a country's indigenous developmental stage prior to the recent push for development helps to determine its measured performance in the early

[46] In a paper which appeared as we were completing this research, Sachs and Warner (1996) show that the significance of the sub-Saharan Africa dummy variable can be eliminated entirely if the growth rate is explained by a set of explanatory factors that include a measure of access to the sea and the proportion of primary products in each country's exports. In future work, we hope to explore whether our PID measures

decades of that push is that different countries' human capital stocks broadly understood as including informal learning, culture, and the collective knowledge base, were differentially pre-positioned to respond to the possibility of modern growth.

To tease out further implications from the analysis, we need to ask how the paths traveled by each country both in the recent past and in the near future are likely to affect the preparedness for industrialization just referred to. For us, the idea that ways of economic life in their entirety influence countries' capacities for modern economic development suggests that the way forward for the less advantaged countries should include attention not only to the impact of formal education--a factor difficult to measure in quality-adjusted terms, and one that fails to show systematic impact in the results obtained here[47]--but also to that of a wider array of factors including citizens' participation in market activity, modern sector employment, exposure to modern ideas and practices, and opportunities for entrepreneurship. Favorable conditions in these respects could help to build up long-term capacities for development in ways that may not show up in output figures for some time. And if this is so, the payoff of expanding employment, increased access to modern farm inputs, or more small business opportunities, which have already been accumulating in the recent past and continue to occur in most societies today, could be far greater than is reflected in their immediate

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retain their explanatory powers when these other variables are included in the model, and to discuss their theoretical significance.

[47] While we have no intention of drawing policy conclusions from our weak result on formal education, it should be noted that the evaluation of our own hypothesis, which emphasizes the role of a more broadly conceived human capital, is in no way dependent upon whether *formal* education is or is not an effective causal agent in development.

impacts on output. Policies of governments and other agents concerned with promoting the growth process might be tailored accordingly.

Other interpretations of our evidence are doubtless possible. We think that our findings are particularly striking in view of the fact that we seem to find higher population density and "pressure on farm land" to be a boon, rather than an obstacle to development, as many might have been supposed they would be. Others might be less surprised that high population densities are favorable to growth, given that they permit more specialization and trade at lower cost, as noted long ago by Adam Smith. They might also argue that high population densities and man-land ratios could be proxying for superior soils and climates, factors not contolled for in our analysis. If carried far enough, such arguments imply that our "stages of development" interpretation is spurious or beside the point.

We do not want to dismiss these arguments, and indeed, we suppose that there is a measure of truth in them. We incorporate the Smithian factor in our own conjectures about why pre-industrial social development would be conducive to modern economic growth. A reasonable case can be made, however, that diminishing returns to population density as such would have set in the most densely populated countries some time ago, in which case its linkage with growth requires additional explanations, such as those suggested by us. That contemporary population growth rates are not positively related to economic growth, in our findings, provides further support for our interpretation of the effect of population density as acting partly through the kind of societal human capital

that in the past, at least, took generations to develop. Boserup's approach suggests that soil quality, for its part, should not be taken as completely exogenous, since cultivation systems can significantly influence soils by either imparting to (as in intensive systems with crop rotation and application of animal manures) or stripping (as in slash-and-burn or annual planting without the latter practices) the ground of nutrients. In any case, it is not obvious why either superior soils or more irrigation facilities, which could indeed raise output per capita, should also be raising *growth rates*, after investment rates have been controlled for.

A subtler challenge to our interpretation of our results is that while there may be a non-Smithian element in the link between pre-industrial development and recent economic growth, the slower growth of countries that had pre-modern societies that were less developed in a social evolutionary sense may be entirely attributable to the weakness of state administration in societies having less of a tradition of large scale states, with none of the other linkages (for instance, those concerning work attitudes and technical skills) playing a role. A very preliminary test of this alternative hypothesis is made possible by the fact that the Barro-Lee data set contains series for the numbers of coups, revolutions, and assassinations in most of the countries included, from which it constructs a "political instability" index which has been found to be significantly correlated with economic growth (see Barro, 1996; Perotti, 1996). We find that this index and its components are *not* significantly correlated with our three measures of pre-industrial

development.[48] This leaves open the possibility that more subtle measures of state capacity and/or national political integration are correlated with those measures, as we would indeed expect them to be. Identifying such measures as well as proxies for the key elements involved in the other hypothesized linkages is beyond the scope of this paper.

6. Conclusion

In this paper, we hypothesized that the stage of pre-industrial social and economic development that a society had attained before embarking on the quest for modern economic growth is an important determinant of its growth performance in the post-War era. We conjectured that societies marked by economic and social structures associated with intensive agricultural production, high population density, and large-scale states, would make the transition to industrialization more rapidly than would those characterized by extensive agriculture or pastoralism, which are associated with low population densities and smaller units of political integration. We suggested that this effect would occur because the societal human capital of the first type of society could more quickly adapt to the requirements of an industrial economy. More specifically, we argued that industrialization would be facilitated, in the more productively intensive and densely populated systems, by more conducive work habits and attitudes, more favorable inventories of technical knowledge, more commercially-oriented practices and cultures,

[48] The Barro-Lee political instability index is a weighted average of the average number of assassinations per million population per year and the average number of revolutions per year. We also constructed another political instability index consisting of a weighted average of the latter measures and of the average number of coups per year, and found that it, too, was not significantly correlated with our three measures of pre-industrial development. Correlations were checked by estimating regression equations with a political

greater economic autonomy of households, greater ease of political integration, and more experience with bureaucratic structures of taxation and administration.

We were able to test these conjectures on a country-level cross-sectional data set covering the years 1960-90, using measures of population density, farm population per cultivated hectare, and the proportion of cultivated land irrigated in 1960 as proxies for the pre-industrial development before the modern period. These measures were added individually, and represented by their first principal component, to the explanatory variable set of a standard growth equation in which the dependent variable was the rate of growth of real GDP per capita, and the other independent variables were the initial GDP per capita, the investment ratio, the initial secondary education ratio, and the population growth rate. The results for our developing country sample supported the hypothesis, in that each of the three PID measures was found to be significantly correlated with growth in the predicted direction, both for the full period studied and for two sub-periods of equal length. Represented by their first principal component, the PID measures were found to explain a larger proportion of the variance left unexplained in an otherwise similar but unaugmented growth regression than do dummy variables for sub-Saharan Africa and Latin America. Moreover, the dummies and PID measure together explained fully 62.5% of that otherwise unexplained variance, as compared with only 40% for the region dummies alone. Support for the hypothesis was also found for a general sample including developed and developing countries.

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instability measure as dependent variable and with the pre-industrial development measures entered

While our main results use PID measures for 1960 as proxies for developmental status somewhat earlier in time, we also found support for our hypothesis for a subsample of countries for which we obtained data on population density for the year 1911. More work might be done to find other measures of PID pertaining to earlier points in time, so as to further test the hypothesis. Investigations of related measures, such as direct indicators of state scale, could help to pinpoint just how, or what aspects of, pre-industrial development have impacted recent economic growth. The hypothesis could also be tested using case-study methods and by applying an approach similar to that used here to data from regions within countries.

We interpret our findings as suggesting most generally the relevance of history to modern economic performance, and more specifically the importance of human capital, conceived more broadly than can be captured by statistics on formal education. Policies that increase the stocks of technical, administrative, and commercial know-how, and the attitudes or ethos linked to the associated activities, could pay off, we have argued, in the form of an increased developmental potential that might be translated into enhanced economic performance only over the longer run. The results thus provide some support for the "capacity-building" emphasis in some recent development programs. We are agnostic about the implications of our analysis for the much-discussed issue of convergence of productivity and well-being over time. And we do not argue that influences of pre-industrial development observable in a particular period of the late 20th Century will persist indefinitely. That such nations as the U.S., Canada, and Australia

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individually and jointly as independent variables.

have achieved modern economic growth without high man-land ratios suggests that it is *the knowledge and attitudes* associated with past structural conditions, rather than those conditions in and of themselves, that are most critical for economic development. Thus, there is no reason to suppose that, e.g., sub-Saharan Africa must achieve East Asian population densities before it can enjoy rapid economic growth. We would argue that what is to be sought are increases in the congruence of the continent's human capital stock with the requirements of modern economic growth. Exactly how this can be done must be the subject of future research.

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