# Factor Returns, Institutions, and Geography: A View From Trade

Scott L. Baier

Clemson University and Federal Reserve Bank of Atlanta

Gerald P. Dwyer, Jr.

Federal Reserve Bank of Atlanta

Robert Tamura

Clemson University and Federal Reserve Bank of Atlanta

January 2005

**Abstract**

We show that estimated productivities of labor and capital which rationalize trade flows across countries are related to total factor productivities which rationalize output differences across countries. We present evidence that these productivies from trade flows are related to the institutions and geography across countries. Protection of property rights is the dominant influence on both labor and capital productivity, with geography less important and democracy even less important. We also present preliminary evidence that protection of property rights has similar effects on workers with only primary education and those with more education.

**Acknowledgement 1** *We thank William Dougan, Stanley Engerman, Casey Mulligan, Rowena Pecchenino, Dani Rodrik, Thomas R. Saving, Robert Tollison and Daniel Trefler for comments on earlier drafts of this paper. LindaMundy provided editorial assistance. An earlier version of this paper was presented at the Villa Mondragone International Economic Seminar. Baier appreciates financial support from the BB&T Bank and the Center for Internationl Trade at Clemson University. The views expressed here are the authors' and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. Any remaining errors are the authors' responsibility.*

## INTRODUCTION

Why was the typical manufacturing worker paid roughly ten times more in the United States than in the Philippines from 1995 to 1999? No doubt part of this difference is due to the quantity of capital per worker, but simple calculations show that it is extremely unlikely that capital and other factors of production account for all of the difference. Suppose that production in manufacturing is characterized by a Cobb Douglas production function in capital and labor with labor's share equal to 0.6 and no differences in the years of schooling completed by manufacturing workers in the U.S. and the Philippines; then the manufacturing capital stock per worker would have to be 478 times higher in the U.S. than in the Philippines to be the sole explanation of the observed wage differences. The typical U.S. worker has about three and a half more years of schooling than the typical Filipino worker in 2000. Even with a relatively high return of 10 percent for each year of schooling, the U.S. capital stock per worker would have to be 333 times larger in the U.S. than in the Philippines to explain the difference in wages – very far from the five times difference in capital per worker in the United States relative to the Philippines. Large disparities in relative wages are not particular to this example of the U.S. and the Philippines. For a set of

80 countries, the average manufacturing wage in the top five percent of countries is 58 times greater than the average manufacturing wage paid in the bottom five percent and ten times greater than the median country's manufacturing wage.[1] Differences that cannot plausibly be explained by other factors of production are referred to as *productivity differences* – a name for the differences in the returns to labor and capital across countries but not an explanation.

Economists have tried to quantify the determinants of cross-country differences in income per person. Since physical capital and human capital can be measured, the obvious starting point is that higher income per person is associated with more human and physical capital per person. Hall and Jones (1999) assume that markets are competitive with factors of production paid their marginal products. Applying the standard growth accounting decomposition to the level of output, they decompose output per worker into the fraction of output that is due to physical capital, human capital, and a residual.[2] The residual, or as Solow termed it, a "measure of ignorance," frequently is referred to as *total factor productivity*. Hall and Jones find that stocks of physical and human capital can account for only 35 percent of the differences between the richest and poorest countries. The remaining 65 percent is due to the residual, total factor productivity. In related work, Klenow and Rodriguez-Clare (1997) find that up to 80 percent of the cross-country variation in the level of output per worker is due to total factor productivity. Over longer horizons, Baier, Dwyer and Tamura (2004) find that variation in the growth of total factor productivity explains up to 80 percent of the cross-country differences in the growth of output per worker.

In an attempt to explain these differences, Hall and Jones examine possible explanations of this variation in output per worker and total factor productivity. They show that output per worker and total factor productivity are highly correlated with

[1] The data are from the World Development Indicators 2003.

[2] This decomposition in the levels sometimes is called 'development accounting.'

institutions that protect personal property rights and with openness to international competition. On a different tack, Gallup and Sachs with Mellinger (1999) find that differences in geography are quite important determinants of cross-country differences in both levels and growth rates of income per person.

There has been substantial interest in understanding the relationships among institutions, geography, income and productivity. Recent empirical analyses include Knack and Keefer (1995), Sachs and Warner (1995), Barro (1996), Hall and Jones (1999), Acemoglu, Johnson and Robinson (2001), Rodrik, Subramanian and Trebbi (2002) and Easterly and Levine (2003). Most of this work has focused on how institutions and geography affect income per person or related quantities such as output per worker. There has been little work done, however, to explore how institutions and geography affect returns to labor and capital separately.[3]

Knowing how institutions influence factor returns is important partly because the relative effects on factor returns are likely to be helpful for understanding the effects of institutions on the level and growth of income per person. As Engerman and Sokoloff (2003, p. 14) point out, different institutions

> may have different implications for different segments of the population. Depending upon the manner in which institutions evolve, or are designed, in a society, they may develop to favor interests of more powerful groups at the expense of others, or even the population at large.

Furthermore, differential effects of institutional changes on higher and lower income members of populations are an important issue in policy discussions. Knowing how institutional changes affect owners of capital compared to workers and knowing how

[3] A notable exception is Rodrik (1999) who finds that countries that have a higher democracy index pay higher wages even after controlling for per capita income and value added in the manufacturing sector relative to workers in manufacturing.

those changes affect higher and lower income workers can help us to understand institutional change as well as informing policy discussions.

In this paper, we estimate the productivity of capital and labor and then examine the relative importance of institutions and geography for those productivities. There is little information available on factor returns that is comparable across countries.

We use the relative factor content of trade to estimate the productivities of capital and labor across countries. We start with a standard model of international trade: the Heckscher-Ohlin-Vanek (HOV) model. In this standard model of an integrated world in which all countries produce all goods, trade in factor services is a function of a country's endowments relative to its consumption of factor services, and trade in goods is a substitute for direct trade in factor services or migration of factors. Trading goods is implicit trading of factor services, which can equalize factor returns. With identical technologies, the HOV model implies that 1. A country has a comparative advantage in producing goods that use its relatively more abundant factors and it is a net exporter of that factors' services. 2. In equilibrium, factor prices are equalized. If all goods are produced by all countries, even if the factors of production are immobile, factor prices are the same across countries in the resulting integrated world equilibrium.[4] Empirical tests of the HOV model examine the relationship between endowments and the observed pattern of trade and find that the HOV model explains little of trade patterns, however.[5] In addition, differences in measured wages across countries indicate that violations of absolute factor price equalization are virtually self-evident. Hence, there must be explanations of the factor content of trade besides the simple HOV model.

[4] At the level of aggregation used for the countries in this paper, there are no industries with zero production. This suggests to us that the conditions for factor price equalization are likely not to be wildly unrealistic in the context of the differences across countries envisaged in the theory.

[5] A partial list of these studies include Maskus (1985) Bowen, Leamer, and Sveikauskus (1985), Trefler (1993, 1995) and Davis and Weinstein (2001).

Half a century ago, Leontief (1953) suggested a possible explanation for the HOV model's poor performance – some countries may use their endowments more efficiently than others. An innovative series of papers by Bowen, Leamer and Sveikauskas (1987) and Trefler (1993, 1995) followed Leontief's suggestion and allowed for technological differences in the HOV model. Trefler (1993) shows that factor-augmenting technology can equate actual trade in factor services and the theoretically implied trade in factor services. Allowing for factor-augmenting technological differences implies that factor prices are equalized in terms of relative efficiency units; i.e., if labor-augmenting technology is five times higher in the United States than in Mexico, workers in the U.S. will receive a wage that is five times greater than the wage paid to Mexican workers who are identical other than being in Mexico. Trefler presents evidence that there is a strong relationship between relative factor payments and relative factor-augmenting productivity.

Allowing for differences in factor-augmenting technology and improving the model's fit may seem appealing, but the measures of productivity that result from trade theory become a measure of ignorance. As Feenstra (2004, p. 61) notes,

> Even if we accept that the HOV equation can fit perfectly by allowing sufficient differences in technologies across countries, this begs the question, *where do the differences come from?* .... Such differences can hardly be accepted as exogenous, however, and must be explicable based on underlying causes. [Emphasis in original.]

This is precisely the same complaint made about total factor productivity in macroeconomics. Substantial effort over several decades has gone into examining why there are differences in total factor productivity across countries. Perhaps that research agenda has implications for factor-augmenting technology?

Indeed, we show that the measures of factor-augmenting technology obtained from trade theory, which also can be called measures of factor productivity, are related to total factor productivity. Theoretically, factor productivity implied by trade is similar to total factor productivity in the following sense: If factor productivity indicates that one unit of U.S. capital is twice as productive as one unit of Filipino capital, then the return to capital will be twice as high in the U.S. as in the Philippines. Similarly, for a given level of capital in the U.S. and the Philippines, if total factor productivity in the U.S. is twice as high as total factor productivity in the Philippines, then capital and labor's returns can be twice as high in the U.S. Therefore, total factor productivity has the same effect on the returns to capital and labor as factor productivity from the HOV model. It would be quite disturbing if macroeconomic theory indicates that one country has relatively high productivity and trade theory reaches the opposite conclusion. Despite this theoretical relationship, factor productivity from the HOV model and the level of total factor productivity from development accounting are based on two independent sets of computations and the relationship of these two measures is an empirical question. Reassuringly, our empirical results indicate that an aggregated measure of factor-augmented productivity is highly correlated with total factor productivity from development accounting. The correlation of these two measures of productivity is 0.87.

In this paper, we explore the determinants of differences in factor productivities across countries. We examine the relationship of institutions and geographic characteristics with the factor productivities that are related to factor returns. For most of our results, we use two factors: physical capital and effective labor.[6] We use these productivities to measure the extent to which institutions and geography influence factor returns. Because a differential effect on those with less education is an important and interesting issue, we also examine the differential effects of institutions and

[6] We use a Mincerian formulation for the returns to schooling and experience, with aggregate labor in terms of efficiency units for the worker with the average level of education and experience.

geography on unskilled and skilled labor based on education. Rather than attempt to construct effective unskilled and skilled labor given the inadequate information available, we measure unskilled labor by the number of workers with at most primary education and skilled workers by the number of workers with education beyond primary school.

Our measures of institutions include how well a country protects property rights and how democratic the country is. With respect to geography, we consider two ways that geography influences factor productivity. First, certain geographic characteristics reduce productivity because they are associated with an unhealthy climate that is not conducive to production. An unhealthy climate is a climate that provides a breeding ground for diseases with possible high death tolls unless substantial resources are allocated to prevention and treatment of these diseases, which means that the climate acts effectively as a tax on production of non-disease-preventing production. Second, geography can limit the extent of the market. Countries that have small local markets, are far away from large markets, and do not have access to water transport may not be able to specialize and exploit economies of scale as much as others, thereby becoming less productive.

The government's protection of personal property rights is highly correlated with factor productivity. Democracy generally is positively correlated with both labor and capital productivity, but this univariate relationship disappears once property rights are included in regressions. Geographic variables can account for some of the cross-country differences in productivity, but the only geography variable that is robustly correlated with productivity is distance to the nearest large market. These results continue to hold when we correct for potential endogeneity of the measures of property rights and democracy. We also find that the effect of property rights protection on the productivity of skilled and unskilled workers is similar.[7]

[7]Distance to the nearest large market is measured by the natural logarithm of the minimum

This paper is organized as follows: Section two presents our construction of factor productivities. We show HOV theory with and without differences in productivity, discuss the data used in this paper and compare the measures of capital and labor productivity to each other and to total factor productivity. In section three we examine the relationships of capital and labor productivities with institutions and geography. We also consider the effects of institutions' endogeneity by using instrumental variable (IV) estimation and present preliminary evidence on whether there are differential effects of institutions and geography on skilled and unskilled labor estimated by completed years of schooling. Section four concludes.

## HOV THEORY AND PRODUCTIVITY DIFFERENCES

In this section, we summarize how HOV theory generates measures of productivity based on Vanek's transformation of trade in goods into trades in factor services. Let $i = 1, ..., H$ index countries, $m = 1, ..., M$ index factors of production and $n = 1, ..., N$ index industries with $M < N$. We define $Y_i$ as the $N \times 1$ vector of industry outputs produced by country $i$. We assume that countries have identical constant returns to scale production functions, markets are perfectly competitive, and the world is free from barriers that distort trade. Each country has an $M \times 1$ vector of endowments $V_i$. We assume that world endowments are distributed in such a manner that the distribution is consistent with an integrated world equilibrium in which all countries produce all goods, which is sufficient to rule out corner solutions. We also assume that the input requirements for producing various industries's outputs are common across countries.

In the baseline HOV model, there are no differences in how efficiently factors are used across countries, and the technology is given by a $M \times N$ matrix of common direct and indirect technology $D$, where $d_{m,n}$ is the amount of factor $m$ required

distance to New York, Rotterdam or Tokyo.

to produce one unit of good $n$. Full employment of resources implies that the vector of factor endowments for country $i$, $V_i = [v_{1,i}, ..., v_{M,i}]'$, is related to output by $V_i = DY_i$. We define $C_i$ as an $N \times 1$ vector of domestic expenditure on final goods and services. If people in all countries have identical and homothetic preferences, country $i$'s expenditure is proportional to its share of world expenditure, i.e., $C_i = s_i C_w$ where $C_w$ is the world expenditure vector and $s_i$ is country $i$'s share of world expenditure. Multiplying country $i$'s expenditure vector by the direct and indirect input requirement matrix yields $DC_i = s_i DC_w = s_i V_w$ where $V_w$ is the $M \times 1$ vector of world endowments. The predicted factor content of trade is factor use in domestic production, $V_i$, minus factor use in domestic expenditure on the goods, $s_i V_w$. The measured factor content of trade, $F_i = [f_{1,i}, ..., f_{M,i}]'$, is the $M \times 1$ vector of implied trade flows of factors, which equals exports minus imports multiplied by the direct and indirect factor requirements matrix, i.e., $F_i = D(EX_i - IM_i)$ where $EX_i$ and $IM_i$ are the $N \times 1$ vectors of country $i$'s exports and imports.

The correlation between the measured factor content of trade and the predicted factor content of trade typically is very low. The sign test, one simple test used to assess the predictions of the HOV model, is the percentage of times that the measured content of factor $m$ in trade, $f_{m,i} = \sum_{n=1}^{N} d_{m,n}(ex_{n,i} - im_{n,i})$, has the same sign as the predicted content of factor $m$ in trade, $\widehat{f}_{m,i} = v_{m,i} - s_i v_{m,w}$. There are $H - 1$ independent observations, the $H$th being implied by the other $H - 1$ countries because the shares of expenditure add up to one. The percentage of sign matches typically is around 50 percent, indicating that the HOV prediction is no better than a flip of a coin.[8]

Trefler (1993) allows for international differences in factor productivity. Using productivity of factor $m$ in the United States as the numeraire for each factor, Trefler

[8] Maskus (1984) termed the consistently poor performance of the of the HOV model the "Leontief commonplace" as opposed to the "Leontief paradox".

calculates the country's effective units of factor $m$ relative to the United States' effective units. He defines $\pi_{m,i}$ as the relative factor augmenting technology for factor $m$ in country $i$, which also can be called the relative productivity of factor $m$ in country $i$. The predicted factor content of trade for factor $m$ by country $i$ adjusted for differences in productivity is $\widehat{f}_{m,i} = \pi_{m,i}v_{m,i} - s_i \sum_{i'=1}^{H} \pi_{m,i'}v_{m,i'}$ in which the $\pi_{m,i}$'s are unknowns. This adds $H$ unknowns for each factor $m$ for the $H$ countries. Given the singularity due to the expenditure shares summing to one, we normalize the U.S. productivity for each factor to one, as does Trefler (1993). If the predicted and actual factor contents of trade are equated, i.e., $f_{m,i} = \widehat{f}_{m,i}$, there are $H-1$ unknowns $\pi_{m,i}$ and $H-1$ linear equations for each factor $m$, $f_{m,i} = \pi_{m,i}v_{m,i} - s_i \sum_{i'=1}^{H} \pi_{m,i'}v_{m,i'}$, where $\pi_{m,US} = 1$. It is possible to solve exactly for these unknown factor productivities $\pi_{m,i}$ that exactly "predict" or "explain" the factor content of trade. As Trefler points out, the estimates of productivity for a factor are independent of mismeasurement of the quantities of other factors and their productivities.

**Data**

As in other HOV studies, the data used in this study are drawn from a variety of sources. Unless otherwise noted, all data are for 1997 for 84 countries with 32 industries of traded goods. The Appendix lists the countries and industries.[9] The data on trade flows are from World Trade Flows 1980-1997 (Feenstra 1999).

Our primary estimates use data on two factors of production: the capital stock and the labor force measured in effective labor units. The capital stock measures are constructed using the perpetual inventory method with an annual depreciation rate of 13.3 percent (Leamer 1984) and the real investment data from Baier, Dwyer,

[9]Data are available to estimate trade productivities for 91 countries, but the insitutional information used in the later regressions is not available for seven of them, which leaves the 84 countries in the empirical analysis and listed in the Appendix.

and Tamura (2004). Aggregate labor force data are converted into effective labor force units by multiplying the labor force by $\exp(\varphi(educ_i, exper_i))$ where $educ_i$ is the number of years of schooling for the average worker in country $i$, $exper_i$ is the average level of experience in country $i$ and $\exp(\varphi(educ_i, exper_i))$ reflects returns to education and experience.[10] Data on the labor force are from the World Bank (2002). Data on education are from Baier, Dwyer, and Tamura (2004).

For some of our analysis, labor is divided into skill categories based on education. Data on education are multiplied by the labor force in each country to arrive at the number of workers with some primary education – called "unskilled workers" and those with at least some education beyond the primary level – called "skilled workers". Because we do not know the average education of the workers in the skill categories, calculating these measures of labor based on education comes at the expense of not being able to measure labor in efficiency units.

Construction of the direct and indirect input requirement matrix is standard (Bowen, Leamer and Sveikauskas 1987). Input requirements are based on the 1997 input-output tables for the United States. The stocks of capital by industry in the U.S. are from the U.S. series "fixed reproducible tangible wealth." To equate the total of these capital stocks and the U.S. perpetual-inventory aggregate capital stock, the capital stock in each industry is multiplied by the ratio of the U.S. perpetual-inventory aggregate capital stock to the total of the U.S. capital stocks from fixed reproducible tangible wealth. This results in a sum of the capital stocks by industry in the U.S. equal to our estimate of the aggregate U.S. capital stock . Data for the labor force

[10] The derivatives of $\varphi$(educ$_i$,exper$_i$) are the returns to an additional year of schooling or experience that can be estimated from Mincerian wage regressions. As in Hall and Jones (1999), Debaere and Demiroglu (2003) and Baier, Dwyer and Tamura (2004), we assume that the return to education for the first four years of schooling is 13.4 percent, 10.1 percent for the second for years, 6.8 percent for all years of education above the 8th year. As in Klenow and Bils (2000), we assume the return to experience is quadratic.

employed in each sector are from the National Income and Product Accounts of the United States and the Bartlesman and Gray productivity database (1997). The labor force is adjusted to equal the total labor force given for the U.S. in World Bank (2002). Data on workers' average education by industry for the Untied States are from the 1990 Census (Ruggles, Sobek *et al.* 2003). Income per capita and population are from the World Bank (2002). Each country's share of world consumption is $s_i = (GDP_i - TB_i)/\sum_{i=1}^{H}(GDP_i - TB_i)$ where $TB_i$ is country $i$'s trade balance and $GDP_i - TB_i$ is country $i$'s absorption of goods and services.

Data on the protection of property rights are from Hall and Jones (1998, 1999). Data on democracy are based on the Polity IV data (Marshall and Jaggers 2004) that update the Polity III data (Jaggers and Gurr 1995), data on legal origin are from La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998), and data on geography are from Gallup and Sachs with Mellinger (1999).

**HOV Estimates**

**Baseline HOV Results for Trade.—**

The assumptions from the baseline HOV model in which technology is assumed to be the same across countries can be summarized as

**Assumption** 1. In each country, factors are mobile across sectors and factor markets clear.

**Assumption** 2. Tastes can be represented by homothetic preferences that are the same across countries, which implies that countries will consume factor services proportional to their world share of consumption; that is, $C_i = s_i C_w$.

**Assumption** 3. Each country has access to the same technology.

**Assumption** 4. The distribution of the endowment of factors is such that world trade is consistent with an integrated world equilibrium in which each final good is produced by every country.

We focus on two implications of the model, namely

**Proposition** 1. Factor price equalization holds, i.e., $w_{m,i} = w_{m,i'}$ where $w_{m,i}$ is the return to factor $m$ in country $i$.

**Proposition** 2. The predicted factor content of trade is $\widehat{f}_{m,i} = v_{m,i} - s_i v_{m,w}$ and the actual factor content of trade is $f_{m,i} = D_m(EX_i - IM_i)$.

A weak implication of the HOV hypothesis is that country $i$ should export the services of its relatively abundant factor and import the services of its relatively scarce factor, which implies that $\widehat{f}_{m,i} \gtreqless 0$ as $f_{m,i} \gtreqless 0$, an implication that can be examined by a sign test. The sign test tabulates the percentage of times that the signs of $\widehat{f}_{m,i}$ and $f_{m,i}$ are the same. The percentage of observations for which the actual and predicted effective labor and capital content of trade have the same sign is 47.8 percent. The HOV model performs worse than a flip of a coin![11] If we attach more weight to observations with a larger factor content of trade as in Trefler (1995), this weighted statistic is 63.5 percent – an improvement but still a far cry from one hundred percent.[12] Allowing for cross-country differences in productivity is a way to weaken the assumptions of the model and examine why this model does not fit.

**HOV Estimates of Productivities.—**

[11] Bowen, Leamer, and Sveikauskus (1987), Trefler (1993, 1995) and Davis and Weinstein (2001) report similar results.

[12] The results are similar if labor is measured in terms of the number of workers rather than in terms of efficiency units. The percent with the correct sign is 47.8 percent using the number of workers. If more weight is attached to observations with a larger factor content of trade, the percentage correct increases to 64.2 percent.

As does Trefler (1993), we allow productivity to differ by country and by factor. Assumptions 1, 2 and 4 of the baseline model are the same. However, we modify Assumption 3 to allow for cross-country differences in factor productivity.

**Assumption** 3′. Technology can differ by country and by factor.

This assumption plus Assumptions 1, 2 and 4 imply that

**Proposition** 1': Factor price equalization holds in terms of efficiency units, i.e., $w_{m,i} = \pi_{m,i} w_{m,US}$.

**Proposition** 2': The actual factor content of trade $f_{m,i}$ is identically equal to the predicted factor content of trade $\widehat{f}_{m,i} = \pi_{m,i} v_{m,i} - s_i \sum_{i=1}^{H} \pi_{m,i} v_{m,i}$ with $\pi_{m,US} = 1$.

Trefler (1993) examined the plausibility of the model by comparing relative factor returns, $w_{m,i}/w_{m,US}$, to the relative productivities, $\pi_{m,i}$. He found a good fit between these relative factor returns and the relative productivities.[13]

Figure 1 shows estimates of aggregate labor and capital productivities. The vertical axis is the country's capital-augmenting productivity and the horizontal axis is the country's labor-augmenting productivity. The figure shows that countries with high measured labor productivity tend to have high measured capital productivity, but

[13] Using a different methodology, Repetto and Ventura (1997) find that, while factor prices do reflect differences in factor-augmenting productivity, disparities exist in relative factor prices even after taking into account differences in productivity. Because of the data requirements for their tests, they have a relatively small sample size and their estimates are imprecise.

Gabaix (1997) calculates the productivity by factor types assuming zero trade and shows little difference between these productivities and the productivities when trade is included in the calculation. We find tht the productivities are on average 10 percent different with trade than without trade. Thus trade conveys some information. Even if it was the case that actual trade is low relative to predicted trade, there must be some explanation. Presumably differences in productivity can be an explanation for the missing trade.

the relationship between these two measures is far from perfect. The correlation between the two measures is 0.58. We find that the mean level of capital productivity is higher than the mean level of labor productivity, and there is less dispersion of capital productivity than labor productivity. This is not too surprising to us. If capital is more mobile than labor, then returns to capital will be more equalized across countries. There are a few countries that have high capital productivities relative to their income, for example Angola, which has high capital productivity possibly due to the endowments of natural resources – diamonds and oil.

### HOV Productivity and Total Factor Productivity

What is the correlation of these trade measures of factor productivity with other measures of aggregate productivity? We compare the factor-augmenting productivity from Trefler's approach to the estimate of productivity from development accounting.

In the growth literature, factor endowments account for little of the cross-country differences in income per worker. Klenow and Rodriguez-Claire (1997) and Hall and Jones (1999) are two recent papers that emphasize this, finding that much of cross-country differences in output per worker are due to differences in total factor productivity. They calculate total factor productivity from an aggregate production function. Let $y_i$ be output per worker in country $i$. With Cobb Douglas production, output per worker is given by

$$y_i = A_i k_i^{\alpha} h_i^{1-\alpha} \tag{1}$$

where $A_i$, $k_i$, and $h_i$, are total factor productivity, capital per worker and human capital per worker in country $i$. Total factor productivity in country $i$ relative to total factor productivity in the U.S. is

$$\frac{A_i}{A_{US}} = \frac{y_i / k_i^{\alpha} h_i^{1-\alpha}}{y_{US} / k_{US}^{\alpha} h_{US}^{1-\alpha}} \tag{2}$$

This relative total factor productivity can be compared to productivity estimated from the factor content of trade. A simple way to aggregate the capital and labor productivities from trade theory is to take a geometric average of the capital and labor productivities, $\pi_i = \pi_{k,i}^{\eta} \pi_{\ell,i}^{1-\eta}$, with the weight on capital's productivity equal to its share of income. We set capital's share of income $\eta$ to 0.33, a value consistent with Gollin's (2002) careful cross-country study of income shares. Figure 2 shows that there is a substantial positive relationship between the geometric average of the trade productivities and relative total factor productivity. The correlation between the measure of relative productivity from the factor content of trade and relative total factor productivity is 0.876, which indicates that the two measures of productivity derived from largely independent data are quite similar.[14]

## PRODUCTIVITY, GEOGRAPHY, AND INSTITUTIONS

What country-specific factors are related to these measures of relative productivity? We focus on the correlations of factors' productivities with geography, property rights protection and democratic government. We separate the potential influence of geography on productivity into "productive geography," which affects productivity through geographic characteristics, and "market geography," which affects productivity through access to large markets and the ability to specialize and exploit economies of scale. Then we describe the measures of property rights and democracy.

Initially, we report the $R^2$ from separate regressions of the productivity measures on productive geography, market geography, property rights protection, and democracy. These are followed by regressions that include different subsets of these four

[14] If productivity differences are assumed to be only labor augmenting as in Hall and Jones (1999), the correlation of relative total factor productivity and the total relative trade productivity is 0.89.

We also performed a grid search allowing capital's share to vary between 0.01 and 0.99. The highest correlation between the aggregated trade productivities and total factor productivity is 0.876 to three digits, which is the value with capital's share ranging from 0.31 to 0.40.

possible influences on productivity. Of course, inferring causality from correlation can be problematic, and high productivity may be a result as well as a cause of institutions. We think that it is likely, though, that a country's geographic characteristics are exogenous relative to their productivity. In the last part of this section, we examine some instrumental-variables estimates of the relationship of productivity with property rights and democracy.

**Geography**

Geography can affect productivity directly by limiting the productivity of resources due to characteristics of an area associated with its geographic location or indirectly by limiting the extent of the market and limiting the ability of factors to specialize and achieve economies of scale. We first review how geography can affect productivity directly and then examine the indirect effects of geography on productivity through markets.

The tropics seem like paradise with an abundance of sun, vegetation and food, but the reality in some tropical areas is quite different. Diet often has limited variety and the seemingly desirable characteristics of the tropics can foster diseases that can adversely affect production of goods and services (Gallup and Sachs with Mellinger 1999). With abundant rainfall and no frost, the tropics are breeding grounds for diseases and these diseases' carriers: perhaps most notably the Anopheles mosquito which spreads malaria and the tsetse fly which spreads sleeping sickness (African trypanosomiasis). To lessen illness and death, resources can be allocated to prevent and treat diseases, but this implies that less of other goods and services is produced. Such use of goods and services may function effectively as a tax on production. We use degrees latitude and the fraction of the population with malaria to measure these adverse effects of tropical diseases.

Deserts are more obviously inhospitable environments for humans that can be associated with lower output. Deserts have little precipitation, high winds, poor soil and extreme temperatures: all characteristics that make capital less productive by making the construction and maintenance of infrastructure more costly and labor less productive because of the extreme environment. To estimate the effect of desert climate on productivity, we use desert area in tropical latitudes relative to total land in each country and desert area in temperate latitudes relative to total land in each country, as do Gallup and Sachs with Mellinger (1999). In sum, the productive geography hypothesis suggests that countries located in more temperate zones (higher latitudes) with a lower prevalence of malaria and countries with a smaller fraction of land covered by desert have more productive capital and labor.[15]

Figure 3 shows the relationships between productive geography and labor and capital productivity. The "productive geography" shown in Figure 3 is the OLS linear combination of the productive geographic factors: latitude, desert, and fraction of the population with malaria. By itself, productive geography explains 42 percent of the variation in labor productivity and six percent of the variation in capital productivity. For labor productivity, latitude and the fraction of the population afflicted by malaria are statistically significant at the five percent level but neither desert variable is statistically significant.[16] For capital productivity, only the amount of land that is tropical desert is statistically significant at the five percent level.

A country's location can affect the size of the economic market and the economy's ability to specialize and achieve economies of scale. To measure geographic factors

[15] While extremely cold environments have different undesirable characteristics, their effects have not been explored in the literature and we leave those possible effects aside in this paper.

[16] Because malaria may be a result of low income or low productivity, we use the incidence of malaria in 1966 because this is likely to be less endogenous than the incidence of malaria in later years.

We also examined whether absolute distance from the equator affects growth and found empirical results similar to those in the text.

that affect specialization and the extent of the market, we measure the size of the country by 1. the logarithm of land area; 2. the proximity to large markets by the logarithm of the minimum great-circle distance to Tokyo, Rotterdam, or New York; 3. the cost of moving goods into and out of a country by a dummy variable equal to one if the country is landlocked; and 4. the fraction of land that is within 100 kilometers of the coast. In sum, we test the market geography hypothesis by examining whether factors of production are more productive if countries are larger in land area and closer to other large markets with cheaper access to water transport.

Figure 4 shows the relationships between market geography and labor and capital productivity. By itself, market geography explains 43 percent of the variation in labor productivity and eleven percent of the variation in capital productivity. Distance from large markets is the only variable that is statistically significant at the five percent level, with the productivity of both labor and capital falling as the distance to a large market increases.

**Property Rights and Democracy**

In addition to geographic factors, the productivity of factors of production is likely to be affected by the institutions in a country. The two institutions that we investigate in this paper are protection of private property rights and the democratic selection of government officials.

The property rights measure is used to examine the effect of protection of property rights on labor and capital productivity. In the absence of protection of property rights, individuals face two types of risks. First, if individuals fear government expropriation, they will try to hide their assets to decrease the probability of government expropriation, which can decrease the efficiency of production. For example, the possibility of expropriation can be reduced by building smaller-than-optimal production facilities that are not as readily obvious or fixed in place and therefore not as readily expropriated (de Soto 2000). This strategy for dealing with expropriation can result in less efficient production than would occur otherwise. Second, as suggested by Tullock (1967) and elaborated by Murphy, Shleifer, and Vishny (1991), Acemoglu (1995), and Grossman and Kim (1996), some individuals may choose to attempt to steal from those who produce goods and services, and those who produce goods will use resources to protect themselves from the predators. Effective protection of private property rights that decreases theft will result in resources being allocated to more productive uses.

We quantify the government's protection of property rights by the same measure used by Knack and Keefer (1995) and Hall and Jones (1999), which is based on five components from the International Country Risk Guide and available from Hall and Jones (1998). The first two components measure the role of government in protecting against predatory private behavior through the rule of law and bureaucratic quality. The other three components measure the government as a possible diverter of resources by measures of government corruption, risk of expropriation, and the government's repudiation of contracts. We use a somewhat arbitrary equally weighted average of these five measures. The relationships between these measures of the protection of property rights and labor and capital productivity are shown in Figure 5. The government's protection of personal property rights explains 69 percent of the cross-country variation in labor productivity and 22 percent of the cross-country variation in capital productivity.

The effect of democratic government on productivity is not obvious. More democratic societies can winnow out bad laws and inefficient leaders, effects which would tend to raise productivity. In this case, political and economic freedom are mutually reinforcing, a point emphasized by Friedman (1962, Ch. 1). On the other hand, people may vote for income redistribution and make the economy less efficient, with the relationship between redistribution and the wealth distribution not necessarily obvious (Peltzman 1980).

To measure democracy, we follow a procedure similar to Rodrik (2000), classifying Jaggers and Gurr's (1995) updated Polity IV measures (Marshall and Jaggers 2004) into two equally weighted groups, Categories A and B, and then using an equally weighted average of these groups.

Category A includes six measures of institutionalized democracy, four of which reflect the selection and the accountability of the executive and two of which reflect the expression of political opinions. Category A's measures of institutional democracy include

- the existence of institutionalized procedures for the transfer of executive power.
- the extent to which subordinates have equal opportunity to become superordinates.
- the choice of the executive by 1. election, 2. a dual process in which one office is elected and the other is hereditary, or 3. hereditary.
- the extent to which decisions made by the executive are accountable to other authorities.
- whether, when and how policy preferences can be expressed.
- whether alternative preferences for policy leadership can be expressed.

Category A is an equally weighted ten year average in which all components are normalized from zero to one, with higher values indicating more democracy.

Category B measures the extent to which the political process is open to the general population. The two components contained in Category B are, first, the extent to which political expression is suppressed or curtailed and, second, the degree to which citizens can express political preferences, the guarantee of civil liberties, and the degree to which people can participate in the political process. Both scores are normalized from zero to one with a score closer to one implying a more democratic and less authoritarian regime. Category B is a ten year equally weighted average of these components.

The overall measure of democracy is an equally weighted average of Category A and Category B measures of democracy. Different weighting schemes yield quantitatively similar results for the measure of democracy.

There is a positive and statistically significant relationship of both labor and capital productivity with this measure of democracy, which explains 39 percent of the cross-country variation in labor productivity and 9 percent of the cross-country variation in capital productivity. Figure 6 shows the relationship of this measure of democracy with labor and capital productivities.

### Productivity, Geography and Institutions – OLS Estimates

In this section, we allow the measures of geography and institutions to enter into a regression specification simultaneously to identify which variables appear to be robustly correlated with productivity. We present tables for capital and labor productivity based on simple OLS regressions that allow for different combinations of the variables.[17]

Table 1 shows the estimated coefficients in OLS regressions for labor and capital productivity.[18] Table 1 shows that property rights are statistically significant and highly correlated with labor productivity in all specifications. On the other hand, democracy ceases to be statistically significant when property rights are included in the regressions. With respect to geography, the only geographic variable that is

[17] The results are similar for the linear estimates presented in the paper and also for log-linear estimates and fractional logit (Papke and Wooldridge 1996) specifications.

[18] The reported standard errors are White-robust standard errors.

robustly related to labor productivity is the logarithm of the minimum distance to a large market.[19]

The regression results are very similar for capital productivity. Property rights are significantly related to capital productivity. There is some evidence that the logarithm of the minimum distance to a major market is related to capital productivity. Democracy, on the other hand, is not statistically significant at the ten percent level in any of the six regressions that include democracy as a right-hand side variable.

How important is relatively unchangeable geography to the more malleable institutions? We answer this question by examining whether a country would have higher productivity with the United Kingdom's geographic position or with her institutions.[20] The United Kingdom has attractive geographic features: direct access to the ocean, relatively short distances to large markets, low incidence of malaria, almost no desert, and a location in a relatively temperate zone. The United Kingdom also has relatively high scores on property rights and democracy. The property rights index is 0.933 compared to a mean of 0.624 and a median of 0.571 and the democracy index is 0.902 compared to a mean of 0.614 and a median of 0.657.[21] We compare the Philippines to the United Kingdom using the regressions for labor and capital productivity in Table 1 that include all variables. If the Philippines kept its institutions but had the United Kingdom's geography, the Philippines' labor productivity would increase from seven percent to 28 percent of the U.S.'s and capital productivity would increase from 25 percent to 26 percent of the U.S.'s. On the other hand, if the

[19] Latitude is statistically significant only if the logarithm of the minimum distance to a major market is not included in the regressions.

[20] Here, we are assuming the costs of switching geographic positions and institutions are zero and that institutions are independent of geography. Obviously, the costs of changing geography and institutions are far from zero. Institutions may well depend partly on geography (Acemoglu, Johnson and Robinson, 2001; Engerman and Sokoloff 2003).

[21] The property rights index for the United States is 0.947 and the democracy index is 0.902.

Philippines were to keep its physical position and adopted the same institutions as the United Kingdom, labor productivity would increase from seven percent to 75 percent and capital productivity would increase from 25 percent to 58 percent. In short, the Philippine's geography which, practically speaking, is either unchangeable or almost entirely exogenous to the Philippines has far less effect on the Philippine's labor and capital productivity than does its protection of property rights and governance.[22] The Philippines is hardly unique.

Consider Ethiopia, a country at roughly the same latitude as the Philippines but with other geographic characteristics that are worse than the Philippines' – a much higher incidence of malaria, no port, and a location farther from large markets. A move to the United Kingdom's geographic position would increase Ethiopia's labor productivity from two percent to 33 percent and capital productivity from 25 percent to 35 percent. If Ethiopia adopted the United Kingdom's institutions, labor productivity would increase from two percent to 74 percent and capital productivity would increase from 25 percent to 61 percent.

Table 2 presents the results of this analysis by quintiles based on the countries' labor and capital productivities, with the numbers in the table being the mean of the values in each quintile. This table shows that adopting better institutions has a bigger impact on productivity than would better geography. If all countries could move to the United Kingdom's geographic position, average labor productivity in the middle quintile would increase from 17 percent of the U.S.'s level to 36 percent. On the other hand, if the world were to adopt the United Kingdom's institutions, labor

[22] Some measures of geography are virtually invariant to anything that happens in a country. Latittude presumably reflects aspects of climate, which can change over time but will be little affected by anything that happens in a small country. Distance to major markets also can change over time but is relatively little affected by anything that happens in a small country. The fraction of land that is desert may not be so immutable because it may reflect farming and grazing practices.

productivity in the middle quintile would increase to 66 percent of the U.S.'s level. The U.K.'s geography would increase the middle quintile's capital productivity by a trivial amount, but the U.K.'s institutions would increase it by 25 percentage points to 73 percent.

While better geography would help people in Ethiopia and the Philippines, better institutions would help them quite a bit more, results in line with those of Rodrik, Subramanian and Trebbi (2004).[23] Our results indicate that protection of property rights is more important than democracy or geography.[24] Institutions clearly can increase the relative well being of both workers and owners of physical capital, even given a disadvantageous location. Our estimates indicate that the Philippines and Ethiopia still would not be as wealthy as the United Kingdom or the United States if they had better protection of property rights, but better protection of property

[23] This conclusion is not sensitive to the specification of the regressions. An ad hoc specification search is not particularly informative, although it can provide an indication of the sensitivity of results to specification. To this end, we ran all possible regressions of labor and capital productivity on any five of the ten variables. Property rights were statistically significant at the five percent level in all 126 regressions for labor productivity including property rights and in 56 of the 126 regressions for capital productivity including property rights. With property rights included, democracy was not statistically significant in any of the 56 regressions for each productivity. With property rights included, the only geography variables that are statistically significant in more than four regressions for either labor or capital productivity are distance to a major market for labor productivity and latitude for capital productivity; distance to a major market is statistically significant in 32 of the 56 regressions for labor productivity that include property rights and distance, and latitude is statistically significant in 18 of the 56 regressions for capital productivity that include property rights and latitude.

[24] As another measure of government efficiency, there are 2002 data on government regulation from the World Bank (2004). If the cross-sectional variation of this variable has changed little with time, these variable for 2002 are additional measures of government efficiency and may be related to 1997 productivity differences. As with democracy, these variables have little or no explanatory power once property rights are included in the regressions.

rights would make their wealth dramatically higher and closer to the U.K.'s than it is. The policy implications of these observations are far from immediate (Rodrik, Subramanian and Trebbi 2004, pp. 157-58), but they indicate a direction for further analysis.

**Robustness to Endogeneity and Measurement Error**

There are several reasons why the coefficients on the above estimates might be biased or inconsistent and, therefore, inaccurately reflect how institutions affect productivity and factor returns. The results may be sensitive to the specification of individual regressions. Causality may run from productivity to institutions; if more productive countries choose better institutions, the importance of institutions may be overstated. On the other hand, the index measures are noisy measures of institutions and these coefficients may suffer from the classic errors in variables bias toward zero.

To examine the importance of reverse causality and measurement error, we use instrumental variables for the institutional variables. The instruments are 1. the legal origin of a country, a set of dummy variables divided into alternatives of English, French, German and Scandinavian, Spanish and Socialist, 2. a dummy variable equal to one if a country ever had a Communist government, 3. a measure of ethnolinguistic fractionalization that measures the likelihood that two randomly matched people in a country speak the same language, and 4. the productive and market geography variables.

Table 3 reports the results from the instrumental variables (IV) estimation. Property rights remain robustly related to labor productivity and the coefficient estimates are higher than in OLS regressions. The evidence for the importance of property rights for capital productivity is weaker than in the OLS regressions. Even so, the measure of property rights is statistically significant at the ten percent level in all but one of the IV specifications, and the democracy index never is statistically significant. As before, the distance to a large market is the only geography variable that is robustly related to labor productivity. There also is some evidence that distance to a large market is related to capital productivity.

### Productivity of Skilled and Unskilled Workers

The evidence above indicates that protection of property rights benefits both workers and owners of capital but could be consistent with unskilled workers losing out. We cannot rule that out because we measure labor in terms of effective labor units, examining how institutions affect a worker with the average years of schooling and experience in that country. Furthermore, if unskilled workers do not benefit, they (not surprisingly) may create roadblocks for policy changes that primarily benefit others. How do geography and institutions affect the productivity of workers with different skill levels?

To provide a first-pass answer to this question, we divide the labor force into workers with at most primary education and those who have completed some secondary or higher education using data from Baier, Dwyer and Tamura (2004). A practical problem arises in using these enrollment data to categorize individuals by skill level because we have no direct data on the years of schooling completed by workers in these two classes. As a result, our measures of productivity are for workers who have completed at most primary school and for workers who have completed more schooling. These two measures of productivity are based on the number of workers in each class instead of the human capital per worker in each class, which would be more comparable to our analysis above.

Table 4 presents the regressions for the workers with no more than primary education and those with more education. This table shows that property rights are more closely related to the productivity of both sets of workers than is geography. As before, the only geographic variable consistently associated with productivity is the logarithm of the minimum distance to New York, Rotterdam, or Tokyo. The coefficient estimates also suggest that better protection of property rights does raise the productivity of skilled workers more than the productivity of workers with less education. At least without controlling for endogeneity, it seems to be the case that high-skilled workers benefit the most from better property rights protection.

The differential results disappear when instrumental variables are used for property rights protection and for democracy. Table 5 shows the estimated equations using instrumental variables. The differential impact of institutions on productivity vanishes in these equations – the coefficient on property rights is statistically different for skilled workers compared to unskilled workers only in the first equation with property rights and the market geography variables.

The apparent difference with OLS and the vanishing of the difference with IV estimation is consistent with an exogenous effect of property rights and endogenous feedback that increases workers' education. Suppose that an exogenous increase in property rights protection occurs. By hypothesis, this will lead to an increase in the returns to both skilled and unskilled labor. This will result in an increase in accumulation of human capital, because returns to it have increased. Consequently, average education increases and the actual education of those who have completed some secondary education or more education increases. While the average education of those with primary education also would increase, the low upper bound for primary education is consistent with a smaller effect on their average education. As a result, OLS using the number of workers with at most primary education and those with more indicates a greater effect of property rights on the productivity of skilled workers because it includes this endogenous increase in years of schooling completed.

We conclude that these results provide no support for concerns that protecting property rights favors one class of workers over another class of workers. In fact, the correlation between low skill productivity and income per worker is positive, 0.80.[25]

## CONCLUSION

In the trade literature, there has been little work done to explain what accounts for cross-country differences in productivities from Trefler's modification of the HOV model. We show that the measures of productivity based on the HOV model are highly correlated with productivity estimated by development accounting. Hence, our research ties these productivities based on trade into the literature on total factor productivity, which has substantial evidence on the effects of institutions and geography on economic growth.

We find that more protection of private property rights is correlated with the productivity of capital, labor and that the higher productivity of labor reflects higher productivity of both skilled and unskilled workers. Once property rights are included in the estimated equations, democracy plays little direct role in influencing factor productivity. In addition, once we control for the potential endogeneity of institutions, the effect of property rights protection on the measured productivity of skilled workers is little different than the effect on unskilled workers' productivity. There is some evidence that the distance from large markets is an important determinant of productivity, but this is of secondary importance compared to institutions.

There are numerous directions that can be pursued to clarify the effect of institutions on productivity. Important questions are how quickly institutional change translates into changes in measured productivity and quantifying whether institu-

[25] Caselli and Coleman (2003) find a negative relationship between the productivity of unskilled workers and output per worker. In their framework, countries choose "appropriate technology"; that is, they can adopt and employ technologies that make one type of workers more productive, but this comes at the expense of making the other type less productive. In our framework, there is no trade-off between the productivity of worker types and the correlation can be positive or negative.

tions have an effect on factor returns independent of the effect on productivity, as in Rodrik (2000). Embedding trade into a model in which there is corruption as in Anderson and Marcouiller (2002) or Anderson and Bandiera (2003) or where countries face a trade-off among different levels of efficiency as in Caselli and Coleman (2004) would go a long way in aiding our understanding of how institutions influence productivity and efficiency.

We leave many other unanswered questions. Most glaringly, why do some countries fail to protect property rights given that both owners of physical and human capital gain from better institutions? We do not doubt that the answer is that some people in these countries would lose. While it may seem plausible to say "The ruling elite would lose and therefore prevents change", it is an uninformative truism. This merely puts a name on the answer without providing any way of identifying these people.

## REFERENCES

Acemoglu, Daron, Simon Johnson and James A. Robinson. 2001. "The Colonial Origins of Development." *American Economic Review* 91 (December), pp. 1369-1429.

Acemoglu, Daron. 1995. "Reward Structures and the Allocation of Talent." *European Economic Review* 39 (January), pp. 17-33.

Anderson, James A., and Oriana Bandiera. 2003. "Traders, Cops, and Robbers." National Bureau of Economic Research Working Paper 9572.

Anderson, James A., and Douglas Marcouiller. 2002. "Insecurity and the Pattern of Trade: An Empirical Investigation." *Review of Economics and Statistics* 84 (May), pp. 342-52.

Baier, Scott L., Gerald P. Dwyer, Jr. and Robert Tamura. 2004. "How Important Are Capital and Total Factor Productivity for Economic Growth?" Unpublished paper, Federal Reserve Bank of Atlanta.

Barro, Robert J. 1996. "Democracy and Growth." *Journal of Economic Growth* 1 (March), pp.1-27.

Bartlesman, Eric J., Randy A. Becker and Wayne B. Gray. 2002. "The Manufacturing Industry Productivity Database." National Bureau of Economic Research Technical Working Paper 205.

Bils, Mark, and Peter J. Klenow. 2000. "Does Schooling Cause Growth?" *American Economic Review* 90 (December), pp. 1160-83.

Bowen, Harry P., Edward E. Leamer and Leo Sveikauskas. 1987. "Multicountry, Multifactor Tests of the Factor Abundance Theory. *American Economic Review* 77

(December), pp. 791-809.

Caselli, Francesco, and John Wilbur Coleman II. 2004. "The World Technology Frontier." Unpublished paper, Harvard University.

Davis, Donald R. and David E. Weinstein. 2001. "An Account of Global Factor Trade." *American Economic Review*. 91 (December), pp. 1423-53.

Debaere, Peter and Ukuf Demiroglu. 2003. "On the Similarity of Country Endowments." *Journal of International Economics*. 59 (January), pp.101-36.

de Soto, Hernando. 2000. *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. New York: Basic Books.

Easterly, William and Ross Levine. 2003. "Tropics, Germs, and Crops: How Endowments Influence Economic Development." *Journal of Monetary Economics*. 50 (January), pp. 3-40.

Engerman, Stanley L. and Kenneth L. Sokoloff. 2003. "Institutional and Non-Institutional Explanations of Economic Differences." National Bureau of Economic Research Working Paper 9989.

Feenstra, Robert. 2000. "World Trade Flows: 1980-1997." University of California at Davis, manuscript and CD.

Feenstra, Robert C. 2004. *Advanced International Trade. Theory and Evidence.* Princeton University Press.

Friedman, Milton. 1962. *Capitalism and Freedom.* Chicago: The University of Chicago Press.

Gallup, John Luke, Jeffrey D. Sachs with Andrew D. Mellinger. 1999. "Geography and Economic Development." Harvard Center for International Development Working Paper 1.

Gollin, Douglas. 2002. "Getting Income Shares Right." *Journal of Political Economy.* 110 (April), pp. 458-74.

Grossman, Herschel I., and Minesong Kim. 1995. "Sword or Plowshares? A Theory of Security of Claims to Property." *Journal of Political Economy.* 103 (December), pp.1275-88.

Hall, Robert E., and Charles I. Jones. 1999. "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *The Quarterly Journal of Economics.* 114 (February), pp. 83-116.

Hall, Robert E., and Charles I. Jones. 1998. "Data Appendix for Robert E. Hall and Charles I. Jones, 'Why Do Some Countries Produce So Much More Output per Worker than Others?"' Unpublished paper at http://emlab.berkeley.edu/users/chad/HallJones400.asc.

Jaggers, Keith and Ted Robert Gurr. 1995. "Tracking Democracy's Third Wave with the Polity III Data," *Journal of Peace Research* 32 (November), pp. 469-482.

Klenow, Peter J., and Andres Rodriguez-Clare. 1997. "The Neoclassical Revival: Has it Gone Too Far?" *NBER Macroeconomics Annual*, edited by Ben Bernanke and Julio Rotemberg, pp.73-102.

Knack, Stephen, and Phillip Keefer. 1995. "Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures." *Economics and Politics* 7 (November), pp. 207-27.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny. 1998. "Law and Finance." *Journal of Political Economy* 106 (December), pp.1113-55.

Leamer, Edward E. 1984. *Sources of International Comparative Advantage: Theory and Evidence*. Cambridge, Massachusetts: MIT Press.

Leontief, Wassily W. 1953."Domestic Production and Foreign Trade: The American Capital Position Reexamined." *Proceedings of the American Philosophical Society*. 97 (4), pp. 332-49.

Marshall, Monty G., and Keith Jaggers. 2004. "Political Regime Characteristics and Transitions, 1800-2002." Website http://www.cidcm.umd.edu/inscr/polity/.

Maskus, Keith E. 1985. "A Test of the Heckscher-Ohlin Vanek Theorem: The Leontief Commonplace." *Journal of International Economics* 19 (November), pp. 201-12.

Murphy, Kevin M., Andrei Shleifer and Robert W. Vishny. 1991. "The Allocation of Talent: Implications for Growth." *The Quarterly Journal of Economics* 106 (May), pp. 503-30.

Papke, Leslie E., and Jeffrey M. Wooldridge. 1996. "Econometric Methods for Fractional Response Variables with an Application to 401(k) Retirement Programs." *Journal of Applied Econometrics* 11 (Nov-Dec), pp. 619-32.

Peltzman, Sam. 1980. "The Growth of Government." 23 (October), pp. 209-87.

Repetto, Andrea and Jaume Ventura. 1997. "The Leontief-Trefler Hypothesis." Unpublished paper, Massachusetts Institute of Technology.

Rodrik, Dani. 1999. "Democracies Pay Higher Wages." *The Quarterly Journal of Economics* 114 (August), pp. 707-38.

Rodrik, Dani, Arvind Subramanian and Francesco Trebbi. 2004. "Institutions Rule: The Primacy of Institutions Over Geography and Integration in Economic Development." 9 (June), pp. 131-65.

Ruggles, Stephen, Matthew Sobek *et al.* 2003. Integrated Public Use Microdata Set Series Version 3. Minneapolis: Historical Census Project, University of Minnesota.

Sachs, Jeffrey D., and Andrew M. Warner. 1995. "Economic Reform and the Process of Global Integration." *Brookings Papers on Economic Activity.* (1), pp. 1-95.

Trefler, Daniel. 1995. "The Case of Missing Trade and Other Mysteries." *American Economic Review* 85 (December), pp. 1029-46.

Trefler, Daniel. 1993. "International Factor Price Differences: Leontief was Right!" *Journal of Political Economy* 101 (December), pp. 961-87.

Tullock, Gordon. 1967. "The Welfare Costs of Tariffs, Monopolies, and Theft." *Western Economic Journal* 5 (June), pp. 224-32.

World Bank. 2004. *Doing Business in 2004: Understanding Regulation.* Washington, D.C.: World Bank.

World Bank. 2002. *World Development Indicators 2002.* Washington, D.C.: The World Bank.

Table 1

Relationship of Factor Productivities with Institutions and Geography

OLS Estimates

(Labor Productivity)

| Right-hand-side Variable | Regressions (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Property Rights | 1.414[a] | | 1.304[a] | 1.434[a] | | 1.406[a] | 1.292[a] | | 1.263[a] |
| | (0.180) | | (0.233) | (0.178) | | (0.210) | (0.200) | | (0.223) |
| Democracy | | 0.664[a] | 0.152 | | 0.610[b] | 0.069 | | 0.502[b] | 0.074 |
| | | (0.140) | (0.138) | | (0.249) | (0.189) | | (0.238) | (0.179) |
| Proximity to Large Markets | -0.062[c] | -0.180[a] | -0.060[c] | | | | -0.124[a] | -0.247[a] | -0.124[a] |
| | (0.033) | (0.033) | (0.033) | | | | (0.043) | (0.050) | (0.044) |
| Fraction of Land Near Coast | 0.124 | 0.008 | 0.089 | | | | 0.034 | -0.070 | 0.026 |
| | (0.096) | (0.140) | (0.102) | | | | (0.109) | (0.147) | (0.109) |
| Landlocked Dummy Variable | 0.080 | 0.072 | 0.078 | | | | 0.041 | 0.031 | 0.043 |
| | (0.081) | (0.095) | (0.079) | | | | (0.082) | (0.108) | (0.084) |
| Logarithm of Land Area | -0.008 | -0.016 | -0.011 | | | | -0.026 | -0.037 | -0.027 |
| | (0.027) | (0.044) | (0.028) | | | | (0.029) | (0.046) | (0.029) |
| Latitude | | | | 0.000 | 0.004[b] | 0.000 | -0.003[c] | -0.004 | -0.003 |
| | | | | (0.001) | (0.002) | (0.001) | (0.002) | (0.003) | (0.002) |
| Fraction of Land in Tropical Desert | | | | -0.107 | -0.144 | -0.085 | 0.008 | 0.037 | 0.031 |
| | | | | (0.081) | (0.156) | (0.103) | (0.101) | (0.150) | (0.113) |
| Fraction of Land in Temperate Desert | | | | -0.058 | 0.318 | -0.030 | 0.092 | 0.261 | 0.128 |
| | | | | (0.424) | (0.544) | (0.446) | (0.421) | (0.464) | (0.427) |
| Fraction of Population with Malaria | | | | -0.144[b] | -0.206 | -0.121 | -0.097 | -0.137 | -0.074 |
| | | | | (0.060) | (0.151) | (0.095) | (0.065) | (0.134) | (0.092) |
| Constant | 0.027 | 1.586[b] | 0.042 | -0.472[a] | 0.006 | -0.507[a] | 0.939 | 2.615[a] | 0.920 |
| | (0.412) | (0.667) | (0.406) | (0.118) | (0.225) | (0.149) | (0.632) | (0.988) | (0.647) |
| R-squared | 0.73 | 0.55 | 0.73 | 0.71 | 0.48 | 0.71 | 0.75 | 0.58 | 0.75 |

Heteroskedasticity-consistent standard errors in parentheses

Statistically significant at 1 percent is denoted by “a”, 5 percent by “b”, 10 percent by “c”.

Table 1 (Cont'd)

Relationship of Factor Productivities with Institutions and Geography

OLS Estimates

(Capital Productivity)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 0.571[a] | | 0.599[a] | 0.772[a] | | 0.743[a] | 0.639[a] | | 0.623[a] |
| | (-0.124) | | (-0.147) | (-0.145) | | (-0.155) | (-0.165) | | (-0.175) |
| Democracy | | 0.196 | -0.039 | | 0.355[b] | 0.069 | | 0.253 | 0.042 |
| | | (0.119) | (0.132) | | (0.167) | (0.149) | | (0.175) | (0.162) |
| Proximity to Large Markets | -0.004 | -0.059[b] | -0.005 | | | | -0.113[b] | -0.173[a] | -0.112[b] |
| | (0.027) | (0.026) | (0.028) | | | | (0.048) | (0.047) | (0.048) |
| Fraction of Land Near Coast | -0.029 | -0.057 | -0.020 | | | | -0.069 | -0.121 | -0.074 |
| | (0.108) | (0.118) | (0.110) | | | | (0.120) | (0.127) | (0.121) |
| Landlocked Dummy Variable | -0.073 | -0.076 | -0.073 | | | | -0.128 | -0.133[c] | -0.126 |
| | (0.077) | (0.077) | (0.077) | | | | (0.081) | (0.079) | (0.082) |
| Logarithm of Land Area | -0.015 | -0.016 | -0.014 | | | | -0.028 | -0.033 | -0.028 |
| | (0.017) | (0.019) | (0.017) | | | | (0.018) | (0.021) | (0.019) |
| Latitude | | | | -0.001 | 0.001 | -0.001 | -0.005[b] | -0.005[b] | -0.005[b] |
| | | | | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) |
| Fraction of Land in Tropical Desert | | | | -0.097 | -0.107 | -0.076 | -0.018 | -0.002 | -0.004 |
| | | | | (0.067) | (0.107) | (0.086) | (0.082) | (0.121) | (0.103) |
| Fraction of Land in Temperate Desert | | | | -0.201 | 0.011 | -0.173 | -0.238 | -0.152 | -0.217 |
| | | | | (0.365) | (0.372) | (0.367) | (0.332) | (0.326) | (0.350) |
| Fraction of Population with Malaria | | | | 0.098 | 0.077 | 0.122 | 0.126 | 0.108 | 0.139 |
| | | | | (0.085) | (0.111) | (0.096) | (0.085) | (0.113) | (0.102) |
| Constant | 0.428 | 1.133[a] | 0.425 | 0.062 | 0.298[b] | 0.027 | 1.476[b] | 2.301[a] | 1.465[b] |
| | (0.364) | (0.369) | (0.367) | (0.111) | (0.144) | (0.135) | (0.622) | (0.578) | (0.626) |
| R-squared | 0.23 | 0.14 | 0.23 | 0.27 | 0.11 | 0.27 | 0.33 | 0.23 | 0.33 |

Heteroskedasticity-consistent standard errors in parentheses

Statistically significant at 1 percent is denoted by "a", 5 percent by "b", 10 percent by "c".

Table 2
Effect of the United Kingdom's Geography and Institutions on Productivities
Estimates by Quintile Based on OLS Estimates

| | Bottom Quintile (Percent) | Fourth Quintile (Percent) | Middle Quintile (Percent) | Second Quintile (Percent) | Top Quintile (Percent) |
|---|---|---|---|---|---|
| Labor Productivity | | | | | |
| Productivity with UK's Institutions | 69.37 | 71.37 | 79.54 | 78.76 | 91.70 |
| Productivity with UK's Geography | 33.77 | 34.17 | 49.58 | 67.12 | 95.96 |
| Actual Labor Productivity | 2.98 | 6.44 | 17.35 | 47.84 | 108.00 |
| Capital Productivity | | | | | |
| Productivity with UK's Institutions | 71.85 | 71.75 | 76.19 | 76.00 | 78.77 |
| Productivity with UK's Geography | 46.38 | 52.71 | 51.67 | 63.14 | 65.84 |
| Actual Capital Productivity | 22.79 | 35.37 | 47.78 | 67.56 | 95.13 |

Table 3

Relationship of Factor Productivities with Institutions and Geography

IV Estimates

(Labor Productivity)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 1.834[a] | | 1.319[c] | 2.143[a] | | 1.781[a] | 1.915[a] | | 1.529[a] |
| | (0.361) | | (0.725) | (0.375) | | (0.475) | (0.382) | | (0.504) |
| Democracy | | 2.397[b] | 0.871 | | 1.985[a] | 0.725 | | 2.013[a] | 0.751 |
| | | (1.033) | (1.014) | | (0.671) | (0.565) | | (0.755) | (0.638) |
| Proximity to Large Markets | -0.006 | 0.002 | 0.017 | | | | -0.053 | -0.173[b] | -0.06 |
| | (0.054) | (0.120) | (0.067) | | | | (0.066) | (0.086) | (0.067) |
| Fraction of Land Near Coast | 0.107 | -0.442 | -0.099 | | | | 0.062 | -0.210 | -0.025 |
| | (0.108) | (0.347) | (0.269) | | | | (0.120) | (0.198) | (0.141) |
| Landlocked Dummy Variable | 0.080 | 0.047 | 0.068 | | | | 0.055 | 0.086 | 0.074 |
| | (0.087) | (0.179) | (0.100) | | | | (0.094) | (0.148) | (0.095) |
| Logarithm of Land Area | -0.011 | -0.057 | -0.028 | | | | -0.025 | -0.067[c] | -0.041 |
| | (0.020) | (0.048) | (0.031) | | | | (0.023) | (0.039) | (0.027) |
| Latitude | | | | -0.002 | 0.003[c] | -0.001 | -0.003 | -0.002 | -0.002 |
| | | | | (0.002) | (0.002) | (0.002) | (0.002) | (0.003) | (0.002) |
| Fraction of Land in Tropical Desert | | | | 0.028 | 0.389 | 0.240 | 0.081 | 0.582[c] | 0.307 |
| | | | | (0.152) | (0.329) | (0.226) | (0.142) | (0.345) | (0.239) |
| Fraction of Land in Temperate Desert | | | | -0.136 | 0.808 | 0.162 | 0.136 | 1.044 | 0.498 |
| | | | | (0.582) | (0.904) | (0.636) | (0.567) | (0.968) | (0.647) |
| Fraction of Population with Malaria | | | | 0.014 | 0.379 | 0.241 | 0.015 | 0.439 | 0.232 |
| | | | | (0.112) | (0.306) | (0.211) | (0.103) | (0.312) | (0.211) |
| Constant | -0.643 | -0.233 | -0.735 | -0.945[a] | -1.077[b] | -1.274[a] | -0.089 | 1.245 | -0.133 |
| | (0.680) | (1.311) | (0.774) | (0.256) | (0.534) | (0.365) | (0.871) | (1.163) | (0.874) |
| R-squared | 0.70 | | | 0.64 | 0.19 | | 0.70 | 0.27 | |

Heteroskedasticity-consistent standard errors in parentheses

Statistically significant at 1 percent is denoted by “a”, 5 percent by “b”, 10 percent by “c”.

Table 3 (Cont'd)
Relationship of Factor Productivities with Institutions and Geography
IV Estimates
(Capital Productivity)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 0.847[b] | | 1.163[c] | 1.053[a] | | 1.022[b] | 0.921[b] | | 1.045[b] |
| | (0.381) | | (0.693) | (0.352) | | (0.421) | (0.374) | | (0.472) |
| Democracy | | 0.811 | -0.534 | | 0.786[c] | 0.063 | | 0.621 | -0.241 |
| | | -0.626 | -0.970 | | -0.470 | -0.501 | | -0.513 | -0.598 |
| Proximity to Large Markets | 0.032 | 0.005 | 0.018 | | | | -0.080 | -0.155[a] | -0.078 |
| | (0.057) | (0.073) | (0.064) | | | | (0.065) | (0.058) | (0.062) |
| Fraction of Land Near Coast | -0.041 | -0.217 | 0.085 | | | | -0.056 | -0.155 | -0.029 |
| | (0.114) | (0.210) | (0.257) | | | | (0.118) | (0.134) | (0.132) |
| Landlocked Dummy Variable | -0.074 | -0.084 | -0.066 | | | | -0.121 | -0.119 | -0.127 |
| | (0.092) | (0.109) | (0.095) | | | | (0.092) | (0.101) | (0.089) |
| Logarithm of Land Area | -0.016 | -0.030 | -0.005 | | | | -0.027 | -0.041 | -0.023 |
| | (0.021) | (0.029) | (0.029) | | | | (0.023) | (0.027) | (0.025) |
| Latitude | | | | -0.002 | 0.000 | -0.002 | -0.005 | -0.005[b] | -0.005[b] |
| | | | | (0.002) | (0.001) | (0.002) | (0.002)** | (0.002) | (0.002) |
| Fraction of Land in Tropical Desert | | | | -0.044 | 0.060 | -0.025 | 0.016 | 0.132 | -0.057 |
| | | | | (0.143) | (0.231) | (0.201) | (0.139) | (0.234) | (0.224) |
| Fraction of Land in Temperate Desert | | | | -0.233 | 0.164 | -0.206 | -0.218 | 0.039 | -0.334 |
| | | | | (0.546) | (0.634) | (0.565) | (0.557) | (0.657) | (0.606) |
| Fraction of Population with Malaria | | | | 0.161 | 0.260 | 0.181 | 0.177 | 0.248 | 0.107 |
| | | | | (0.105) | (0.215) | (0.187) | (0.101)* | (0.212) | (0.198) |
| Constant | -0.012 | 0.487 | 0.044 | -0.126 | -0.041 | -0.154 | 1.011 | 1.967[b] | 1.025 |
| | (0.716) | (0.795) | (0.740) | (0.240) | (0.374) | (0.324) | (0.855) | (0.790) | (0.819) |

Heteroskedasticity-consistent standard errors in parentheses
Statistically significant at 1 percent is denoted by "a", 5 percent by "b", 10 percent by "c".

Table 4
Relationship of Skilled and Unstilled Workers' Productivity with Institutions and Geography
OLS Estimates
(Primary Education)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 0.643[a] | | 0.638[a] | 0.841[a] | | 0.807[a] | 0.657[a] | | 0.648[a] |
| | (0.164) | | (0.153) | (0.132) | | (0.126) | (0.180) | | (0.174) |
| Democracy | | 0.257[b] | 0.006 | | 0.392[a] | 0.082 | | 0.241[c] | 0.021 |
| | | (0.104) | (0.061) | | (0.139) | (0.087) | | (0.136) | (0.083) |
| Proximity to Large Markets | -0.096[a] | -0.154[a] | -0.096[a] | | | | -0.118 | -0.181[b] | -0.118 |
| | (0.032) | (0.028) | (0.032) | | | | (0.084) | (0.074) | (0.085) |
| Fraction of Land Near Coast | 0.1 | 0.059 | 0.098 | | | | 0.093 | 0.042 | 0.091 |
| | (0.083) | (0.106) | (0.091) | | | | (0.067) | (0.084) | (0.069) |
| Landlocked Dummy Variable | 0.038 | 0.035 | 0.038 | | | | 0.026 | 0.02 | 0.027 |
| | (0.053) | (0.058) | (0.053) | | | | (0.042) | (0.047) | (0.042) |
| Logarithm of Land Area | 0.023[c] | 0.021 | 0.023 | | | | 0.022[c] | 0.017 | 0.022[c] |
| | (0.014) | (0.018) | (0.014) | | | | (0.012) | (0.017) | (0.012) |
| Latitude | | | | 0.002[b] | 0.004[a] | 0.002[b] | -0.001 | -0.001 | -0.001 |
| | | | | (0.001) | (0.001) | (0.001) | (0.003) | (0.003) | (0.003) |
| Fraction of Land in Tropical Desert | | | | -0.087[b] | -0.095 | -0.062 | -0.048 | -0.038 | -0.041 |
| | | | | (0.042) | (0.082) | (0.049) | (0.078) | (0.094) | (0.076) |
| Fraction of Land in Temperate Desert | | | | 0.176 | 0.408 | 0.209 | -0.016 | 0.063 | -0.006 |
| | | | | (0.280) | (0.358) | (0.273) | (0.221) | (0.252) | (0.227) |
| Fraction of Population with Malaria | | | | 0.004 | -0.017 | 0.032 | 0.035 | 0.009 | 0.041 |
| | | | | (0.034) | (0.070) | (0.050) | (0.035) | (0.061) | (0.044) |
| Constant | 0.176 | 0.932[a] | 0.176 | -0.401[a] | -0.148 | -0.443[a] | 0.371 | 1.235 | 0.365 |
| | (0.226) | (0.293) | (0.226) | (0.082) | (0.108) | (0.104) | (0.838) | (0.745) | (0.851) |
| R-squared | 0.63 | 0.53 | 0.63 | 0.57 | 0.39 | 0.57 | 0.64 | 0.54 | 0.64 |

Heteroskedasticity-consistent standard errors in parentheses
Statistically significant at 1 percent is denoted by "a", 5 percent by "b", 10 percent by "c".

Table 4 (Cont'd)

Relationship of Skilled and Unstilled Workers' Productivity with Institutions and Geography

OLS Estimates

(Secondary Education)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 1.311[a] | | 1.182[a] | 1.331[a] | | 1.299[a] | 1.177[a] | | 1.139[a] |
| | (0.164) | | (0.213) | (0.169) | | (0.196) | (0.182) | | (0.201) |
| Democracy | | 0.643[a] | 0.179 | | 0.578[b] | 0.078 | | 0.481[b] | 0.095 |
| | | -0.131 | -0.100 | | -0.223 | -0.200 | | -0.216 | -0.200 |
| Proximity to Large Markets | -0.053[c] | -0.160[a] | -0.051[c] | | | | -0.129[a] | -0.240[a] | -0.129[a] |
| | (0.029) | (0.030) | (0.029) | | | | (0.036) | (0.044) | (0.036) |
| Fraction of Land Near Coast | 0.110 | -0.004 | 0.068 | | | | 0.007 | -0.091 | -0.004 |
| | (0.093) | (0.134) | (0.099) | | | | (0.107) | (0.141) | (0.107) |
| Landlocked Dummy Variable | 0.094 | 0.086 | 0.091 | | | | 0.046 | 0.038 | 0.049 |
| | (0.080) | (0.094) | (0.078) | | | | (0.080) | (0.103) | (0.082) |
| Logarithm of Land Area | -0.005 | -0.013 | -0.009 | | | | -0.025 | -0.035 | -0.027 |
| | (0.026) | (0.041) | (0.027) | | | | (0.027) | (0.043) | (0.028) |
| Latitude | | | | 0.000 | 0.003[b] | 0.000 | -0.004[b] | -0.004[c] | -0.004[b] |
| | | | | (0.001) | (0.002) | (0.001) | (0.002) | (0.002) | (0.002) |
| Fraction of Land in Tropical Desert | | | | -0.116 | -0.146 | -0.092 | -0.008 | 0.027 | 0.022 |
| | | | | (0.073) | (0.138) | (0.092) | (0.089) | (0.134) | (0.103) |
| Fraction of Land in Temperate Desert | | | | -0.040 | 0.313 | -0.008 | 0.078 | 0.244 | 0.124 |
| | | | | (0.410) | (0.518) | (0.423) | (0.409) | (0.442) | (0.407) |
| Fraction of Population with Malaria | | | | -0.139[b] | -0.191 | -0.113 | -0.101 | -0.128 | -0.071 |
| | | | | (0.059) | -0.135 | -0.086 | -0.062 | -0.121 | -0.085 |
| Constant | -0.029 | 1.387[b] | -0.012 | -0.417[a] | 0.017 | -0.457[a] | 1.048[c] | 2.553[a] | 1.024[c] |
| | (0.385) | (0.630) | (0.376) | (0.114) | (0.202) | (0.137) | (0.568) | (0.899) | (0.581) |
| R-squared | 0.71 | 0.55 | 0.72 | 0.70 | 0.46 | 0.70 | 0.74 | 0.58 | 0.74 |

Heteroskedasticity-consistent standard errors in parentheses

Statistically significant at 1 percent is denoted by "a", 5 percent by "b", 10 percent by "c".

Table 5

Relationship of Skilled and Unstilled Workers' Productivity with Institutions and Geography

IV Estimates

(Primary Education)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 1.446[a] | | 1.441[b] | 1.560 | | 1.457[a] | 1.475[a] | | 1.459[a] |
| | (0.455) | | (0.574) | (0.397) | | (0.382) | (0.437) | | (0.419) |
| Democracy | | 1.675[b] | 0.008 | | 1.237[a] | 0.206 | | 1.234[a] | 0.030 |
| | | (0.803) | (0.803) | | (0.310) | (0.455) | | (0.461) | (0.531) |
| Proximity to Large Markets | 0.011 | -0.006 | 0.011 | | | | -0.024 | -0.132 | -0.024 |
| | (0.059) | (0.081) | (0.053) | | | | (0.094) | (0.085) | (0.055) |
| Fraction of Land Near Coast | 0.067 | -0.310 | 0.065 | | | | 0.130 | -0.050 | 0.127 |
| | (0.111) | (0.274) | (0.213) | | | | (0.097) | (0.160) | (0.117) |
| Landlocked Dummy Variable | 0.038 | 0.015 | 0.038 | | | | 0.044 | 0.056 | 0.045 |
| | (0.068) | (0.137) | (0.079) | | | | (0.064) | (0.083) | (0.079) |
| Logarithm of Land Area | 0.019 | -0.012 | 0.019 | | | | 0.023 | -0.003 | 0.022 |
| | (0.019) | (0.041) | (0.024) | | | | (0.016) | (0.037) | (0.022) |
| Latitude | | | | 0.000 | 0.004[a] | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | (0.001) | (0.001) | (0.001) | (0.003) | (0.003) | (0.002) |
| Fraction of Land in Tropical Desert | | | | 0.050 | 0.232[c] | 0.110 | 0.049 | 0.321[b] | 0.058 |
| | | | | (0.083) | (0.121) | (0.182) | (0.086) | (0.157) | (0.199) |
| Fraction of Land in Temperate Desert | | | | 0.096 | 0.709[c] | 0.181 | 0.042 | 0.578 | 0.056 |
| | | | | (0.308) | (0.391) | (0.512) | (0.314) | (0.458) | (0.538) |
| Fraction of Population with Malaria | | | | 0.165[c] | 0.342[b] | 0.230 | 0.181[b] | 0.387[b] | 0.190 |
| | | | | (0.095) | (0.144) | (0.169) | (0.091) | (0.167) | (0.176) |
| Constant | -1.105 | -0.558 | -1.106[c] | -0.881[a] | -0.813[a] | -0.974[a] | -0.979 | 0.334 | -0.980 |
| | (0.728) | (0.876) | (0.612) | (0.261) | (0.239) | (0.294) | (1.067) | (0.998) | (0.727) |

Heteroskedasticity-consistent standard errors in parentheses

Statistically significant at 1 percent is denoted by "a", 5 percent by "b", 10 percent by "c".

Table 5 (Cont'd)

Relationship of Skilled and Unstilled Workers' Productivity with Institutions and Geography

IV Estimates

(Secondary Education)

| Right-hand-side Variable | Regressions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Property Rights | 1.505[a] | | 0.942 | 1.843[a] | | 1.426[a] | 1.603[a] | | 1.102[b] |
| | (-0.329) | | -0.689 | (-0.363) | | (-0.446) | (-0.362) | | (-0.491) |
| Democracy | | 2.041[a] | 0.951 | | 1.845[a] | 0.836 | | 1.885[a] | 0.976 |
| | | (0.759) | (0.964) | | (0.399) | (0.531) | | (0.553) | (0.622) |
| Proximity to Large Markets | -0.027 | -0.013 | -0.002 | | | | -0.080 | -0.171[a] | -0.090 |
| | (0.044) | (0.082) | (0.063) | | | | (0.050) | (0.053) | (0.065) |
| Fraction of Land Near Coast | 0.102 | -0.368 | -0.123 | | | | 0.026 | -0.220 | -0.087 |
| | (0.096) | (0.273) | (0.255) | | | | (0.109) | (0.239) | (0.137) |
| Landlocked Dummy Variable | 0.094 | 0.066 | 0.081 | | | | 0.056 | 0.089 | 0.080 |
| | (0.080) | (0.155) | (0.095) | | | | (0.081) | (0.142) | (0.093) |
| Logarithm of Land Area | -0.007 | -0.046 | -0.026 | | | | -0.025 | -0.064 | -0.045[c] |
| | -0.024 | -0.057 | -0.029 | | | | -0.024 | -0.071 | (-0.026) |
| Latitude | | | | -0.002 | 0.003 | -0.001 | -0.003[b] | -0.003 | -0.003 |
| | | | | -0.002 | -0.002 | -0.002 | (-0.002) | -0.003 | -0.002 |
| Fraction of Land in Tropical Desert | | | | -0.018 | 0.345[b] | 0.226 | 0.042 | 0.534[b] | 0.336 |
| | | | | (0.102) | (0.172) | (0.213) | (0.097) | (0.249) | (0.233) |
| Fraction of Land in Temperate Desert | | | | -0.096 | 0.765 | 0.247 | 0.108 | 0.972 | 0.579 |
| | | | | (0.420) | (0.523) | (0.598) | (0.420) | (0.612) | (0.630) |
| Fraction of Population with Malaria | | | | -0.025 | 0.347[c] | 0.237 | -0.024 | 0.407[c] | 0.258 |
| | | | | (0.098) | (0.184) | (0.198) | (0.090) | (0.231) | (0.206) |
| Constant | -0.338 | -0.080 | -0.439 | -0.759[a] | -0.980[a] | -1.138[a] | 0.345 | 1.279 | 0.287 |
| | (0.605) | (1.008) | (0.735) | (0.242) | (0.293) | (0.343) | (0.745) | (1.105) | (0.852) |

Heteroskedasticity-consistent standard errors in parentheses

Statistically significant at 1 percent is denoted by "a", 5 percent by "b", 10 percent by "c".

Figure 1:  Labor and Capital Productivity

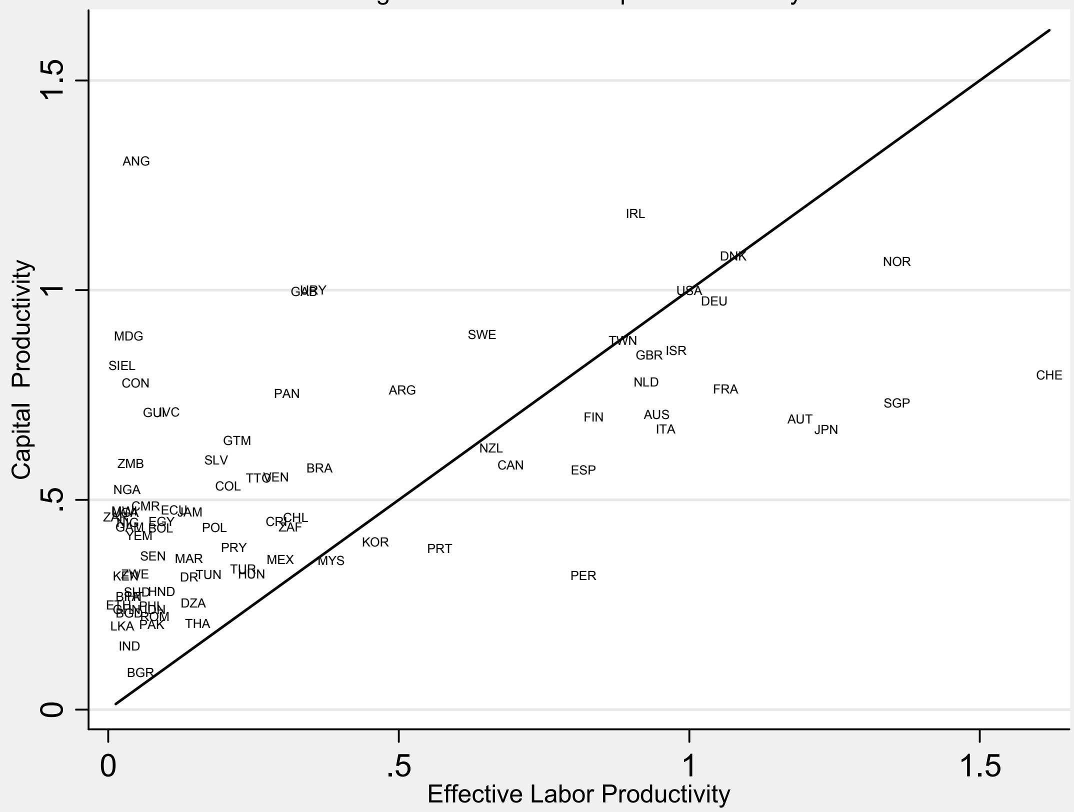


Figure 2: Total Factor Productivity and Trade Productivity

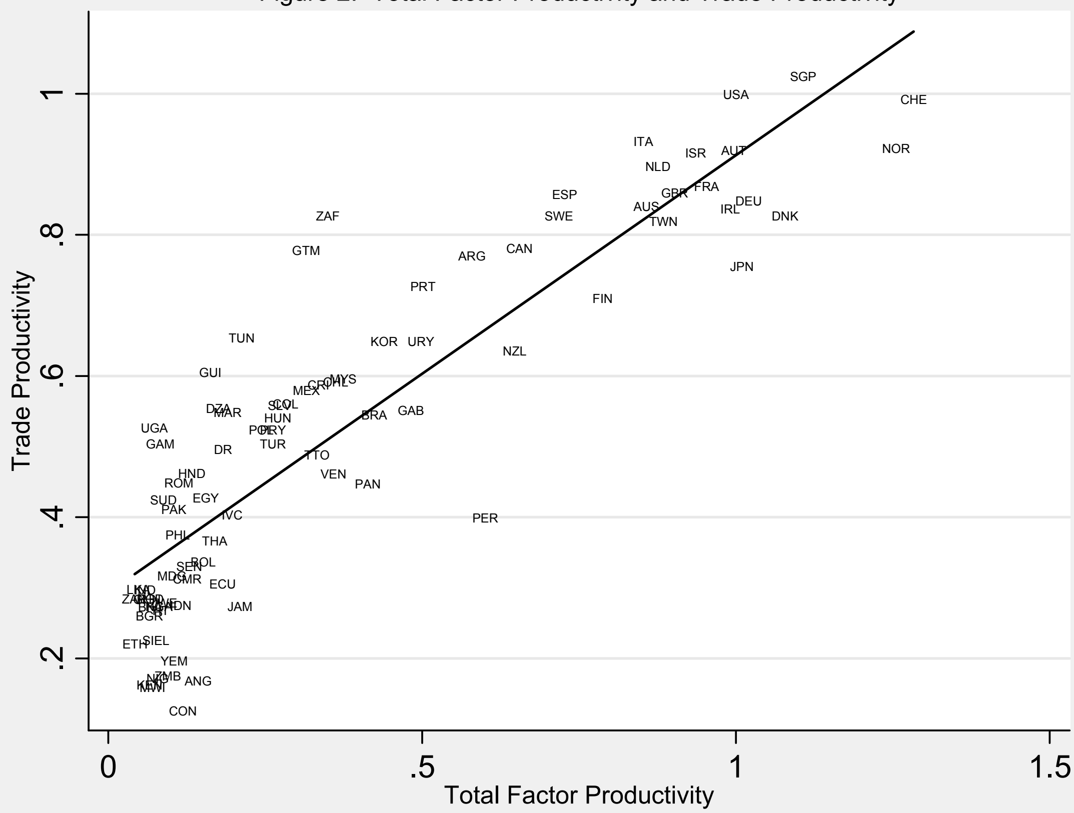


Figure 3: Productive Geography, Labor, and Capital Productivity
;

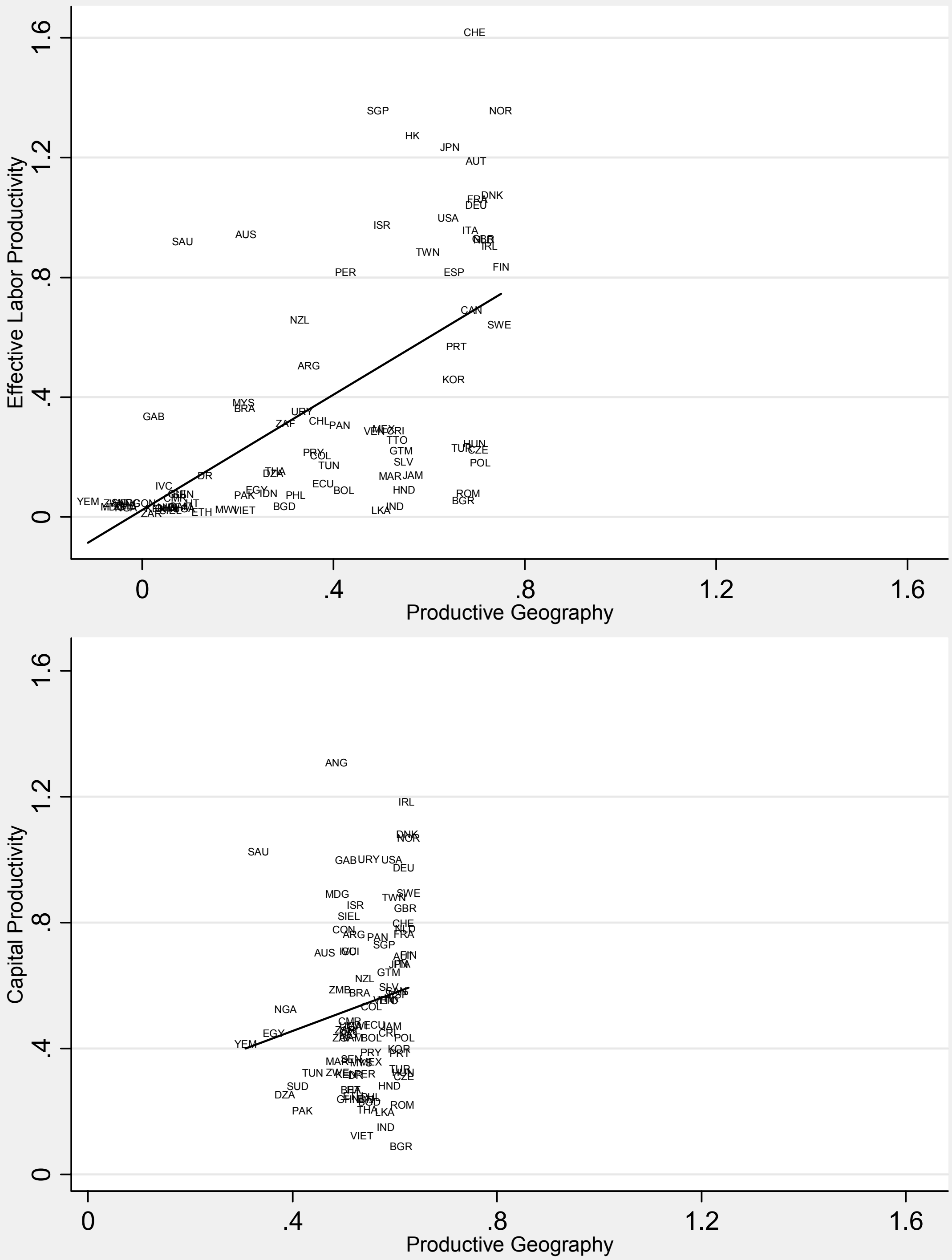


Figure 4: Market Geography, Labor, and Capital Productivity
;

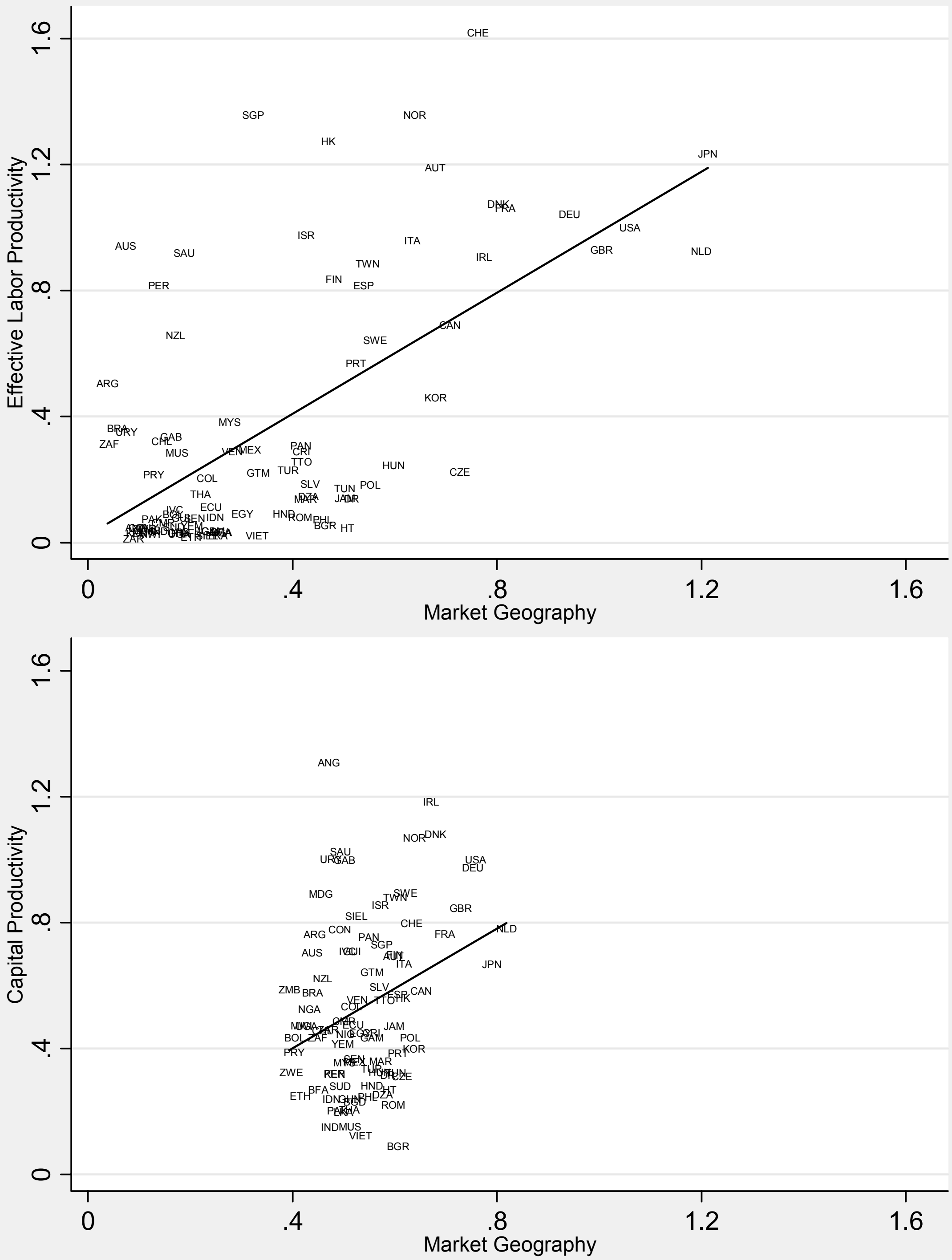


Figure 5: Property Rights, Labor, and Capital Productivity
;

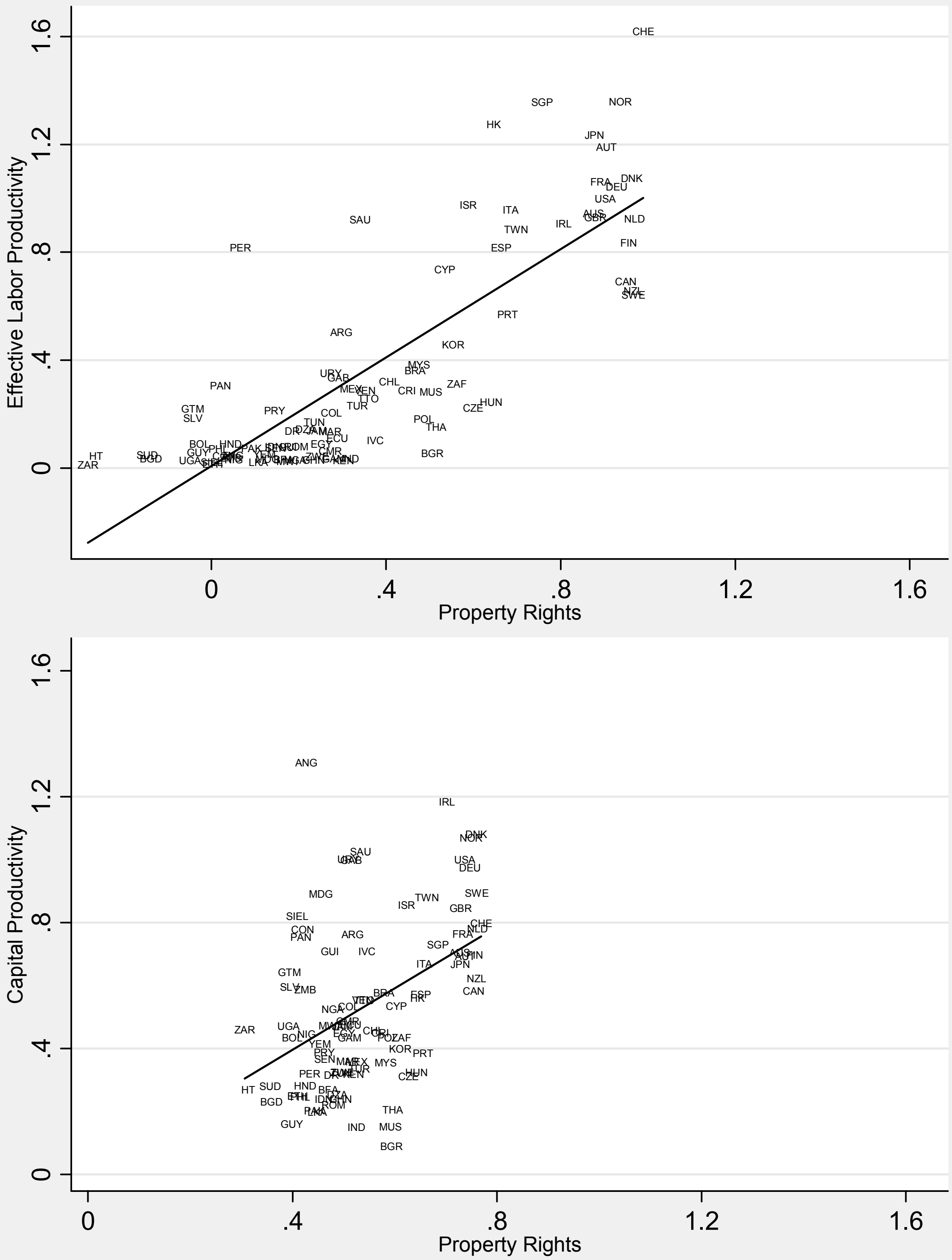
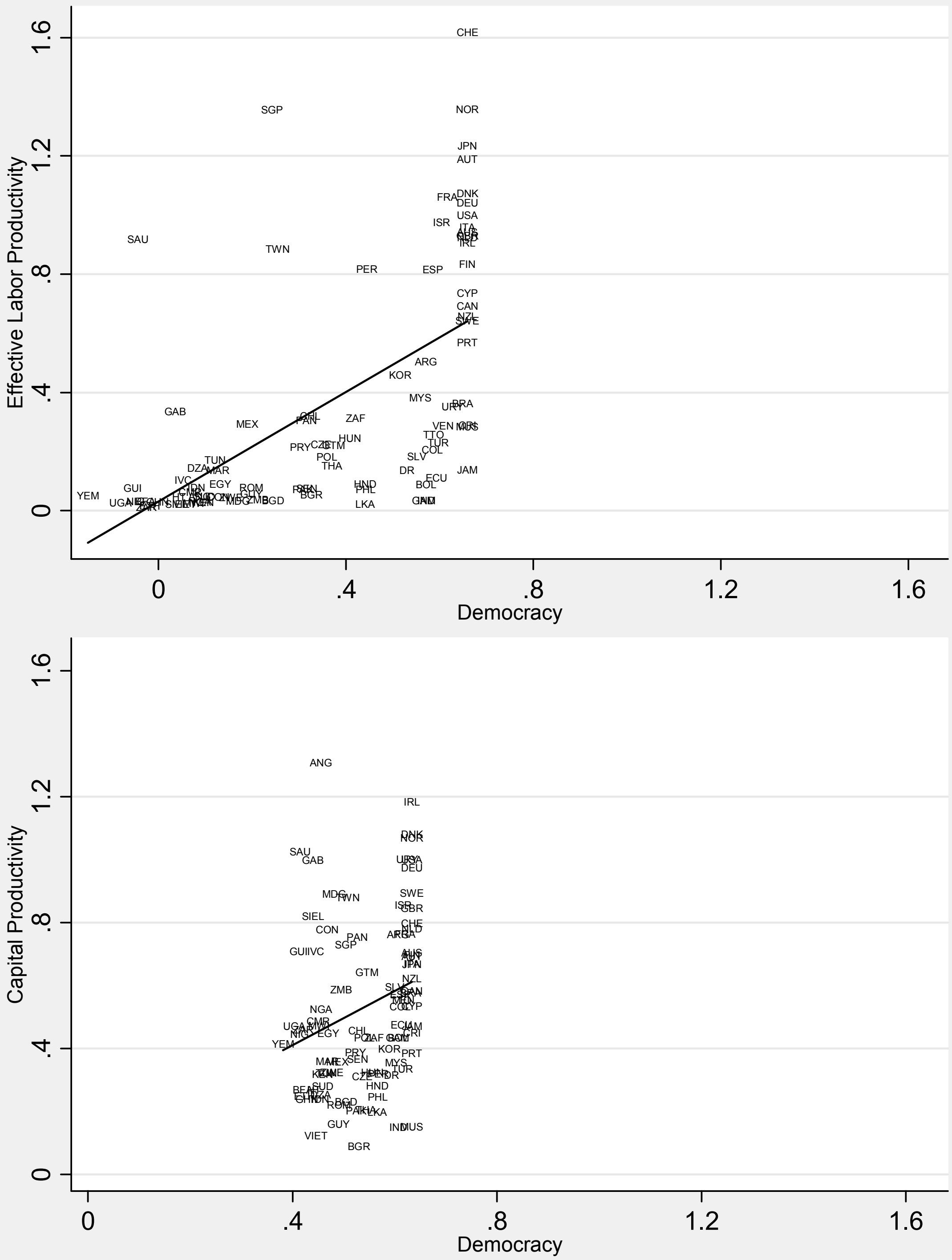


Figure 6: Democracy, Labor, and Capital Productivity
;



Appendix Table 1
Countries (84) Included in Empirical Analysis

| | | |
|---|---|---|
| Algeria | Haiti | Senegal |
| Angola | Honduras | Sierra Leone |
| Argentina | Hungary | Singapore |
| Australia | India | South Africa |
| Austria | Indonesia | Spain |
| Bangladesh | Ireland | Sri Lanka |
| Bolivia | Israel | Sudan |
| Brazil | Italy | Sweden |
| Bulgaria | Ivory Coast | Switzerland |
| Burkina Faso | Jamaica | Tawain |
| Cameroon | Japan | Thailand |
| Canada | Kenya | Trinidad and Tobago |
| Chile | Korea, Rep. | Tunisia |
| Colombia | Madagascar | Turkey |
| Congo | Malawi | Uganda |
| Congo, Democratic Republic | Malaysia | United Kingdom |
| Costa Rica | Mexico | United States |
| Denmark | Morocco | Uruguay |
| Dominican Republic | Netherlands | Venezuela, RB |
| Ecuador | New Zealand | Yemen, Rep. |
| Egypt, Arab Rep. | Niger | Zambia |
| El Salvador | Nigeria | Zimbabwe |
| Ethiopia | Norway | |
| Finland | Pakistan | |
| France | Panama | |
| Gabon | Paraguay | |
| Gambia | Peru | |
| Germany | Philippines | |
| Ghana | Poland | |
| Guatemala | Portugal | |
| Guinea | Romania | |

Appendix Table 2
Industries (32) Included in Empirical Analysis

| Industry | BEA Code |
|---|---|
| Food and Kindred Products | 14 |
| Tobacco | 15 |
| Apparel | 16, 17 18, 19 |
| Pulp, Paper and Allied Products | 24, 25 |
| Printing and Publishing | 26A, 26B |
| Drugs | 29A |
| Soaps, Cleaners and Toilet Goods | 29B |
| Agricultural Chemicals | 27B |
| Industrial Chemicals and Synthetics | 27A |
| Rubber and Plastic Products | 32 |
| Primary Metals | 37 |
| Non-Ferrous Metals | 38 |
| Fabricated Metals | 38, 40,41,42 |
| Farm Machines | 44,45 |
| Construction, Mining Equipment | 46 |
| Computers | 51 |
| Other Non-Electrical Equipment | 43, 47,48,49,50,52 |
| Household Appliances | 54 |
| Household Video | 56 |
| Electrical Components | 57 |
| Other Electrical | 53,55,58 |
| Motor Vehicle | 59A, 59b |
| Other Transport | 60, 61 |
| Lumber, Wood, Furniture | 20, 21, 22, 23 |
| Stone and Clay | 36 |
| Glass | 35 |
| Instruments | 62, 63 |
| Other Manufactures | 64 |
| Agriculture | 01, 02, 03, 04 |
| Mining | 05, 06, 07, 09, 10 |
| Gas/Oil | 08 |
| Construction | 11, 12 |