1. Introduction

In their seminal 2001 paper, *The Colonial Origins of Comparative Development: An Empirical Investigation,* Daron Acemoglu, Simon Johnson, and James Robinson, hereby Acemoglu et al. (2001) set out to examine the question of the effects of institutions on national income per capita. More specifically, the authors ask, what is the effect of institutions that have property right protections, measured by the risk of capital expropriation, on economic performance? To answer such a question, Acemoglu et al. (2001) argue that colonization was more likely to occur in places that had lower mortality rates. These colonies then developed 'inclusive' institutions that protected property rights more than in places where Europeans did not settle or where colonial institutions were primarily 'extractive'. In the long run, these institutional differences in property-right protections persisted, creating exogenous differences between nations that then affected GDP per capita. Using an IV regression, where settler mortality is used as an instrument for the risk of capital expropriation, Acemoglu et al. (2001) find that the effect of capital expropriation risk on GDP per capita is large, and posit that it serves to explain the variation seen in GDP per capita across modern nations.

2. Outline and Hypothesis

Accordingly, the primary question of this paper asks, do Acemoglu et al.'s (2001) findings, and their larger story of the factors that contribute to national income, hold up under scrutiny? To answer this question, this paper will first replicate the findings of Acemoglu et al. before examining the validity of two critiques of the paper, being that current health conditions and/or climatic conditions are better determinants of national income per capita. Accordingly, this paper hypothesizes that although Acemoglu et al.'s (2001) IV findings hold up under scrutiny, current health and climatic conditions serve as better predictors of national income than mortality rates as an instrument for the risk of capital expropriation. Formally then, H0: Mortality rates as an instrument for the risk of capital expropriation are better predictors of national income per capita than current health or climatic conditions. H1: Current health or climatic conditions are better predictors of national income per capita than mortality rates as an instrument for the risk of capital expropriation.

3. Replication Results

Figure (1) Regressing loggdp on risk

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Call:
lm(formula = loggdp ~ risk, data = gs)

Residuals:
    Min      1Q  Median      3Q     Max
-1.8351 -0.4449  0.1804  0.4834  1.2072

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.73119    0.41465  11.410  < 2e-16 ***
risk         0.50511    0.06232   8.105 3.24e-11 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7225 on 60 degrees of freedom
Multiple R-squared:  0.5227,    Adjusted R-squared:  0.5147
F-statistic:  65.7 on 1 and 60 DF,  p-value: 3.241e-11
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The first step in examining my hypothesis is to replicate Acemoglu et al.'s (2001) findings. Accordingly, Figure (1) above seeks to recreate Acemoglu et al.'s regression results in their Table (2) of the effects of loggdp on risk using OLS without including covariates or fixed effects. Examining Figure (1), we see an intercept of 4.73119, representing the expected value of loggdp when the risk variable is zero. Examining the first coefficient, expropriation risk, sees an increase of 0.50511, with a SE of 0.06232, at a statistically significant level of 3.24e-11. This means that, on average, a one-unit increase in the average protection against expropriation risk is associated with a 0.50511 increase in loggdp. The regression also had a low total p-value and high R-squared, indicating that this model can explain a majority of the variance in loggdp. Such a result is consistent with the results of Acemoglu et al.'s Table (2) specification (2), which does not include fixed effects or controls. My regression results had a smaller estimate of 0.505 compared to Acemoglu et al.'s 0.052 but had similar SEs, both of approximately 0.6 (rounding down). Evaluating such results in light of Acemoglu et al.'s argument, my regression found less effect magnitude compared to Acemoglu et al., but overall, my results confirm that there is a strong positive relationship between institutions that protect against the risk of capital expropriation and economic performance. In this regard, this regression confirms the initial argument of Acemoglu et al. (2010); however, as even they note, such results should not be considered causal due in part to reverse causality and omitted determinants of income differences, both of which introduce bias into the regression.

Figure (2) IV estimation of loggdp on risk using logmort0

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Call:
ivreg(formula = loggdp ~ risk | logmort0, data = gs)

Residuals:
     Min       1Q   Median       3Q      Max
-2.35130 -0.54193  0.05887  0.67539  1.63873

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   2.1345     1.0139   2.105   0.0395 *
risk          0.9053     0.1552   5.834 2.32e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9384 on 60 degrees of freedom
Multiple R-Squared: 0.1946,     Adjusted R-squared: 0.1812
Wald test: 34.04 on 1 and 60 DF,  p-value: 2.321e-07
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Figure (2) represents an instrumental variable (IV) regression that estimates the causal effect of the expropriation risk index on the log of GDP, where the instrument used is the log mortality rate, logmort0. Acemoglu et al. (2001) instrument risk on loggdp to address potential endogeneity issues in their OLS estimation of the relationship between institutions and economic performance. As the authors note, institutions may be endogenous to economic performance, and thus, there may be reverse causality or unobserved variables which bias the OLS estimate. By using mortality as an instrument, the IV regression can better identify the effect of the expropriation risk on GDP per capita by exploiting the fact that mortality rates were determined by historical events and uncorrelated with other factors that may influence contemporary economic development. Examining Figure (2), we see that the IV estimate is larger than the OLS estimate, which is to be expected as the OLS estimate is biased downwards due to the potential endogeneity problem, while the IV estimate addresses this bias. The IV regression shows that for every unit increase in the expropriation risk index, loggdp increases by 0.9053, holding other variables constant. The regression is significant, with a p-value of 2.321e-07. The R-squared value is lower than the OLS model at 0.1946, suggesting that the IV model explains less of the variance in loggdp and that other factors could also influence it. Similar to the OLS model, my IV regression results support Acemoglu et al.’s (2001) findings, suggesting a positive relationship between the expropriation risk and GDP, supporting the idea that secure property rights are essential for economic growth. Overall, the IV addresses the OLS’ endogeneity problem and supports the arguments of Acemoglu et al. (2001).

The use of logmort0 as an instrument in the IV regression is based on Acemoglu et al.'s (2001) assertion that a linear relationship exists between logmort0 and expropriation risk, meaning that "ex-colonies where Europeans faced higher mortality rates have substantially worse institutions today." Mortality's relevance is convincing; it follows that mortality rates would affect decisions on where and how to colonize, and thus, high mortality rates may have played a role in the character of colonial institutions. Thus, I believe that mortality as an instrument is well justified in its relevance. However, a strong argument can be made that mortality is endogenously determined by unmeasured factors, like wars, institutional investment, or the availability of medical care, thereby violating the exogeneity assumption. Moreover, as David Albouy notes in his critique of Acemoglu et al. (2001), "mortality rates are endogenous: places with lower future security of property rights and lower output per capita essentially suffer from positive measurement error in mortality rates" (Albouy, 2008). In this regard, there is serious concern that Acemoglu et al.'s claim of exogeneity does not hold and that unobserved factors affecting settler mortality rates may have led to biased estimates.

4. Critique

4.1 Current health conditions

Critics of Acemoglu et al. (2001), have asserted that "Rather than look back hundreds of years for the causes of national prosperity, it is more plausibly the case that current health conditions matter more. After all, it is hard for workers to be productive when they are ill. Moreover, current health conditions are likely to be related to health conditions in the past, including at the time Europeans began to set up institutions of colonial rule." Vitally, such a critique implies that the instrument logmort0 does not fully capture the effect of health on contemporary economic outcomes, and that measures such as current health conditions, better explain variation in GDP per capita. The critique suggests that Acemoglu et al.'s (2001) results which rely on mortality may be biased, and thus, not capture the causal effect of risk on GDP per capita. Accordingly, in an effort to compensate for health effects, we can include measures of current health conditions in a new IV, to examine whether they help to account for the potential impact on economic development and better identify the causal effect of risk on economic outcomes. The results of this new regression are seen in Figure (3) below.

Figure (3) IV Regression including Malaria

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Call:
ivreg(formula = loggdp ~ risk + malaria | malaria + logmort0,
    data = gs)

Residuals:
     Min       1Q   Median       3Q      Max
-1.79712 -0.38548  0.05167  0.43961  1.19904

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.5047     1.5905   2.832  0.00631 **
risk          0.5892     0.2216   2.658  0.01010 *
malaria      -0.7513     0.3956  -1.899  0.06242 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6545 on 59 degrees of freedom
Multiple R-Squared: 0.6147,     Adjusted R-squared: 0.6017
Wald test: 44.28 on 2 and 59 DF,  p-value: 1.8e-12
```

The new IV regression includes malaria as an additional, exogenous regressor that tries to rectify the issues identified by the critique by implementing a regressor representative of current health conditions. In doing so, the effect of malaria on economic growth is explicitly controlled, increasing the precision and accuracy of the estimate of the effect of risk on GDP per capita. Interpreting the regression coefficients, expropriation risk, causes a 0.5892 increase in loggdp, at a 0.05 significance level. The malaria coefficient has an estimate of -0.7513 at a non-significant level. The adjusted R-squared value has increased to 0.6017, suggesting that the inclusion of malaria has improved the model's explanatory power. By including the malaria regressor, we effectively control for the effect of a modern health condition, improving the precision of our estimate of the effect of risk on GDP per capita. Of note, the statistical significance of risk has decreased and is noisier than in previous regressions, demonstrating that malaria and other current health conditions do, in fact, capture some of the effects of risk on GDP per capita. Overall, including malaria as an exogenous regressor helps to address the critique by controlling for the effect of current health conditions and thus improving the accuracy of the IV. The results of the IV regression in Figure (3) suggest that the critique that current health conditions, represented by malaria, better captures the causal effect of risk on GDP per capita and does have some merit. By including malaria as an additional exogenous regressor, the IV estimates more accurately the impact of expropriation risk on GDP per capita and implies that our previous estimates that did not control for current health conditions were less accurate. Overall, the inclusion of malaria as an exogenous regressor serves to provide a more nuanced understanding of the relationship between risk, mortality, health, and GDP per capita.

4.2 Climatic Conditions

Figure (4) Effect of climatic conditions on GNP.

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Call:
ivreg(formula = loggdp ~ risk + latitude + rainmin + meantemp +
    malaria | malaria + latitude + rainmin + meantemp + logmort0,
    data = gs)

Residuals:
     Min       1Q   Median       3Q      Max
-1.97659 -0.37638  0.05329  0.49183  1.43762

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.826390   9.663121   0.396    0.694
risk         0.679619   1.298187   0.524    0.603
latitude    -0.443694   2.509885  -0.177    0.860
rainmin     -0.001405   0.024690  -0.057    0.955
meantemp     0.008777   0.085524   0.103    0.919
malaria     -0.745955   0.818403  -0.911    0.366

Residual standard error: 0.7368 on 56 degrees of freedom
Multiple R-Squared: 0.5366,     Adjusted R-squared: 0.4952
Wald test: 16.16 on 5 and 56 DF,  p-value: 7.675e-10
```

The second major critique of Acemoglu et al. (2001), attributes national productivity to climatic conditions. Accordingly, Figure (4) is a IV regression which includes latitude, rainmin, and meantemp as additional regressors. Examining the coefficients, none of the additional variables are statistically significant, and have also caused the original estimates to also become non-significant. Furthermore, the adjusted R-squared has decreased down to 0.4952, indicating that the model explains only about half of the variation in loggdp. Accordingly, the results from Figure (4) do not provide strong evidence that national productivity is primarily a result of climatic conditions. Therefore, the inclusion of climatic variables does not appear to have much merit in explaining national productivity. As this paper has explored, Acemoglu et al.'s (2001) findings, that mortality rates as an instrument for the risk of capital expropriation are predictors of national income per capita, are compelling. Replicating Acemoglu et al. (2001), I find similar effect sizes and statistical significance, indicating that there is validity to their argument. However, as this paper initially hypothesized, current health conditions or climatic conditions may be better determinants of national income per capita. My analyses of these critiques have produced mixed results, indicating that current health conditions do explain some of the variation in logdgp, while climatic conditions do not. Accordingly, we can formally reject the H1 hypothesis and accept the null H0, concluding that although current health conditions improved the accuracy of our estimates, neither current health conditions or climatic conditions, are better predictors of national income per capita than mortality as an instrument for capital expropriation risk.

Bibliography:

Acemoglu, D., Johnson, S., Robinson, J, A. (2001) The Colonial Origins of Comparative Development: An Empirical Investigation. *American Economic Review, 91(5).* p. 1369-1401.

Albouy, D, Y. (2008). The Colonial Origins of Comparative Development: An Investigation of the Settler Mortality Data. *NBER.* Working Paper, 14130.