What About Technology?

Technological Adoption History and Economic Growth in United States Counties

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Abstract

Deep Roots literature has focused on how distant historical characteristics help explain cross country variations in economic growth. Scholars have also attempted to investigate how these traits affect economic growth in the United States. Recently, Fulford, Petkov, & Schiantarelli developed an ancestry data set for U.S. counties for purposes of assessing the effects of Deep Roots characteristics on economic growth in the U.S. Despite being the most powerful measure in the Deep Roots literature, their paper failed to make use of the measure of technological adoption developed by Comin, Easterly and Gong (2010). In this paper, I take the ancestral data of U.S. counties developed by Fulford, Petkov, & Schiantarelli and combine it with the technological adoption measure by Comin, Easterly and Gong (2010) to create a measure of each county's ancestral history of technological adoption. I then run a series of fixed effects regressions and demonstrate that technological adoption appears to be the most important Deep Roots and ancestral characteristic effect on economic growth in the US.

Introduction:

The importance played by the past in shaping modern economic conditions has been given increased attention by scholars in the last few decades. Initially, the focus was on the role of geography and environment in explaining the divergence in economic growth across countries. Jared Diamond help popularize these theories in 1997 with his book 'Guns, Germs, and Steel.' These theories propose that environmental and geographic characteristics, such as ruggedness of terrain and distance from the equator, affect any given population's move to settled agriculture and domestication of animals which, in turn, affect these countries' economic growth path.

The literature claims that geography has both direct effects on economic growth, through the physical erection of barriers to trade and specialization, and indirect effects, through its effects on culture and institutions. If environment primarily affects economic outcomes through these indirect effects, then, scholars noted, the prosperity of a nation should not be predicted by its geography but by the ancestral geography of the people who currently inhabit it. These claims led to the migration adjusted Deep Roots literature started by Putterman and Weil (2010). Their studies indicate that factors such as years of settled agriculture, state history, and respect for authority are important explanations for differences in economic growth across nations.

Of all these variables, the most important one was the Comin, Easterly and Gong (2010) measure of technological adoption. This variable explained 18% of cross-country variation in income per-capita. Recently, a school of literature has emerged employing the decentralized structure of the United States to investigate how the Deep Roots characteristics affect economic outcomes in the U.S. The most comprehensive study so far was done by Fulford, Petkov, & Schiantarelli (2020). They use census data to make an accurate measure of every

US county's ancestry. This allows them to make Deep Roots measures of each county's population to determine the effect on economic growth.

However, the technological adoption measure was left out of their paper however. In this paper I use their ancestry data to create a measure of the ancestral history of technological adoption for every U.S. County from 1890 to 2010. I then run a fixed effects model to see how technological adoption affects economic growth. My results indicate that a history of technological adoption is of significant importance for economic growth. When compared to other Deep Roots measures, technological adoption appears to be the most robust Deep Roots measure. It maintains the size of its effects and its significance better than other measures such as state history.

Deep Roots Summary:

The Deep Roots literature emerged from the literature on geography and its effects on economic outcomes. It proposes that if the major mechanisms by which geographical and environmental conditions affected economic growth was through their effect on culture, then histories of the populations dominating a country should be studied rather than the history of the country itself.

Putterman and Weil (2010) consider two variables for measuring Deep Roots, adoption of settled agriculture and early state development. Adoption of settled agriculture establishes the length of time taken for any given people group to progress from hunter-gather status to settled agriculture. Those who made the transition further back have a deeper history of settled agriculture. State history measures how long ago a people developed a tribal government. These governments need to come from within the population as opposed to being imposed on it by force. The further back the population formed a government, the deeper its state history. Putterman and Weil (2010) investigate the possible effect of these factors on a country's GDP per-capita and inequality after adjusting for post 1500 A.D. migration patterns. These results indicate that adjusting a modern country's 1500 A.D. ancestry predicts a large amount of current day GDP per capita and income inequality. One third of cross-country inequality in income can be explained by the heterogeneity of the population's ancestral agricultural and political experience. This result is robust to controls for the mini-European and African countries.

Comin, Easterly, and Gong (2010) take the Putterman and Wile (2010) migration adjusted population and assign a new variable to it. They consider technological adoption rates and investigate how they predict a country's GDP per capita. They focus on technological adoption as opposed to innovation because adoption indicates an openness to trying new things and a willingness to adapt more innovative production systems. A culture willing to do this is important for economic growth. The dates of technological adoption Comin, Easterly, and Gong (2010) use go back to 1000 B.C., 0 A.D, and 1500 A.D. Adoption rates for the first two time periods only measure whether the technology was in use by the population, not how widespread the usage was. The 1500 A.D. adoption rates measure intensity of technological usage. Their results indicate that ancestral technology adoption in 1500 A.D. is a better predictor of 2000 A.D. GDP per-capita than migration adjusted state history and settled agriculture history. The 1000 B.C. and 0 A.D. rates predict a country's 1500 A.D. adoption rate, but their effects on A.D. 2000 GDP per capita dissipate after a series of control variables are put in place.

There is a growing body of literature focusing on Deep Roots traits as they are expressed in the United States. The ethnic diversity of the U.S. makes it an ideal testing ground for assessing how differing cultures and ethnicities affect economic growth.

Nowrasteh and Powell (2020) did a study on immigration from the poorest countries in the world and how it affected economic growth across Europe and the U.S. Their results indicate that immigration from poor countries increases economic freedom across European countries and has no effect across the U.S. These results have been criticized for over control bias(Jones and Fraser 2021).

Another recent paper, by Giuliano and Tabellini (2022), demonstrates how migrants from Europe in the 1920s replicated their preferences for a welfare state in the U.S. Using IV methods, they demonstrate that an increase in European immigration resulted in a county's increased preference for government spending and support for the Democratic party. This effect lingers to this day.

These studies, however, do not make great use of actual Deep Roots measurements. Fulford, Petkov, & Schiantarelli (2020) use privileged census data in order to make the first accurate mapping of the national ancestry of the US population from 1840 to 2010. This data is generated at the county group level. Using this data, they generate Deep Roots measures of U.S. counties. They take cross national measures, including state history, ancestral trust, political culture, and respect for authority, and multiply them by the percentage of each nationality withing the county's population. This average is used to measure a county's Deep Roots history. They then perform a series of fixed effects estimates which demonstrate that several of these factors have robust effects on a county's economic growth. The most robust of these factors seems to be state history and trust.

Technology Adoption by County:

Here, I take the ancestral measures designed by Fulford and estimate the measure of a county's ancestral history of technological adoption by multiplying the technological adoption measure of the nation by the fraction of people in a county deriving ancestry from that nation.

I then run a series of fixed effects regressions with this panel data similar to those run by Fulford, Petkov, & Schiantarelli (2020). I do this to see how well technological adoption predicts a county's economic performance. The model is as follows:

$$Y_{ct} = \varnothing_c + \varnothing_{ct} + \alpha_{ct} + \beta Z_{ct} + \delta Y_{ct} + \epsilon_{ct}$$

Y_{ct} = log income per capita of county c at time t.$\varnothing_{ct}$ controls for census division-specific year effects. I tested the effect that a variety of deep roots characteristics βZ_{ct} have on on Y_{ct}. The Deep Roots variables we measure in addition to technology are state history, political culture, education level, constraint on the executive, and political participation. The particulars of these variables are explained in Petkov, & Schiantarelli (2020). We also controll for series of other factors with δY_{ct} including log population, population density, and two lags of log county gdp. We also control for the fraction of the population that is native American and African-American. The African-American fraction is very important.

The results are reported in table 1. As we can see, technology has a significant independent effect on a county's economic outcome. It surpasses all other Deep Roots measures with the exception of state history. When all the measures are combined in a horse race, technology is second only to state history once again.

This story changes, however, once we add controls for African-Americans and native-Americans. In Table 2 the importance of state history dissipates once we control for the fraction of African-Americans in the county. The significance level drops from being significant at the .001 level to only being significant at the .05 level. Technology adoption does not face a similar drop, and it becomes more significant than state history.

Our final robustness check employs IV variables to predict these Deep Roots ancestries. Both of these were used in Fulford, Petkov, & Schiantarelli (2020) and are fully explained there. The first IV we use is a predicted ancestry of county using a county initial ancestral population and the growth of that ancestry at national levels (minus the state said county it is in). The second IV we use is the distance of a county from a railroad or highway system. This measure builds on Sequeira et al. (2019) who highlight the likelihood of immigrants to populate areas with easier access. Fulford, Petkov, & Schiantarelli (2020) make predictions on ancestry using a county's distance from either a highway or railroad. The specific details of these IV constructions are detailed in Petkov, & Schiantarelli (2020). I use these predictions of ancestral composition to predict the measure of technological adoption. I then use the predicted technological adoption measures as an instrument for the actual technological adoption ancestry.

These results are presented in Table 3:

{Insert Table }

Both are significant using the 1st IV which predicts ancestry using initial endowment and national growth rate. Once controls for African ancestry are added, the significance of state history falls to the .05% level. Technology remains significant and important.

The second IV we use predicts ancestry using a county's distance from a railroad or highway. Both technology and state history are important if African-American ancestry is not controlled for, but once one controls for African-American ancestry, state history becomes insignificant. Technological adoption rates continue to be significant at the .05% level.

Table 1:

	LogGDP(1)	LogGDP(2)	LogGDP(3)	LogGDP(4)	LogGDP	LogGDP	LogGDP
State History	1.73528 (.0770346)						1.423167*** (.147024)
Polotical Culture		.6625072 *** (.0377988)					.3975705*** (.1016167)
Executive Constraint			.1019546 (.0067415)				-.0099771 (.011)
Political Participation				.024774 (.001694)			-.0144398 *** (.003409)
Ancestral Education					.0962164*** (.0065427)		-.024231 (.0146932)
Technology Adoption						.8040439***	.2846514***
						(.0396601)	(0788046)
FE	YES	YES	YES	YES	YES	YES	YES
N observations	14,421	14,421	14,421	14,421	14,421	14,421	14,421
N groups	1,146	1,146	1,146	1,146	1,146	1,146	1,146

Table 1. Summarizes our Fixed Effects regression results. These results show the effect of our deep roots measurements on a counties log income per capita. We control for log population, population density, and two lags of log county gdp.
Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2:

	LogGDP(1)	LogGDP(2)	LogGDP(3)
State History	.6726358*** .174383)		
Technology Adoption		.2996823 *** (.0662734)	
Polotical Culture			.000515 (.0021708)
African American	YES	YES	YES
FE	YES	YES	YES
N observations	14,421	14,421	14,421
N groups	1,146	1,146	1,146

Table 2. Summarizes our Fixed Effects regression results. These results show the effect of our deep roots measurements on a counties log income per capita. We control for log population, population density, and two lags of log county gdp. In addition we also have controls for the fraction of the population that is Native American and African American. Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusion:

Deeps Roots are important for explaining economic growth through its effects on culture and institutions. However, some roots are more important for economic growth than others. Here, I constructed a measure of the technological adoption usage of U.S. counties and compare it to previously developed Deep Roots measure for U.S. counties. Technology is the most significant Deep Roots variable used to explain economic growth and is more robust than other important measures, such as state history. Future research should investigate how an ancestry in technological adoption affects economic growth. A history of technology may be important for creating an environment friendly to innovation. One method of measuring this could be to look at a county's ancestry and how it relates to its patent record.

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