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Data Assignment 3 Write Up

Introduction
This analysis examines the relationship between technological advancement and GDP per capita growth from 1970 to 1999. Economic theory suggests that as new technologies diffuse—improving productivity, communication, and infrastructure—countries can enhance their output and living standards. To explore these dynamics, this study focuses on a set of technology growth measures—agricultural tractors, electricity production, fertilizer use, radio, and television—and assesses how their adoption correlates with changes in GDP per capita. Additionally, the analysis compares results for developed and non-developed countries to determine if the benefits of technology differ depending on a country's stage of economic development.

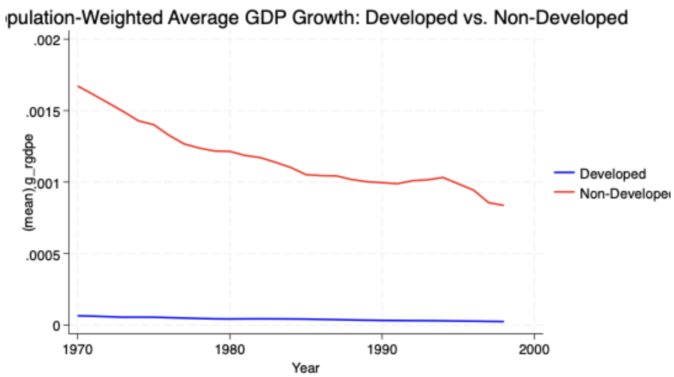
Data
Data are drawn from two primary sources. The Penn World Table (PWT 10.01) provides country-level data on real GDP, population, and control variables such as human capital, investment share, and trade shares. The NBER dataset supplies information on technological adoption indicators. The sample is restricted to the years 1970–1999, and countries are dropped if they do not have at least 20 years of data. Country names are standardized to ensure a proper merge, and both datasets are combined to form a panel of country-year observations.

The final dataset includes GDP per capita and technology variables along with control measures. To illustrate the basic properties of the data, a summary statistics table is provided below:

Variable	Mean	SD	Min	Max
g_rgdpe	.0099748	.021622	7.72e-06	.212005
g_ag_tractor	.312797	1.324015	.000019	33.33333
g_elecprod	6.54e-07	5.90e-06	3.12e-11	.0001
g_fert_total	.0327491	.1515913	2.78e-06	4.761905
g_radio	.3029665	.8573991	.0001724	20
g_tv	.025574	.2630581	2.46e-07	10
hc	1.917682	.6669184	1.007409	3.555839
csh_i	.2071299	.1143327	-.101107	.9502093
trade_open~s	-.0323445	.1335866	-1.167603	.976071
labsh	.5301355	.1298338	.1508483	.8965429

This table allows a comparison of means, standard deviations, and ranges for the key variables. Notably, non-developed countries often exhibit higher average technology growth rates, reflecting more room for technological catch-up compared to developed countries.

Visualizing Trends
Before diving into the regressions, it is informative to compare GDP growth patterns over time for developed and non-developed nations. The following figure shows the population-weighted average GDP growth rates for both groups:



Here, developed countries' GDP growth rates remain relatively flat over the study period, suggesting a stable growth environment. In contrast, non-developed countries start with higher growth rates that trend downward over time, potentially indicating challenges in sustaining high growth as initial catch-up effects wane.

Empirical Strategy and Regression Analysis
The main analysis uses Ordinary Least Squares (OLS) regressions to examine how growth in each technology correlates with GDP per capita growth. The dependent variable is the growth rate of real GDP per capita (g_rgdpe), and the key explanatory variables are the growth rates of agricultural tractors, electricity production, fertilizer use, radio, and television adoption. Control variables include human capital (hc), investment share (csh_i), and trade openness (csh_x + csh_m), as well as the labor share of income (labsh).

The estimated model is:

$$\text{g\_rgdpe} = \beta 0 + \beta 1 \textit{g\_ag\_tractor} + \beta 2 \text{g\_elecprod} + \beta 3 \textit{g\_fert\_total} + \beta 4 \text{g\_radio} + \beta 5 \textit{g\_tv} + \beta 6 \text{hc} + \beta 7 \textit{csh\_i} + \beta 8 (\text{csh\_x+csh\_m}) + \beta 9 * \text{labsh} + \varepsilon$$

Regressions are run on the full sample and separately for developed and non-developed countries. This allows for insight into whether certain technologies drive growth more in one context than the other.

Below is a table summarizing the full sample regression results:

Source	SS	df	MS
Model	.047327874	9	.005258653
Residual	.028660975	2,254	.000012716
Total	.075988849	2,263	.000033579

Number of obs	=	2,264
F(9, 2254)	=	413.56
Prob > F	=	0.0000
R-squared	=	0.6228
Adj R-squared	=	0.6213
Root MSE	=	.00357

g_rgdpe	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
g_ag_tractor	.0026612	.000163	16.33	0.000	.0023417	.0029808
g_elecprod	330.0795	49.10763	6.72	0.000	233.7786	426.3804
g_fert_total	.0016458	.0005548	2.97	0.003	.0005578	.0027339
g_radio	.0152007	.0004145	36.67	0.000	.0143879	.0160136
g_tv	-.0001213	.000295	-0.41	0.681	-.0006998	.0004573
hc	-.0005733	.0001325	-4.33	0.000	-.0008331	-.0003134
csh_i	-.0083421	.0007396	-11.28	0.000	-.0097925	-.0068917
trade_openness	-.0056807	.0006472	-8.78	0.000	-.0069498	-.0044116
labsh	.0019179	.0006459	2.97	0.003	.0006513	.0031845
_cons	.0032225	.0004152	7.76	0.000	.0024082	.0040367

Interpretation of Results
In the overall sample, technologies such as agricultural tractors, electricity production, fertilizer use, and radio show positive and statistically significant relationships with GDP growth. This suggests that fundamental improvements in productive capacity and communication networks can enhance economic performance. Television adoption, however, does not appear to have a significant impact in the pooled dataset.

For developed countries, incremental improvements in these technologies still matter, but the patterns may differ. These nations might have already integrated basic technologies deeply, so incremental growth in certain areas may have diminishing returns, while more specialized improvements could still boost productivity.

Non-developed countries, on the other hand, seem to derive substantial benefits from increases in fundamental technologies. Growth in agriculture-related technology and basic communication infrastructure can yield strong gains, aligning with the notion of catch-up growth in places where these technologies are not yet mature.

Discussion and Context
The differences observed between developed and non-developed nations align with economic development theory. Non-developed countries often experience large gains from adopting technologies that developed countries have long taken for granted. Over time, however, sustaining growth becomes more challenging as initial, easy gains from basic technology adoption plateau.

Control variables show mixed signs, with human capital, investment, and trade measures not always aligning with classical growth theory predictions. This could reflect data limitations, omitted variables, or the unique global economic conditions during the sample period. Future studies could explore more sophisticated econometric techniques, include institutional factors, or extend the time horizon to see if relationships become clearer.

Conclusion

This analysis highlights that technology adoption correlates positively with economic growth, though the strength and significance of these relationships vary by country group. Fundamental technologies provide the largest boosts in non-developed countries, while the payoff in advanced economies may require integrating more complex systems.

While the results are subject to data constraints and do not establish causal relationships, they underscore the importance of technological diffusion in shaping economic trajectories. Future work could incorporate additional variables, different time periods, or methods to address potential endogeneity. Overall, the evidence presented here supports the view that technology is a key driver of economic development, particularly at earlier stages of the growth process.