

# Analysis of the determinants of economic growth economics essay

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This paper presents an empirical analysis of the determinants of economic growth, paying particular attention to the conditional convergence hypothesis. We use data on a large cross-sectional dataset of countries to examine the factors that influence the degree of economic growth experienced by a country and to what extent. With respect to conditional convergence, this hypothesis is strongly supported in the data with a conditional convergence of around 2%, which is robust across specification. Our results must be interpreted with caution however, until the unexpected coefficients on literacy and life expectancy can be adequately explained. Also the quality of data and econometrics procedures has been constrained with time restrictions and data limitations.

## **1. Introduction**

One of the key predictions of the neo-classical growth model is a convergence between countries. Countries are predicted to converge to their balanced growth paths, and therefore to the extent that differences in output per worker arise from countries being at different points relative to their balanced growth paths, poor countries would be expected to converge to the level of richer ones. In this paper we are going to use cross-sectional data in order to examine the conditional convergence hypothesis and the determinants of a countries economic growth. The methodology is similar to that used in Robert Barro's 1996 empirical study.[1]The study will use updated data and a number of the explanatory variables will vary significantly from those used by Barro. This will enable interpretation of the robustness of the original findings, in particular with respect to the conditional convergence hypothesis. Barro's original study found that there

was around a 1% rate of conditional convergence when looking at growth between 1960 and 1985 and 1970 and 1985.[2]In the next section of the paper we will discuss the data and sources used in the study, and then in the third section we will outline the basic model to be estimated, along with the additional factors incorporated within it. Some of the additional variables have previously been investigated in the literature. Bhattacharyya found that the effect upon growth rates of the rule of law index was marginally positive impact upon countries growth from 1960 to 2002.[3]Barro states that theoretical reasoning suggests that enhanced property rights and the rule of law will likely promote economic growth.[4]The econometric estimation of the model will be discussed and the results will be analysed in the context of the conditional convergence hypothesis. Finally we will interpret the empirical findings with respect to the theory and discuss possible improvements or extensions that could improve the performance of the model. Murphy and Ukpolo have investigated the evidence for the applicability of the conditional convergence hypothesis to Africa.[5]They present evidence of conditional convergence of African countries between 1960 and 1985 and find a lower rate of convergence, which they attribute to political and infrastructural institutions. The paper reports a conditional convergence for Africa of around 1.7%, lower than they estimate for the rest of the world. Adabar has investigated the evidence for the conditional convergence hypothesis in a slightly different context. He looked at the rate of conditional convergence with India and found that the rate is around 12% per 5-year span, or a rate of 2.4% per year.[6]This is higher than the more general convergence between countries and could suggest that there are

political and cultural differences which slow the rate of cross-country convergence. He also highlights some of the difficulties with measuring human capital which will be encountered later.

## **2. Data**

The majority of the data used in this study has been sourced from the UN Human Development Report of 2009 (HDR).[7]The World Fact Book[8]was used to obtain GDP in 1980 data, The Economist[9]for the index of democracy, and The World Justice Project for an index of rule of law.[10]The data set used was compiled by the author from the sources listed above. A common concern in data analysis is the reliability of the data. This is particularly relevant in the area of cross-sectional country studies, as the data is often imprecisely measured or stated as estimated figures. In the case of the Human Development Report, many of the variables contained within it are measured in different time periods from others, and even within the same variable, different observations may be from different time periods, or estimated figures based on less reliable data sources. This problem is extenuated for the less economically developed countries, so it will be important to consider whether the differences in quality of data have created any bias within the estimates of the coefficients.

## Summary Statistics

### Variable

### Observations

### Mean

### Standard Deviation

### Skewness

### Kurtosis

### Minimum Value

### Maximum Value

Average Growth 1980-2007 1340.0550.0260.615.39-0.0270.155  
 GDP per capita in 1980 1344192.836278.891.955.8510028172  
 Log of GDP per capita in 1980 1347.281.530.202.004.6110.25  
 Fertility in 1995 1763.791.820.331.871.38  
 Fertility in 2010 (projected) 1762.931.480.871.6617.  
 1Adult Literacy in 1975 9561.9131.68-0.331.685100  
 Adult Literacy in 2007 17883.918.97-1.374.0026.2100  
 Democracy Index 1625.582.23-0.051.921.529.88  
 Rule of Law Index 1812.450.990.442.190.494.  
 46Oceania Dummy 1820.040.214.4520.8001  
 North America Dummy 1820.010.109.3889.0101  
 Asia Dummy 1820.240.431.242.5401  
 South America Dummy 1820.080.273.1811.0801  
 Central America Dummy 1820.120.322.416.7801  
 Africa Dummy 1820.280.450.981.9601  
 Life Expectancy in 1980 17261.4710.59-0.542.0836.4576.09  
 Gini Coefficient 14040.769.160.643.4024.774.30  
 Oil Exporting Dummy 1840.040.204.4821.0501  
 Europe was used as the base case for the continent dummies and is hence omitted from the summary statistics.

### 3. The Model

The dependent variable in the model is the logarithm of the average rate of economic growth between 1980 and 2007. It is this rate of growth that we will attempt to explain using a number of dependent variables. The first candidate dependent variable is GDP per capita in 1980. The coefficient on this variable has the interpretation of being a conditional rate of convergence. Due to the conditional convergence hypothesis we would expect the coefficient to have a negative sign. This would indicate, that controlling for other factors, the lower the relative level of the GDP at the start of the period the higher the expected growth rate in that period. Next we will use life expectancy as a proxy for the quality of health care in a country, and therefore the higher the quality of health care the greater the effective quantity of labour, which would see life expectancy have a positive effect upon growth. Life expectancy could also have a negative influence because it increases the total population and also increases the dependency ratio which in turn reduces the growth rate. In the data there are two measures of fertility, from 1995 and a projected figure for 2010. These two measures are correlated with a coefficient of 0.93 which suggests the fertility rate is stationary over time. Ideally the fertility rate from 1980 would be used, but as this is unavailable we will use the 1995 figure. If the fertility rate is assumed stationary, then this is a reasonable approximation. A priori the expectation is that higher fertility rates will lead to lower growth. This is for a number of reasons, including an increase in the dependency ratio and an increasing population. Previous studies have shown that fertility rates typically decline with measure of prosperity. Barro found that " an

exogenous drop in birth rates would raise the rate of per capita output".

[11]Government spending has an ambiguous theoretical effect upon growth.

If government spending is of the form of increased total investment, when investment is below the dynamically efficient level, then we would expect increased government spending to increase growth. However, government spending can also crowd out private investment and reduce the total efficiency of investment. We will also investigate the effects that the level of democracy and the extent to which countries adhere to the rule of law have upon growth. Rule of law is used to act as a proxy for political stability and conditions within the country and hence we would expect to find a positive relationship between the index and economic growth. The effect of the level of political freedom, measured by the democracy index will also be investigated. Controlling for GDP convergence we would expect adult literacy and other measures of human capital to have a positive impact upon growth. We have used the rate of adult literacy in 1975 to act as a proxy for the quality of the countries human capital at the beginning of the period we have measured growth from. (Data from 1980 was unavailable). Increasing human capital should have a positive effect upon growth, and so contemporary data will also be used to investigate the effects of improving literacy. The approach we are going to take is one of defining a simple base model to which we can add additional potential explanatory variables. The basic model is similar to that specified by Barro. Barro's specification consisted of explaining per capita growth rates through a number of determinates. Barro uses the log of GDP, a measure of education, the log of life expectancy, an interaction term between log GDP and education, the log of the fertility rate,

the government consumption ratio, rule of law, terms of trade and democracy indexes and the inflation rate. He also looks at the impact of dummy variables for different continents. This paper will conduct a similar analysis using an updated data set, different proxies for some of the determinants considered by Barro and a few additional determinants.

## **4. Results**

Dependent Variable Growth 1980-2007



**Independent****Variable****(1)****(2)****(3)****(4)****(5)****(6)****(7)****Log of GDP****-0.0087\*\*\*****-0.0189\*\*\*****-0.0201\*\*\*****-0.0229\*\*\*****-0.0225\*\*\*****-0.0216\*\*\*****-0.0217\*\*\*****1980****(0.0013)(0.0017)(0.0018)(0.0022)(0.0021)(0.0021)(0.0021)**

## **Fertility Rate**

**-0.0113\*\*\***

**-0.0091\*\*\***

**-0.0086\*\*\***

**-0.0087\*\*\***

**-0.0106\*\*\***

**-0.0082\*\*\***

**1995**

(0.0015)(0.0017)(0.0017)(0.0016)(0.0015)(0.0016)

## **Education**

**0.0003\***

**0.0002**

**0.0003**

**2007**

(0.0001)(0.0001)(0.0002)

## **Rule of Law**

**0.0083\*\***

**0.0117\*\*\***

**0.0108\*\***

**0.0130\*\*\***

## **Index**

(0.0026)(0.0317)(0.0031)(0.0032)

**Democracy****-0.0030****-0.0021****-0.0029\*****Index**

(0.0014)(0.0013)(0.0013)

**Oil Exporter****0.0106****Dummy**

(0.0144)

**Africa****-0.0130\*****Dummy**

(0.0055)

**N**

134134128128126132132

**R2**

0.25990.55110.54980.59400.61150.60590.6290

**F**

42.89\*\*\*62.71\*\*\*45.42\*\*\*42.54\*\*\*38.65\*\*\*30.92\*\*\*33.67\*\*\*Robust

standard errors in parentheses\* p &lt; 0.05, coefficient significant at 5% level\*\*

p &lt; 0.01, coefficient significant at 1% level\*\*\* p &lt; 0.001, coefficient

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significant at 0. 1% level. The above models were computed using robust standard errors to account for any non-normality of the error term. In addition, statistical tests were carried out to determine whether any such non-normality existed within the residuals of the equation. We found no evidence of heteroskedasticity or skewness in the residuals, and only weak evidence ( $p= 0. 0414$ ) of excess kurtosis. The RAMSEY Reset test of functional form was unable to reject the null hypothesis of a correctly specified model, as was the similar Link Test. A Breusch-Pagan-Godfrey test for heteroskedasticity was conducted and we were unable to reject the null hypothesis of homoskedastic errors. We discovered one unusually influential observation in the data, which was Bhutan, but even in this case the influence was relatively mild, as it fell within a marginal increase in the threshold. The statistical tests suggest we have a well specified model. Whilst only the African Dummy is reported in the table results above, the complete set of continent variables were tested and Africa was the only one to be found to be significant. The " Africa Effect" is a well documented, albeit controversial hypothesis that the African continent is somehow different from the rest of the world. However, the dummy is probably representing some tangible differences between African countries and the rest of the world, such as climate, which have not been incorporated within the model. The Oil Exporters dummy was included as we believed that it was reasonable to consider the possibility that the abnormal economic effects of a country being oil-rich (such as greatly increased inequality, effects on political systems, etc) may otherwise bias the results. The effects of this dummy were diminished when the rule of law and democracy indices were considered in

the model. The effects of adult literacy and life expectancy were both also tested in the model but had no significant effects. Adult literacy is highly collinear with education and both would have acted as a proxy for human capital, and the inclusion of education rather than literacy provides the stronger result, both econometrically and pedagogically. Life expectancy also had no significant effect, suggest that it was either a poor proxy for quality of health care or that the health of the population does not have a significant impact upon growth.

## **5. Discussion**

The core theoretical prediction of conditional convergence is robustly supported by the results of this investigation. In all the model specifications considered within this paper, we find the coefficient on initial GDP per capita in the year growth is measured from to be significantly negative. This is in line with previous studies on this topic, in particular Barro (1996) cited in the introduction. Judged on the criteria of finding conditional convergence between countries growth rates dependent on initial GDP levels, this investigation has been successful. However, the success of the objective of finding an empirical model to describe the determinants of long-run economic growth is less clear cut. A number of the effects incorporated into the model that the theory suggests are important have either had incorrect signs or been insignificant in the econometric analysis. Reasons may include bias from omitted variables, inappropriate proxies for the variables that determine growth, errors in the recording of the data (either by the original source or by the author in compiling the dataset), incorrectly specified functional forms or incorrect interpretation of what the variables are

measuring. The first four of these are almost certainly present within this investigation. Further studies in this area could focus on obtaining superior proxies for human capital, consider the effects of terms of trade, and incorporate climatic and geographical differences into the model.

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