Henrik Nygaard

Do Poverty Traps Delay Economic Growth?

Bacheloroppgave i Samfunnsøkonomi
Veileder: Colin Green
Mai 2021

Bacheloroppgave

NTNU
Norges teknisk-naturvitenskapelige universitet
Fakultet for økonomi
Institutt for samfunnsøkonomi

NTNU
Kunnskap for en bedre verden

Henrik Nygaard

Do Poverty Traps Delay Economic Growth?

Bacheloroppgave i Samfunnsøkonomi
Veileder: Colin Green
Mai 2021

Norges teknisk-naturvitenskapelige universitet
Fakultet for økonomi
Institutt for samfunnsøkonomi

NTNU
Norwegian University of
Science and Technology

Table of Contents

1. Introduction

Economic growth is one of the most central terms in macroeconomic theory, and it is used by economist all over the world in comparing economic wellbeing across countries. After World War II, many economists have jubilated over their country's continuous growth and development. In industrialized countries one may suggest that it is expected to achieve constant economic growth and economic well-being, but that is not the case for everyone. Countries like Nicaragua, Rwanda and Haiti and many other agricultural countries have experienced little to no economic growth in GDP per capita in the time period 1971-2001 (as seen in Table 1.1). On the other hand, countries like Ireland, China and India have experienced a tremendous amount of growth in GDP per capita (as seen in Table 1.2). Why did the per capita GDP not increase for Nicaragua, Rwanda and Haiti? Some people would refer to poverty traps as the reasoning behind this trend. Poverty traps are described as mechanisms in the economy that tend to reinforce poverty, in which results in a vicious cycle that is hard to get out of, making todays poverty situation, a continuous problem for future development.

While there are probably many factors that contribute to poverty traps, three variables seem to get highlighted more commonly than others: the savings rate, population growth and productivity. At least that is what traditional economic growth models suggests. The purpose of this paper is to test whether or not these claims have any bearing, by comparing economic growth with a developed country and a developing country through the savings rate, population growth and productivity with a regression model. We will take a look at Finland and Burundi, and how their GDP per capita has been affected over the period of 1985-2019.

GDP per capita (constant 2010 US$)

Country name	*1971*	*2001*	*Avg. yearly growth rate % (GDP) 1971-2001*
Nicaragua	2,166.8	1,312.8	1.1154
Rwanda	349.7	367.2	3.66
Haiti	1,417.2	1,127.2	1.4904

Table 1.1: *Outline of GDP per capita for Malawi, Rwanda and Haiti.*

	GDP per capita (constant 2010 US$)		
Country name	*1971*	*2001*	*Avg. yearly growth rate % (GDP) 1971-2001*
Ireland	13,034.2	45,695.6	5.1507
China	238.0	1.901.4	8.669
India	393.5	851.6	4.7

Table 1.2: *Outline of GDP per capita for Ireland, China and India.*

1.1 Finland

Finland has generally experienced an exponential growth in GDP since the study period of 1985-2019 (see fig.1.1.), except for a brief period of time in the early 1990´s, also referred to as the Finnish great depression[i]. The reasoning behind this can be traced back to the financial deregulation that was initiated in the 1980s, in a time where OECD countries had a big upswing of the business cycle, resulting in a destabilized economy. Since then, Finland have almost tripled its GDP per capita from 17,608$(1993) to 48,782$(2019) (US$ 2010). Finland also scores high on the Human Development Index (HDI) with a score of 0.925 of 1 (2018), making Finland amongst the top 5% of countries in human development. There is no sign of poverty traps in this country, at least not on a macroeconomic level. Hence, I will use Finland as an example of a developed country.

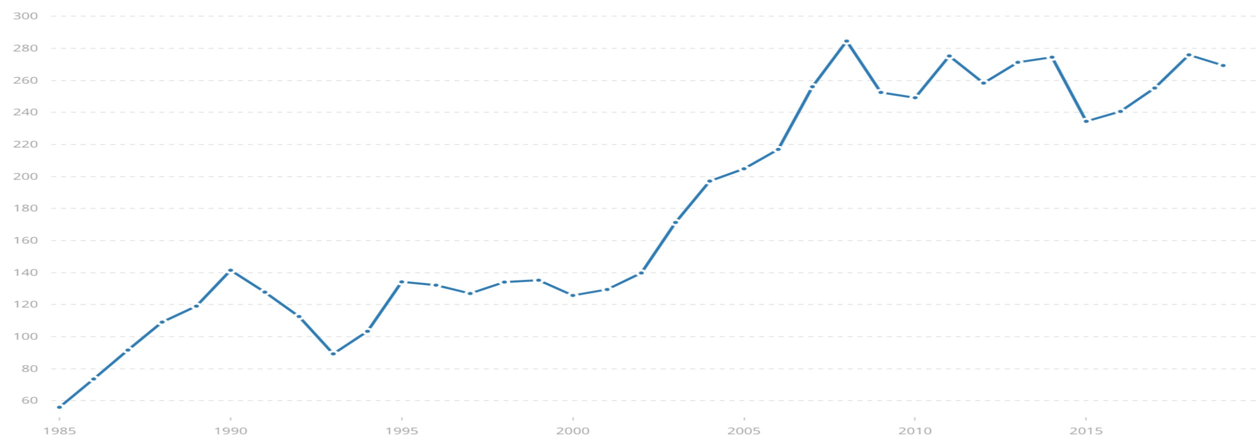


Figure 1.1: *Finland´s GDP in current US$, in billions*[ii]

1.2 Burundi

Burundi doubles the number of inhabitants (11.9 million) compared to Finland (5.54 million), even though Finland is over 10 times as big in land area. Burundi have experienced an increase in GDP, especially after the Burundian Civil War that lasted from 1993 to 2005 that occurred as the two ethnic groups (Hutu and Tutsi) engaged in ethnic violence[iii]. Since the end of the War, Burundi tripled their total GDP in 14 years (2005-2019). On the other hand, the population doubled in the same timeframe, making GDP per capita less impressive. Burundi scores among the lowest in the world on the Human Development Index, with a score of 0.423 of 1, making Burundi the 5th lowest country on the list of participants in HDI from the UN[iv]. Burundi struggles with extreme poverty amongst it´s citizens, and I want to figure out if this can be explained with the variables of poverty traps that I have chosen.

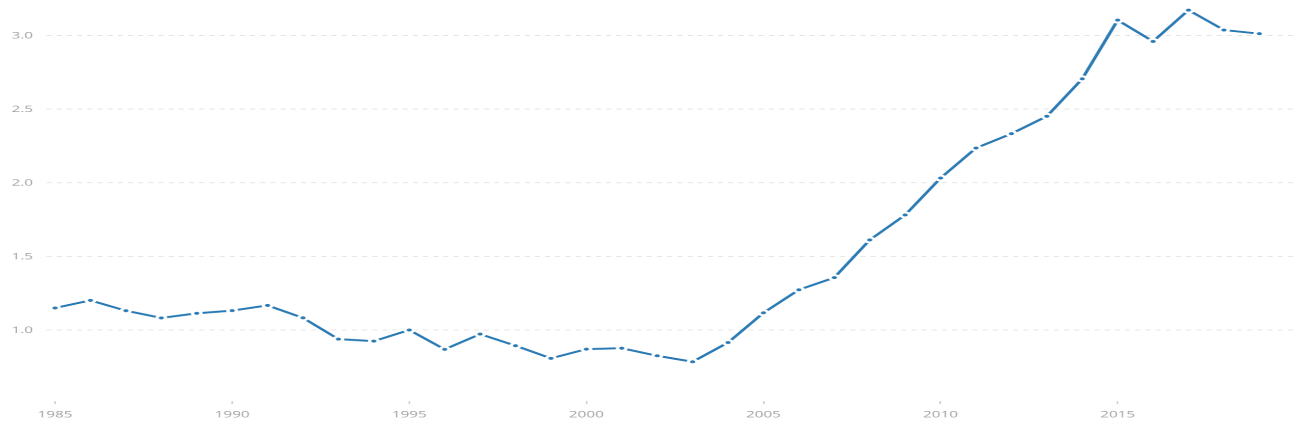


Figure 1.2*: Burundi´s GDP in current US$, in billions*[v]

2. Literature Review

Several researchers have examined the dynamic relationships between economic growth and variables that contribute to poverty traps on a macroeconomic level. On the contrary, it is very hard to find empirical joint testing of the different mechanisms that correlates to poverty traps, despite that one could argue that the effect of poverty traps can inflict damage on each other. Kraay and McKenzie (2014)[vi] factually supports the idea that multiple microeconomic mechanisms in developing countries contributes to national consequences, and that savings and coordination-failure between investment level and labor productivity can lead to lost potential growth. Still, they focus more on what can be done to prevent it in the future rather than empirically testing whether or not they have any context.

The traditional growth models of Harrod (1939)[vii], Domer (1946)[viii], and Solow (1956)[ix] displays the fact that increased savings will lead to increased economic growth over time, because of increased investments. These models are known as Keynesian models, which are known for its belief in how aggregate demand influences economic output and inflation. For example, in the fiscal policies that follows the Keynesian model, there would be reasonable to increase taxes in order to increase national savings, which then would result in economic growth. The idea that increasing national savings boosts economic growth have been both challenged and backed up by more recent studies. Giavazzi, Jappelli and Pagano (1998)[x] discuss circumstances in which the expected responses of national savings to fiscal policy does not apply in the same way as the Keynesian predictions. Using 18 OECD countries over 26 years, with an ordinary least squares (OLS) estimation, they find that some cases contradict conventional Keynesian predictions, especially when fiscal regulations are large and often occurring. The article wants to make a point of that savings is a result of economic growth, and not the opposite.

On the other hand, Anoruo and Ahmad (2001)[xi] counters Giavazzi, Jappelli and Pagano (1998)[xii] proposition with testing by using the Harrod-Domar model (Keynesian model), following a 37-year period with seven developing countries in Africa. Their study suggests that there is a positive relation between increased savings rate and economic growth, in both ways. There are possibilities of a country achieving a higher GDP from expansive fiscal policies, as well as achieving higher savings rate from an increased GDP. This will be useful to discuss further in my thesis, as I will use the HD-model to display how poverty traps can occur from the savings rate in the theoretical highlighting, and if it actually correlates with my testing.

When it comes to population growth, Kidane (2010)[xiii] displays how increased population, especially in developed countries, can cause what is called a demographic poverty trap. Kidane defines this as the negative relationship between population growth and economic development, whereas having an increase in population begets a lower standard of living. In his empirical findings he discovered population pressure on resources, lower nutritional status and a lower productivity rate per capita for the tested population. This study shows the negative aspects of an increase in population, but it does not set a universal rule for how population growth inflicts a country. We have seen countries experience exponential economic growth, while still maintaining a high population growth. Further in my thesis, I will display how the population growth is centered in the Keynesian development economics theory.

Many people have studied the effects of the different variables that can lead to poverty traps and discussed the inequality of economic growth, but few have tried to see the relations between them and the impact of them all together in a modern economy. There is some uncertainty to what extent poverty traps actually impact economic growth. That is why this paper wants to acknowledge the accurate effects of poverty traps.

3. Development Economics Theory

The research question heavily bases its fundamental understanding in development economic theory. In this section I will briefly look at the fundamentals that substantiates the variables in the econometric model that will be displayed later.

3.1 Harrod-Domar Model (Closed economy)

The Harrod-Domar growth model can show an intuitive understanding of the different scenarios that can cause poverty traps. The model is a Keynesian model, which means it´s origin is from the basic macroeconomic accounting identity with national income as the dependent variable, while other macroeconomic factors are used as endogenous variables to calculate national income. To simplify the model, I have chosen a model with a closed economy and no government sector. This is to highlight the influence of population growth and savings rate. This leaves us with the following model:

$$Y_t = C_t + S_t \qquad (3.1)$$

Where Y equals national income today (GDP), C equals consumption today and S equals savings today. Quite intuitively, this explains how disposable income is either used in the present (C_t), or in the future (S_t), which makes S_t the same as investment level (I_t) if we assume a perfect capital market. We now have to include a capital output ratio. The capital output ratio (θ) is used as a measure of capital productivity, meaning how much of an increase in income gets added with an increase in capital stock (K_t):

$$\theta = \frac{K_t}{Y_t} \qquad (3.2)$$

Note: since it is inverted, this means a decrease in capital stock will increase the capital output ratio. The higher the value, the less productive it is. We can now define the savings rate (s) as the rate of income that is not consumed each period (3.3), and articulate capital in next period as (3.4):

$s = \frac{S(t)}{Y(t)}$ (3.3) $K_{t+1} = K_t + S_t$ (3.4)

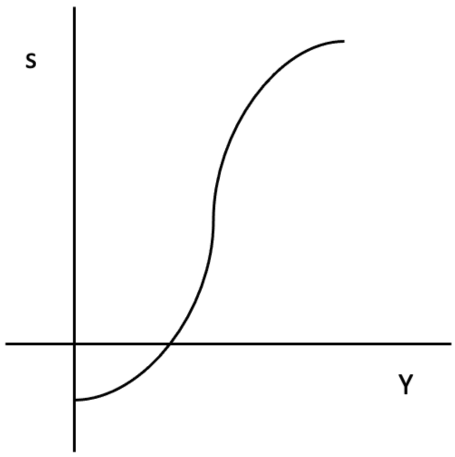
We now assume that capital output rate and savings rate are constant over time, making (3.2) and (3.3): $S(t) = sY(t)$, and $K(t) = \theta Y(t)$, combining this with (3.4), making equation (3.5a), that shows the growth rate of income as a function that is positively related to the savings rate, and negatively related to the capital output ratio:

$$\theta Y_{(t+1)} = \theta Y_t + sY_t \qquad (3.5a)$$

$$\frac{Y_{(t+1)} - Y_t}{Y_t} = \frac{s}{\theta} = \Delta Y \qquad (3.5b)$$

3.1.1 Savings Rate

As seen from equation (3.5b), the HD-model suggest that a higher savings rate will increase future economic growth, because it ensures a higher investment level in the future. How does this correlate with the discussion of poverty traps? If we consider a subsistence economy with a low national income, savings will not be prioritized as the present economy has to be stimulated to be sufficient enough for basic needs. It is expected that if it becomes a surplus in income, the savings rate will be bigger, but having a savings rate at zero or at a negative rate (debt) ensures that there is no savings to take from in the next period, which results in that they cannot accumulate capital (S(t)=I(t)=0). Thus, creating a poverty trap. Ray, D.(1998)[xiv] made a simple model with savings on the y-axis, and income on the x-axis to show this phenomenon. This S-shaped curve represents the different degrees of economic growth when increasing the savings rate. This model implies that at high levels of savings gives a higher marginal return on income than at low levels of income.



3.1.2 Population Growth

If we include population growth into the equation, and assume a population grows at rate (n), and make the growth rate of income(ΔY) to per capita growth rate of income (Δy^*)we get the following equation:

$$\frac{s}{\theta} = (1 + \Delta y^*)(1 + n) \qquad (3.6a)$$

$$\frac{s}{\theta} \approx \Delta y^* + n \qquad (3.6b)$$

This equation shows us that a country needs to increase their capital stock or increase their savings rate, in order to maintain the same level of income growth if the population growth is positive. According to the HD-model, an increase in population growth will lead to lower GDP per capita if savings rate does not increase, or the inverse capital output ratio decreases. The follow-up question should then be if an increase in population can contribute to a more productive per capita income outside of capital stock. That is where Total Factor Productivity (TFP) becomes relevant.

3.2 Total Factor Productivity

Total Factor Productivity (TFP) is a catch-all estimation for the different factors that measures productivity in a macroeconomic setting and the efficiency of capital and investment. This is done by dividing the total production (output) by the weighted average of inputs. The normative way of measuring the weighted average of inputs is through labor and capital. Intuitively, TFP finds the relationship between outputs, meaning the total product and inputs. This is typically measured in either GDP or GNP as total output, inputs can be everything from capital stock to technological change or education, and I will get back to the data structure of TFP in my empirical model later in the thesis. For now, we can get an understanding of TFP with the most widely used production function, a Cobb-Douglas function:

$$Q = AK^{\alpha}L^{\beta} \qquad (3.7)$$

Where Q is total product, K is capital, meaning technology, innovation and capital stock. α is output elasticity of capital, L is quantity of labor and β is the output elasticity of labor. By rearranging the CD-function, we get the main equation for total factor productivity:

$$A = \frac{Q}{K^{\alpha}L^{\beta}} \qquad (3.8)$$

TFP, in the model represented as A, shows total output divided by the weighted average of inputs. The value of TFP does not prove anything without a plurality of observations. It is more useful to investigate trends of productivity growth over time instead of the absolute value. In that way, we can figure out the productivity's role in economic growth. That can be displayed as the output growth rate ($\frac{\Delta Q}{Q}$): [xv]

$$\frac{\Delta Q}{Q} = \frac{\alpha(\Delta K)}{K} + \frac{\beta(\Delta L)}{L} + \frac{\Delta A}{A} \quad (3.9)$$

3.3 Discussions on Theory

The problem with strictly utilizing models like the Harrod Domar model to analyze and predict values, is the fact that there are a lot of assumptions, some of who we can legitimize to some extent, but others can in worst case directly lead to deviations from the realistic result. For example: in Keynesian models we assume that all participants always have rational behaviors and is responsive when it comes to economic decision-making. Practically, that is to some extent false, as it ignores all possible irrationality in human nature. We simplify in order to have tangible models, making it absorbable and flexible enough to be universal, at the cost of it being too all-inclusive and a higher risk of it not being factual[xvi]. TFP have a lower risk of being biased, as it is only an estimate of productivity. The question that comes to mind, is whether or not the mechanisms of savings rate, population growth and productivity will have the same expected results in my study as it assumes in theory.

4. Data

4.1 Source

The data collected for GDP, savings rate and population growth are all from the reliable source of The World Bank Group open database[xvii]. The time-series consist of data collected from 1985 to 2019, with yearly observations on each variable for both countries: Finland and Burundi. GDP is measured as GDP per capita at a constant US dollar value from 2010, savings rate represents the gross savings percentage of GDP that is not used for consumption each year. Population growth shows the annual percentage growth in population in the country from the previous year.

The total factor productivity is collected from Penn World Table version 10.0[xviii]. PWT 10.0 is a database that has studied the relative levels of income, output, input and productivity for 183 countries between 1950-2019. They estimate their TFP in a more complex manner than previously described in (3.2) to make it able to be unbiased, e.g., including variables that aims to cross-country differences, as well as purchasing power parity[xix]. The dataset shows the relative productivity in the nation at constant national prices. The reference year is 2017 = 1, meaning if it is above 1 the country was more productive in than in 2017.

All variables in the dataset include 35 observations, except for the savings rate variable for Burundi, which includes 34 observations because of missing data from year 2019 (1985-2018). The likeliness of it having a significant impact on our study is very small. Still, it should be acknowledged as a marginal error in the empirical results.

4.2 Descriptive Statistics

In this section, the basic descriptive statistics of the data. The first table (table 4.1) shows the values of the explained variables GDP per capita for both countries, meaning that GDP per capita is what we will be investigating as a result of the explanatory variables. The table shows the mean(average GDP per capita), Standard deviation (amount of dispersion from average GDP per capita) and the minimum and maximum value:

	Explained variables (GDP per capita)	
	Finland	*Burundi*
Mean	40030.9	255.85
Standard dev.	7369.204	42.64
Minimum	28643.27	208.07
Maximum	49440.86	336.58
Observations	35	35

Table 4.1: *Descriptive statistics for GDP per capita in 2010 US$ for Burundi and Finland*

The explanatory variables are displayed in table 4.2. The savings rate shows the amount of disposable income in a country that is saved each year. Finland has a noticeably bigger savings rate average than Burundi, with 25.256%, in contrast of Burundi´s mean of 6.63%.

In general, Finland has a lower population growth, as well as total factor productivity. TFP does not tell us that much for the moment being. The purpose of TFP will be highlighted when comparing it to the GDP per capita in the regression analysis.

The most important thing we can observe from this data, is that the standard deviations are much higher to the relative size of the variable average value for Burundi rather than Finland. Intuitively, this makes sense as a more uncertain economy will result in higher fluctuations than in a stable economy like Finland.

Explanatory variables

	Finland		*Burundi*	
	Mean	*Standard dev.*	*Mean*	*Standard dev.*
Savings rate	25.256	4.024924	6.6332*	4.271458*
Population growth	0.3512	0.1144385	2.612483	0.7330667
Total Factor Productivity	0.9272	0.0929323	1.190306	0.1814273

Table 4.2: *Descriptive statistics for the independent variables for Finland and Burundi. *Savings rate for Burundi has a missing observation from 2019.*

5. Empirical Model

5.1 Model Description

In this section, we will be looking at the regression model that will be used in the empirical analysis. In section 4.2, we looked at the different variables that we will be using in the model. More specifically, we will be looking at the following regression models:

$$gdpf = \beta_0 + \beta_1 savingsf + \beta_2 popgrowthf + \beta_3 tfpf + \in \qquad (A)$$

$$gdpb = \beta_0 + \beta_1 savingsb + \beta_2 popgrowthb + \beta_3 tfpb + \in \qquad (B)$$

Where gdpf/gdpb is GDP per capita (US$ 2010), β_0 is the intercept, savings (f/b) is the savings rate (annual %age rate of GDP), popgrowth (f/b) is the population growth (annual %age rate), tfp (f/b) is the total factor productivity (where 2017=1) and ∈ is the indicator of other influential factors that is not picked up by the explanatory variables. ∈ has the following traits:

$$E(\in) = 0 \qquad (a)$$

$$Var(\in) = \sigma^2 \qquad (b)$$

$$\in = N(\mu, \sigma^2) \qquad (c)$$

The models above show the regression models for both countries. (A) displays Finland´s model and (B) represents Burundi. The reasoning behind splitting the model into two parts, is to avoid multicollinearity and ensure that the regression model results are solely related to the country of interest. In this thesis, we are never jointly testing the two countries, as it is not relevant for what we want to figure out. The models are multiple linear regression models, because of the several explanatory variables.

5.2 Hypothesis Testing Theory

Before getting into the empirical results, we first have to define the hypothesis testing theory. In general, hypothesis testing boils down to finding out if there are statistically significant proof for an original hypothesis, often referred to as a null hypothesis (H_0). We want to know if it is correct or if the null hypothesis has to be rejected in favor of an alternative hypothesis(H_A). The hypothesis testing will operate on a confidence interval of 95%, meaning that the tests have to be inside the range of 95% distance from the mean to be statistically significant. This creates $\alpha = 0.05$. The critical value for F-test will therefore be $f_{0.05,q,n-k}$ and for the T-test it will be $t_{0.025,n-k}$.

5.2.1 T-Tests

The different scenarios where we will use the T-test and F-test will vary in if we consider including only one variable or multiple variables in our test. The T-test will only occur when we want to single out the different variables. For example, when measuring the effect of savings rate on GDP per capita. We can illustrate this mathematically:

$$\widehat{\beta_i} \sim N(\beta_i \,, \sigma^2{}_{\widehat{\beta_i}}) \qquad (5.1)$$

$\widehat{\beta_i}$ is the estimated parameter from the ordinary least squares (OLS) regression. We then get the equation:

$$\frac{\widehat{\beta_i} - \beta_i}{\sigma\beta_i} \sim N(0,1) \qquad (5.2)$$

We change the notation of the standard deviation, as we do not know the true standard deviation. We replace it to the expected estimator of st.dev. (standard error), $se\beta_i$, while notating n as number of observations and k as number of parameters in the T-test:

$$\frac{\widehat{\beta_i} - \beta_i}{se\beta_i} \sim t_{n-k} \qquad (5.3)$$

The test will then be given as (5.4), which indicates the test statistic value defined by the estimate parameter and the null-hypothesis evaluation (β_i).

$$TS = \left\{\frac{\widehat{\beta_i} - \beta_i}{se\beta_i}\right\} \qquad (5.4)$$

5.2.2 F-Tests

When we want to estimate multiple variables at the same time, we use the F-test. Since we use multiple linear regression models in out tests, this will also be relevant to see the connections between the different explanatory variables and how it affects economic growth and if they conclude what development economics theory suggests. To do so, we first have to define the different measurements of sum of squares:

	Equations	*Explanations*
SSE (Explained sum of squares)	$\sum_{i=1}^{N}(\hat{Y}_i - \bar{Y})^2$	Sum of the squares of the deviations of the predicted values
SSR (Residual sum of squares)	$\sum_{i=1}^{N}(Y_i - \hat{Y}_i)$	Deviations predicted from actual empirical values (unexplained)
SST (Total sum of squares)	$\sum_{i=1}^{N}(Y_i - \bar{Y})^2$	Total variation (SSE + SSR)

Table 5.1: *The different sum of squares.*

The sum of squares will help us find out if the variables are jointly statistically significant. To do the test, we need to look at the main model, which we will call the unrestricted model (u), and a regression model of the variables of choice for the given hypothesis test, which we will call the restricted model (r), which assumes that the null hypothesis is true. The difference in sum of squares when subtracting the restricted models sum of squares with the unrestricted model, will give us an intuitive idea of the effect of the given variables.

We know from econometric theory that $\bar{Y}$ does not change when including more variables, as it just depends on already measured values. That means the total sum of squares will be the same for both the restricted and unrestricted model. That gives us the following equations:

$$SSE_u + SSR_u = SST \ = \ SSE_r + SSR_r \qquad (5.2)$$

Giving from the reasoning of difference in sum of squares with the restricted model and the unrestricted model, we get:

$$SSE_u - SSE_r = (SST - SSR_u) - (SST - SSR_r) = SSR_r - SSR_u \qquad (5.3)$$

The deviation in residual sum of squares is the same as the deviation in the explained sum of squares. We need to find out if the reduction in the residual sum of squares is significant enough to match out 95% confidence level, thus concluding whether we reject or confirm our H_0. The test-statistic is measured like this:

$$TS = \frac{\frac{SSR_r - SSR_u}{q}}{\frac{SSR_u}{n-k}} \sim f_{q,n-k} \qquad (5.4)$$

$f_{q,n-k}$ indicates the f-distribution, with (q, n-k) dimensions of freedom. We will now look at the empirical results from our multiple linear regression model.

5.3 Empirical Results

Finland	*(1F)*	*(2F)*	*(3F)*
savingsf	-290.4123	-26.1143	-
	(123.527)	(363.2595)	-
popgrowthf	-3863.514	-14478.76	-
	(4356.6)	(12776.22)	-
tfpf	76024.79	-	74234.7
	(4799.81)	-	(4852.801)
Constant	-21768.39	45775.39	-28800.13
	(5900.88)	(12105.26)	(4521.459)
R-squared	0.8953	0.0476	0.8764
n	35	35	35
SSR	193394698	1.7585e+09	228197737

Table 5.2: *The relationship between GDP per capita (US$ 2010) and other variables for Finland. Across all columns the dependent variable is GDP per capita. All models are estimated using the OLS method.*

Burundi	*(1B)*	*(2B)*	*(3B)*
savingsb	.2754	5.2243	-
	(.447)	(1.526)	-
popgrowthfb	12.659	-18.093	-
	(2.638)	(8.824)	-
tfpb	245.9764	-	224.6957
	(11.448)	-	(11.991)
Constant	-72.0632	269.588	-11.61174
	(16.9862)	(23.8008)	(14.43266)
R-squared	0.9575	0.3037	0.9141
n	35	35	35
SSR	2526.0887	41402.798	5309.8339

Table 5.3: The relationship between GDP per capita and other variables for Burundi Across all columns the dependent variable is GDP per capita. All models are estimated using the OLS method.

Table 5.2 shows that including Total Factor Productivity drastically decreases the savings rate, meanwhile it dampens the effect of population growth(1F-2F). TFP remains almost unchanged if we remove the other variables to make a simple regression model (3F).

Table 5.3 shows us the same reasoning between TFP, savings rate and population growth. It remains practically unchanged when making a SLR regression model (3B). It shows a positive relation between population growth and GDP per capita in (1B), which means an increase in population leads to a higher GDP per capita. This is also the case for the savings rate.

5.4 Tests on Individual Variables (T-Tests)

Since we have looked at the economic development theory in section 3, we have already formed some of our hypothesizes based on the results of the assumptions given in that context. Firstly, we will define the critical value for all tests for individual variables. We can have a universal critical value, because all of our tests contain the same amount of area coverage in the t-distribution dividing $\frac{\alpha}{2} = 0.025$ as well as the same number of dimensions of freedom (n-k = 32) :

$$t_{0.025,32} = 2.042$$

The main goal is to figure out if the assumptions made previously will have the same results in our tests, starting with the savings rate. The theoretical assumption is that a higher savings rate will increase GDP per capita. Let's see if this assumption is correct for Finland:

$$H_0: \beta_1 > 0$$

$$H_A: \beta_1 \leq 0$$

$$TS(Finland) = \left\{\frac{\widehat{\beta_1} - \beta_1}{se\beta_1}\right\} = \frac{-290.4123 - 0}{123.527} = -2.351$$

Since TS<2.042(c), we reject H_0, as it proves that savings rate for Finland is not statistically significant. Even without a significance level we could conclude that the correlation between GDP per capita and savings rate is negative. We will do the same with Burundi:

$$H_0: \beta_1 > 0$$

$$H_A: \beta_1 \leq 0$$

$$TS(Burundi) = \frac{0.2754 - 0}{0.447} = 0.616$$

We also reject H_0, as TS<2.042(c), meaning at 95% confidence level, the savings rate´s effect on GDP per capita is not statistically significant.

Now let´s look at the population growth. The assumptions made here is that an increase in population growth should have a negative impact on GDP per capita. H_0 in this case will be rejected if the test statistic is higher or equal to the critical value:

$$H_0: \beta_2 < 0$$

$$H_A: \beta_2 \geq 0$$

$$TS(Finland) = \left\{\frac{\widehat{\beta_2} - \beta_2}{se\beta_2}\right\} = \frac{-3863.514 - 0}{4356.6} = -0.8868$$

$$TS(Burundi) = \frac{12.659 - 0}{2.638} = 4.799$$

Out of the two countries, Finland is the only one to not reject the null hypothesis. The hypothesis test shows that the population growth increase negatively effects economic growth. On the other hand, Burundi´s result is the opposite. Burundi directly contradicts the theory of a decrease in GDP per capita as a result of population growth.

The final explanatory variable we want to look at is the total factor productivity. The total factor productivity shows a high output from the MLR regression. The hypothesis is that an increase in total factor productivity will lead to a higher GDP per capita:

$$H_0: \beta_3 > 0$$

$$H_A: \beta_3 \leq 0$$

$$TS(Finland) = \left\{\frac{\widehat{\beta_3} - \beta_3}{se\beta_3}\right\} = \frac{76024.79 - 0}{4799.81} = 15.84$$

$$TS(Burundi) = \frac{245.9764 - 0}{11.448} = 21.486$$

Both countries show a significant increase in GDP per capita from the tests (15.84>2.042, 21.486>2.042). This correlates with the given hypothesis meaning that we do not reject H_0.

5.5 Tests on Multiple Variables (F-Tests)

From the results of section 5.4, we found out that both countries rejected the H_0 of savings rate. Burundi rejects the given hypothesis for population growth as well. What we want to figure out in this section, is whether or not the two variables savings rate and population growth have any impact on economic growth jointly. We generate a joint hypothesis test that suggest that the effect of savings rate and population growth equals zero:

$$H_0: \beta_1 = \beta_2 = 0$$

$$H_A: min.one\ \beta_i \neq 0, \quad i = 1,2$$

We use equation (5.4) to estimate the test statistic with data from (1F) on the restricted residual SSR, while (1F) is used for the unrestricted SSR for Finland:

$$TS(Finland) = \frac{\frac{SSR_r - SSR_u}{q}}{\frac{SSR_u}{n-k}} = \frac{\frac{52281977379 - 193394698}{2}}{\frac{193394698}{35-1}} = 4578.75$$

We find the critical value in the F-distribution with the tail $\alpha = 0.05$:

$$f_{0.05,2,34} = 3.3158$$

For the null hypothesis to be true, the TS has to be lower than the critical value. For Finland, the TS is much higher than the critical value, which means we reject the null hypothesis. The savings rate and population growth do have a big impact on GDP per capita.

$$TS(Burundi) = \frac{\frac{5309.8339 - 2526.0887}{2}}{\frac{2526.0887}{35-1}} = 0.0162$$

$$f_{0.05,2,34} = 3.3158$$

We can confirm our hypothesis; with a 95% confidence level, the savings rate and population growth does not have a big direct impact on GDP per capita in Burundi. Other factors have a bigger impact on GDP per capita, like tfpb and $\in$.

6. Discussion and Limitations

6.1 Comparing Results

We have shown the descriptive statistics for each country, as well as implemented a regression analysis for the regression model. The regression model makes a lot of different answers to what is expected from a traditional development economics standpoint. The savings rate did not have the expected increase in GDP per capita as it would suggest. At a 95% confidence interval, Burundi could not show that they were trapped in a poverty trap from the savings rate, even though the GDP per capita have not increased that much in the study period. In fact, both the savings rate and population growth show surprising results in Burundi.

The coefficient of population growth for Burundi shows that a percentage point increase in population increases GDP per capita with 12.659 US dollars. This contradicts the theory of population growth as previously mentioned. An increase in n will distribute the GDP among more people, which should in itself decrease GDP per capita. This might not be the case for Burundi because of increased productivity. If we look at this from a microeconomic perspective, one could argue that households in countries with high poverty are more dependent on children to supply income for its family through child labor[xx]. The opposite can be said for Finland, as it correlates with the hypothesis. This means that the hypothesis that poverty traps are induced by population growth can be rejected.

Productivity seems to have a big impact on the economy's growth. I we look at the regression model in table 5.2, we can see that using TFP decreases the value of savings and improves population growth. This makes intuitively sense, as productivity includes labor efficiency, which increases with an increase in population. The savings rate will not be as efficient, as investing in consumption in current period pays off more when the productivity is higher. We can also see that the increase in TFP is more correlated than in Finland from the T-test. This may be the case because of technological borrowing from developed countries that often occurs in developing countries. When innovation and technology become more available in the global market because of mass producing in industrialized countries, it becomes available for developed countries, who will experience a higher growth in technological advancement relative to its current level compared to countries with an already high capital stock[xxi].

6.2 Limitations in the Model

There are two main limitations that I would like to address from this study. One of them is that we have only investigated two countries, which means that we cannot conclude that the results are significant for all economies. Even though there are no evidence of poverty traps for Burundi in the chosen variables, this does not mean that there are no signs of poverty traps in other countries, let alone in Burundi.

The other limitation is that I should have investigated the effect of total GDP on these variables, as it may give different results. Because population growth and per capita GDP both measure itself from an increase in population, there is a chance of collinearity between them, which my give incentives to think that it has inflicted the coefficient not being statistically significant. Still, the robustness of the study has been strengthened by the amount of regression analyses and hypothesis testing to make significant comparisons of the effect of the coefficients.

7. Conclusions

The analysis of this paper shows that poverty traps from the savings rate and population growth does not occur in our study. The effect of these claims remains unsignificant when we include productivity. This however highlights the effect of productivity and its important role in economic growth.

The fact that savings rate and population growth prove to be less significant, disproves the traditional economic growth theories. The main objective of this paper was to figure out if the claims of the HD-model and the general understanding of productivity could be approved or disproved. Since we have rejected a big part of the assumptions, this study concludes that there is no delay in economic growth as a result of savings rate, population growth or a productivity increase.

Citations

---

[i] Honkapohja, S., Koskela, E., Gerlach, S., & Reichlin, L. (1999). '*The Economic Crisis of the 1990s in Finland. Economic Policy*', p. 401-436.

[ii] University of Groningen and University of California, Davis, '*Total Factor Productivity at Constant National Prices for Finland*', retrieved from FRED, Federal Reserve Bank of St. Louis; [https://fred.stlouisfed.org/series/RTFPNAFIA632NRUG]

[iii] Pike, J, '*Burundi Civil War*', Global security [https://www.globalsecurity.org/military/world/war/burundi.htm]

[iv]Human Development Report Office 2020, 'Human development data center', UN development programme [http://hdr.undp.org/en/data]

[v] https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=BI

[vi] Kraay, A., and McKenzie, D. (2014). '*Do Poverty Traps Exist? Assessing the Evidence.*' Journal of Economic Perspectives, 28 (3)

[vii] Harrod, R. (1939), '*An Essay in Dynamic Theory*', Economic Journal, Vol. 49, pp. 14–33.

[viii] Domer, E.D. (1946), '*Capital Expansion, Rate of Growth, and Employment*', Econometrica, Vol. 14, pp. 137–47.

[ix] Solow, R. M. (1956), '*A Contribution to the Theory of Economic Growth*', Quarterly Journal of Economics, Vol. 70, pp. 65–94.

[x] Giavazzi, F. and Jappelli, T. and Pagano, M. (1998) '*Searching for Non-Keynesian Effects of Fiscal Policy*' IGIER Working Paper No. 136

[xi] Anoruo, E. and Ahmad, Y. (2001). '*Causal Relationship between Domestic Savings and Economic Growth: Evidence from Seven African Countries*' African Development Review

[xii] Giavazzi, F. and Jappelli, T. and Pagano, M. (1998) '*Searching for Non-Keynesian Effects of Fiscal Policy*' IGIER Working Paper No. 136

[xiii] Kidane, A. (2010). (Rep.). '*The Poverty Demography Trap in Third World Countries: Empirical Evidence from Tanzania*' Environment for Development Initiative.

[xiv] Ray, D (1998) '*Development economics*' Princeton University Press

[xv] Obaidullah, J., '*Total Factor Productivity*' Xplaind, *[*https://xplaind.com/692231/total-factor-productivity]

[xvi]Todaro, M. P. (2015), '*Economic development*', The George Washington University. – 12th Edition

[xvii] World Bank, World Development Indicators. (2019)

[xviii] Feenstra, R. C., Inklaar R. and Timmer, M. P. (2015), '*The Next Generation of the Penn World Table*' American Economic Review, 105(10), 3150-3182, available for download at [www.ggdc.net/pwt]

[xix] Inklaar, R. and Timmer, M. P. (2013) '*Capital, labor and TFP in PWT 8.0*', Groningen Growth and Development Centre, University of Groningen [https://www.rug.nl/ggdc/docs/capital_labor_and_tfp_in_pwt80.pdf]

[xx] Todaro, M. P. (2015), '*Economic development*', The George Washington University. – 12th Edition

[xxi] see xx

NTNU

Kunnskap for en bedre verden