Inflation and Growth

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Abstract

This paper updates the study of inflation's effect on growth conducted by Robert J. Barro in "Determinants of Economic Growth," which found a negative relationship between inflation and GDP growth. In this reproduction the same variables will be used from the same sources whenever possible using three periods of time following the pattern used by Barro. Inflation rates in these more recent time periods follow similar patterns as in Barro's study with lower standard deviations of annual inflation rates.

1. Introduction

A nation's Gross Domestic Product or GDP is measured as the value of all final goods and services produced by that nation in the given year. The economic growth of the nation is measured as the growth rate of the previously measured GDP. Economists tend to focus heavily on the economic growth as even small increases in growth can have staggering effects on the goods and services available to individuals over time due to the compounding nature of growth.

In order for economists to understand prices in a nation, bundles of goods and services are created. These bundles are created for various sectors as well as for household goods. The bundle measuring the average prices of household goods form the CPI or consumer price index. The inflation rate of a nation can be calculated as the percent change of the CPI. Since the Great Inflation of the 1970s, economists began to pay close attention to the effect that inflation has on the economy and its growth

The purpose of this study is to better understand the relationship between inflation and economic growth. This will be achieved by comparing each nation's growth rate with its inflation rate while controlling for various additional independent variables in order to isolate the effect of inflation.

2. Theory Overview

GDP can be understood to be a function of labor, capital and total factor productivity or TFP. Capital is the non-labor inputs to production such as farming equipment, and TFP is the efficiency at which an economy can produce given its inputs. Inflation can negatively both capital and total factor productivity.

Unexpected and high inflation hurts the return of investments, discouraging future investment, hurting the accumulation of capital. Progressive tax systems, if not altered to account for inflation, will lead to reduced return on capital under periods of inflation, further discouraging investment, lowering the accumulation of capital. The decrease in capital accumulation decreases growth (Andres and Hernando 1997, 3).

Inflation can lead to the misallocation of resources by increasing three additional costs which shifts resources away from more efficient uses. Menu costs are the various costs that firms incur when changing prices in order to account for inflation, an example of this is the cost that a restaurant will have to pay to print new menus in order to adjust to the increased cost of labor and ingredients. The higher inflation is, independent of variability, the higher the menu costs will be. Shoe leather costs are the costs incurred in efforts to avoid the effects of inflation by decreasing their cash holdings. These costs have a positive relationship with inflation regardless of volatility of inflation rate. Search costs are the costs incurred by buyers and sellers looking for one another. An example of this is the job market, the employee, the seller of labor, incurs search costs in the time spent filling out applications, working on their resume and attending interviews. The employer in this scenario incurs search costs by holding interviews and comparing applications.

When inflation is high and volatile, prices are unstable and additional time is needed in order for both buyers and sellers to find a price with which they are satisfied (Andres and Hernando 1997, 3). Additionally, when inflation is volatile, economic actors are discouraged from entering more efficient, long-term contracts as they are unsure of how much they would actually make after the cost of inflation, these misallocations of resources lower total factor productivity (Motley 1998,16; Clark 1997, 1).

3. Literature Review

The existing literature covering the relationship between inflation and growth is often conflicting, some studies such as Fischer agree that there is a statistically significant relationship between the two measures but disagree on the percent inflation at which inflation begins to negatively impact growth (Fischer 1993, 18). Pollin and Zhu found that below 15%-18%, inflation is associated with an increase to GDP growth and a decrease below the threshold (Pollin and Zhu 2006, 608). Burdekin et al. found the threshold to be at 8% for industrialized nations and 3% for developing nations whereas Khan and Sehadji found the threshold for industrialized nations to be 1-3% for industrial nations and 11-12% for developing nations(Burdekin et al. 2004, 530;Khan and Sehadji 2001,19). Barro in *Determinants of Economic Growth* found the threshold at which a negative correlation could be found between inflation and growth to be 40%.

Other Studies find that some economies have a wholly positive correlation between growth and inflation. Yilmazkuday found that there was a positive correlation between growth and inflation in countries with weak institutions (Yilmazkuday 2022, 11). The basis for this finding was that in countries with weak financial institutions have poor access to capital as a result and that the additional money supply associated with inflation increases real investment(Yilmazkuday 2022, 4).

Some studies are unable to find a correlation between inflation and growth such as Levine and Renelt (Levine and Renelt 1992, 959). Others argue that as the results of the regression can often be hypersensitive to the drawing of the parameters of your study, meaning that as you change which years, countries, and amount of time within your periods chosen, your results change as well. As a result, they conclude that econometrics cannot be used in order to find a correlation between inflation and output that is robust. Ericsson et al. argues "these regressions are a doubtful and misleading basis for inferences about economic policy (Ericsson et al. 2001, 251)."

4. Data and Methods

This paper will explore four separate regression models. Regressions (1) and (2) use the inflation rate over the same time period that growth is measured. Regressions (3) and (4) use the inflation rate five years prior to the time period that growth is measured to capture any effects that may not be immediate. Regressions (2) and (4) use a standard deviation of annual inflation rate measure to capture the effect that inflation volatility may have on growth rate that would not be seen otherwise. In this section all data was sourced from the World Bank's Data Bank unless otherwise stated.

Table 1. Reference of regression models

	No Inflation Rate Standard Deviation	Includes Inflation Rate Standard Deviation
Matching Inflation Period	(1)	(2)
Early Inflation Period	(3)	(4)

Table 2. Definition of Variables

Variable	Description
GRO	Annual growth rate of per capita GDP over the period expressed in 2015 USD
INFL	Annual growth rate of CPI over the period
INIT	Log base 10 of initial per capita GDP expressed in 2015 USD
SCHL	Log base 10 of average years of schooling over the first five years of the period
INTR	INIT * SCHL
LIFE	Log base 10 of average life expectancy over the period
FERT	Log base 10 of average fertility rate over the period
	Average percent of GDP consumed by the

	government excluding education and military
GOV	expenditures over the period
DEMO	Average democracy index score over the period
DESQ	DEMO squared
ROL	2020 rule of law index score
TOT	Annual growth rate of the export price: import price ratio
STD	Standard deviation of the annual inflation rates in the period

Table 3. Descriptive Statistics

Regressions (1&2)			Regressions (3&4)		
Variable	Mean	Std. deviation	Variable	Mean	Std. deviation
GRO	0.01742	0.02084	GRO	0.01724	0.02084
INFL	0.07312	0.15502	INFL	0.07721	0.14927
INIT	3.60802	0.60786	INIT	3.62033	0.60871
SCHL	7.61198	3.33266	SCHL	7.68042	3.31810
INTR	29.12861	16.18851	INTR	29.46171	16.19326
LIFE	1.83027	0.06303	LIFE	1.83204	0.06206
FERT	0.40600	0.21120	FERT	0.40211	0.20984
GOV	9.12033	3.93689	GOV	9.07634	3.92544
DEMO	0.56521	0.23330	DEMO	0.56772	0.23428
DESQ	0.37366	0.26207	DESQ	0.37696	0.26352
ROL	0.55197	0.13803	ROL	0.55384	0.13891
TOT	0.00496	9.39265	TOT	0.00507	9.46533
STD	4.25364	15.20597	STD	4.22521	15.26670

In these regressions GRO will be the dependent variable and is measured as the average growth rate of real GDP per capita in each country using the GDP per capita in 2015 US$ of the first and last year of each period.

The primary variable in this model is INFL and is found by using the consumer price index of the first and last year of each time period for regressions (1) and (2), regressions (3) and (4) will be using the consumer price index of five years before the time period and five years into the time period (for the 1995-2005 time period, the consumer price index of 1990 and 2000 will be used). Standard deviation of annual inflation rate is used a measure of inflation rate volatility. As discussed in section two, inflation rate volatility has negative effects on both TFP and capital accumulation, both of which are factors which contribute to growth. As was the case in Barro, the correlation between standard deviation of annual inflation rate and per capita growth rate is expected to be negative(Barro 1998, 96). As an economy nears its steady state, growth begins to slow down in order to account for this we will include the real GDP per capita in 2015 US$ of the first year of the time period. The correlation of this initial GDP is expected to be negative as was the case in Barro (Barro 1998, 96). We log this variable in order to account for the exponential nature of growth. Changes in terms of trade can impact employment and production in nations with specialized exports, and is expected to have a positive correlation with growth, as was the case in Barro (Barro 1998, 96).

We will use the level of schooling during the beginning of the period in order to isolate the effect that initial human capital has on growth and will be measured in the average years of education attained in the first year of each period and was sourced from Our World in Data. The correlation between economic growth and education is expected to be positive due to education contributing to human capital. This was the case in Barro (Barro 1998, 96). The regression model will additionally utilize an interaction variable which will capture how schooling affects how sensitive an economy's growth is to initial GDP. In Barro's *Determinants of Economic Growth* the correlation between this variable and growth was negative indicating that as a nation becomes more educated its growth is more sensitive to the starting GDP (Barro 1998, 96). The correlation between the education * log (GDP) interaction variable is expected to also be negative as this is an update of Barro's study. Human capital as well as TFP in the form of health of workers can be measured in part by the life expectancy of a population. It is expected that life

expectancy will have a positive correlation with growth, as was the case in Barro (Barro 1998, 96). Life expectancy is logged in order to more accurately capture its empirical relationship with growth. In an economy with a growing population, more capital is distributed to new workers than is distributed to existing workers, this results in a negative correlation between fertility and per capita economic growth. This effect is exacerbated by the diversion of resources away from production and towards child rearing. The expected correlation is negative as was the case in Barro (Barro 1998, 96).

Government spending is considered to be less efficient than private spending and the taxes required to do so further decreases economic growth, as a result the correlation with growth is expected to be negative as was the case in Barro (Barro 1998, 96). Rule of law positively impacts the attractiveness of investment as it is a measure of "the effectiveness of law enforcement, the sanctity of contracts, and the state of other influences on the security of property rights (Barro 1998, 27." The correlation of this variable is expected to be positive as additional investment results in increased economic case and this was the case in Barro (Barro 1998, 96). For this variable, a single year's rule of law index score was used as historical data was not complete enough to include in the first period, years that were scored had very little if any variation year to year. The World Justice Project's "WJP Rule of Law Index" was used for this data. Economic freedoms have a positive correlation with economic growth, the connection between political freedoms and economic freedoms is less clear as wealth redistribution slows growth, but checks on government power decrease bribery which would otherwise decrease economic growth (Barro 1998, 49). In *Determinants of Economic Growth* the resulting correlation between democracy index scores and economic growth was positive and significant (Barro 1998, 96). Herre et al.'s "Democracy" was used for democracy index scores. The equation regression is listed below as equation (1)

$$GRO = \beta_0 + \beta_1 INFL + \beta_2 INIT + \beta_3 SCHL + \beta_4 INTR + \beta_5 LIFE + \beta_6 FERT + \beta_7 GOV + \beta_8 DEMO + \beta_9 DESQ + \beta_{10} ROL + \beta_{11} TOT + \beta_{12} STD \tag{1}$$

5. Findings

Table 4

Variable	Regression (1)		Regression (2)		Regression (3)		Regression (4)	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
INTERCEPT	**0.402**	0.000	**0.422**	0.000	**0.372**	0.000	**0.397**	0.000
INFL	-0.005	0.492	0.008	0.377	0.005	0.534	0.012	0.148
INIT	**-0.026**	0.001	**-0.027**	0.000	**-0.028**	0.000	**-0.028**	0.000
SCHL	-0.001	0.615	-0.001	0.622	-0.002	0.445	-0.002	0.535
INTR	0.000	0.688	0.000	0.610	0.001	0.483	0.001	0.511
LIFE	**-0.132**	0.002	**-0.142**	0.001	**-0.113**	0.008	**-0.126**	0.003
FERT	**-0.078**	0.000	**-0.079**	0.000	**-0.076**	0.000	**-0.077**	0.000
GOV	**-0.002**	0.000	**-0.002**	0.000	**-0.002**	0.000	**-0.002**	0.000
DEMO	**-0.090**	0.003	**-0.091**	0.002	**-0.089**	0.003	**-0.093**	0.002
DESQ	**0.077**	0.012	**0.075**	0.012	**0.075**	0.014	**0.077**	0.010
ROL	**0.039**	0.041	**0.037**	0.049	**0.041**	0.032	**0.038**	0.044
TOT	0.060	0.170	0.067	0.118	0.068	0.121	0.073	0.088
STD	-	-	**0.000**	0.002	-	-	**0.000**	0.001
R-squared	0.360031657		0.386147735		0.363836898		0.392917474	
observations	242		242		240		240	

No statistically significant correlation could be found between inflation rate, lagged and unlagged, or the standard deviation of inflation rate. This is not surprising given that Barro could not find statistical significance between inflation rates and growth in countries with inflation rates below 40%. The time periods studied in this paper had very few examples of inflation above 40%, when filtered to include only instances of countries with data available for all variables and inflation rates above 40% only 4 instances existed. Statistically significant correlations could not be found for schooling, schoolings interaction with initial GDP, or terms of trade growth. This was more

surprising as Barro had been able to find statistically significant correlations for these variables. Schooling and its interaction's lack of statistical significance may be caused by a change in the measured used. Barro used a measure of years of secondary schooling of males by the age twenty-five, while this study used total schooling years of all genders and all level, as this second measure was better documented presently. Research into the topic of the relationship between various measures of education and economic growth could prove insightful. The lack of statistical significance for terms of trade growth could be a result of fewer countries specializing in one primary export/import, research on diversity of industry in nations may also prove insightful. Furthermore, LIFE, DEMO both resulted in statistically significant correlations in the opposite direction than Barro found. A negative correlation between life expectancy and growth might be due to an increase in non-working years in the population's life-span. DEMO's unexpected negative correlation was less surprising as the correlation political freedom and economic growth was not well developed.

6. Conclusions

Results from this study found no relationship between inflation rates and growth rates, this can lead to monetary policy decisions that do not prioritize the reining in or generation of inflation for the sake of increasing growth. Studies in the future can focus more on the effect of inflation on human welfare rather than growth as inflation may have an effect on the quality of life of the population.

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