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The relationship between population growth and economic growth in Mexico

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Abstract

The relationship between population growth and economic growth is of great interest both for demographers and for development economists. Considering the case of Mexico, the objective of this study was to analyze the dynamic relationship between population growth and economic growth, through a structural break cointegration analysis for the period 1960-2014. The Gregory-Hansen cointegration test confirmed the existence of a long run equilibrium relationship between population and economic growth in Mexico. Based on the results of this test, we used 1985 as the year in which the structural break occurs in the cointegrating equation and therefore we included a dummy variable for this year in the VECM developed in the paper. In the short run, it was found that economic growth has a negative effect on population growth. In the long run, it was found that population has a positive effect on per capita GDP and that per capita GDP positively affects population. Additionally, a Granger causality test indicated that per capita GDP is Granger-caused by population and population is Granger-caused by per capita GDP, thus revealing the presence of a mutually reinforcing relationship between these two variables. In sum, the results found in this study suggest the existence of a bi-directional causality between population growth and economic growth in Mexico.

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1. Introduction

There are many studies focused on the analysis of the relationship between population growth and economic growth. However, there is no consensus among researchers about whether population growth has positive, negative or no effects on economic growth.

According to Darrat & Al-Yousif (1999), there are mainly three schools of thought regarding the relationship between population growth and economic growth. The first one is the orthodox (or Malthusian) vision, which states that rapid population growth leads to lower economic growth and poverty. The second one, the Revisionist school, takes the opposite view, arguing that higher population growth increases the stock of human capital, thus contributing to economic growth. Finally, the Transition theory maintains that population growth is in part due to changes in income; i.e. populous countries are populous as a result of being economically poor.

Birdsall (1988) analyzes the historical evolution of the thought concerning this phenomenon. She notes that in the fifties and sixties, it was believed that rapid population growth would be detrimental to the economy, coinciding with the Malthusian school of thought postulate. In the late seventies the idea was that the abundance of labor in poor countries, in relation to the amount of available land and capital, would hamper economic growth. By the end of the eighties, population growth was not seen as a problem which by itself would result in a shortage of food or other natural resources, but rather it was perceived as only one factor, which combined with others, could cause slower economic growth. Moreover, from this period afterwards, it was considered that the negative effects which a high rate of population growth could have on economic growth are rather minimal, as it was considered that other economic factors have a larger effect on economic growth, such as imprudent macroeconomic policies adopted by some poor countries as well as these countries' weak political and social institutions. Finally, it was concluded that population changes are not only a cause but also a consequence of economic changes (Birdsall, 1988).

Despite the evident importance of this issue, especially for developing countries, empirical evidence about the relationship between population growth and economic growth for the case of Mexico is very scarce. Thus, the objective of this research is to determine if there is a relationship between population growth and economic growth in Mexico, both in the short run as in the long run. Following Furuoka and Munir (2011), a Vector Error Correction Model (VECM) is used to examine the relationship of these two variables during the 1960-2012 period.

The rest of the paper is divided as follows. The first part analyzes the demographic transition in Mexico and its possible relation with economic growth. The next section presents a brief literature review. Section four describes the variables used in the study. Section five explains the econometric model used in the paper. The sixth section of the paper presents the main results obtained in the econometric model and the last section proposes some conclusions and policy implications which could be drawn from the study.

2. The Demographic Transition and Economic Growth in Mexico

Population growth in Mexico during the last decades has gone through several phases. From the 50's to the mid-seventies the demographic dynamics of the country was characterized by sustained high birth rates and by a steady decline in the mortality rate.

According to Cabrera (1994), between 1940 and 1970, death rates in the country fell abruptly, which resulted in one of the largest rates of population growth worldwide in that time. Regarding the evolution of natality rates, Hernandez Laos (2004) notes that birth rates remained high during this period (44.3 births per thousand in 1940; 44.7 in 1950; 47.3 in 1960 and 43.7 in 1970).

Thus, several authors (Chen et al., 1990; Coale (1978)) indicated that the demographic transition (the process through which societies can progress from having high fertility and high mortality rates to low fertility and low mortality rates) in Mexico had not been completed by the end of the sixties because while the death rate had fallen steadily, the birth rate had remained high. However, beginning in the late seventies, fertility rates began to fall rapidly, from 6.7 children per woman in 1970 to 2.2 in 2013 (World Bank Group, 2015), in what constitutes one of the fastest declines in fertility of the world. This strong decrease in fertility rates, coupled with the sustained decrease in the mortality rate, caused a strong fall in population growth, which fell from a 3.4 percent annual growth rate in the decade from 1960 to 1970 to a rate of 1.4 percent per year in the 2000-2010 decade (World Bank Group, 2015).

Meanwhile, the rate of economic growth in the country during the last decades has varied greatly. In the period 1950-1980, the average growth rate of per capita GDP was 3.4 percent per year, it was negative in the 80's (-0.3 percent per year), recovered in the 90's (1.9 percent annually), and then decreased again in the first decade of this century, to an annual rate of one percent per year. Thus, in general it can be observed that when the rate of population growth in Mexico was very high (from the 50's to the late 70's), it was also then that the growth rate of per capita GDP was higher, and when the growth rate of the population began to decline so did the rate of economic growth.

However, as Sedano (2008) points out, the most important economic effects of the demographic transition occur through changes in the age structure of the population, particularly through changes in the dependency burden. Through a descriptive analysis, the author argues that in the case of Mexico there was no relation between changes in the dependency burden and the rate of economic growth, neither during the period of high economic growth (1950-1980) nor in the period of low economic growth (1981-1995). It is only after 1996 that a possible correlation between the two variables starts to arise.

While these relationships are only descriptive and not necessarily represent causation, it is interesting to analyze the case of Mexico to investigate whether in fact there is a relationship between demographic growth and economic growth.

3. Literature Review

As stated in the Introduction, there is no consensus among researchers about the effects of population growth on economic growth. Empirical studies have found evidence in favor of negative and positive effects as well as of no effects at all. Most studies before the decade of the eighties were cross-sectional studies based on only correlation analysis and did not address the more relevant analysis of causality (e.g. Barlow (1994); Kelley (1988); Kuznets (1967)). These studies did not adequately address the potential problem of reverse causation between economic growth and population, nor the sensitivity of the results to the selection of countries to be included in the econometric analysis and the presence of possible problems of spurious correlation (Kelley and Schmidt, 2001).

However, since the pioneering study of Darrat and Al-Yousif (1999), later research started to use more appropriate methodology, such as cointegration analysis and Granger causality, to try to determine causal relationships between demographic growth and economic growth. Among the studies which found that population growth has a positive effect on economic growth are those of Darrat and Al-Yousif (1999), Furuoka (2009), Furuoka and Munir (2011) and Furuoka (2013). Studies that found a negative effect of population growth upon economic growth include those of Dao (2013) in a study of forty five African countries, and Darrat and Al-Yousif (1999) for the cases of Sri Lanka and Thailand. Other studies found no evidence of any relationship between population growth and economic growth (Dawson & Tiffin (1998) for the case of India; Thornton (2001) for the case of seven Latin American countries and Singha and Jaman (2012) for the case of India). Table 1 shows a summary of these findings.

For the case of Mexico there are only a few studies about the relationship between population growth and economic growth. Most of them are limited to mainly a descriptive and very general analysis of the relationship between the two variables (Cabrera, 1994; Coale, 1978; Sedano, 2008). We only found two papers using econometric time series analysis approaching this issue (Darrat and Al-Yousif (1999) and Thornton (2001)). However, these papers do not analyze the case of Mexico exclusively, but that of several Latin American countries, among them Mexico.

Using data for the 1955-1975 period, Coale (1978) constructed population simulations for the Mexican case, estimating that without decreasing fertility rates the Mexican economy would not be able to grow. However, he asserted that the Mexican case was unusual because, although fertility rates during this period did not decrease, the economy grew very fast, as per capita income had doubled in 20 years while life expectancy also grew rapidly.

Sedano (2008) analyzed the relationship between real per capita income and other demographic and social variables (life expectancy, fertility rates, population growth, age distribution, degree of urbanization, rates of net migration and working age population). The author concludes that Mexico has failed to put into productive use its workforce, as it failed to generate greater savings and investment while the economically active cohort had steadily grown. Moreover, although the country has been able to reduce its dependency ratio, this has not been reflected in notably higher levels of education of the workforce.

In an analysis developed for several countries including Mexico, Darrat and Al-Yousif (1999) found that for the case of this country there was a unilateral positive effect of population growth on economic growth. However, Thornton (2001) concluded that in the case of Mexico population growth does not cause nor is caused by per capita GDP.

4. Data

The objective of this paper is to determine, for the case of Mexico, if there is a relationship between population (POP) and economic growth, measured in terms of real per capita Gross Domestic Product (PCGDP). The period covered in the analysis is 1960-2014. All data were log-transformed in order to correct possible problems of heteroscedasticity in the series. The GDP variable was obtained from World Development Indicators (World Bank Group, 2015) and is expressed in constant national currency units (Mexican constant pesos). Annual population data was also obtained from World Development Indicators (World Bank Group, 2015).

5. Econometric Model

Based on the methodology suggested by Furuoka and Munir (2011), a Vector Error Correction Model (VECM) is estimated to determine if there is a relationship between population growth and economic growth, both in the short run as well as in the long run.

A VEC model can be expressed as follows:

$$DY_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i Y_{t-i} + KDV_t + \varepsilon_t \quad (1)$$

Where:

$Yt = (LPOP, LPCGDP)$ is the vector of all endogenous variables as defined above, expressed in its first differences (D).

Π = It is the long run part of the model, which contains the cointegration coefficients β and α.

Γ= It is the matrix of short-term parameters.

DV= It contains deterministic variables, such as the constant and a trend variable.

ε_t= It is the vector of the disturbance terms, which are assumed to be uncorrelated with their lagged values nor with the variables on the right side of the equation.

6. Empirical Findings

6.1 Stationarity Tests

Considering that the time series in the model span more than 50 years, it was necessary to perform a stationarity test that incorporates the possibility of a structural break in the series. The test applied was the Banerjee, Lumsdaine, and Stock (1992) test, whose results are shown in Table 2. It can be seen in this table that both population and GDP per capita are stationary in their differences even in the presence of a structural break in both series.

6.2 Cointegration Tests

Considering that, as in the case of the tests of stationarity for the individual variables, the sample period included in the model is quite long, covering more than 50 years, we decided to use a cointegration test which allows for the possibility of a structural break in the cointegrating equation. This was done through the Gregory and Hansen (1996) cointegration test, whose results are shown in Table 3. It can be seen in that table that the ADF* and Zt* tests reject the null hypothesis of no cointegration, with breaks in 1985 according to the ADF* test and in 1984 according to the Zt* test. Since the Za* test indicates that it is not possible to reject the null hypothesis of no cointegration with a structural break in 1984, we decided to use 1985 as the year in which the structural break occurs in the cointegrating equation and therefore we include a dummy variable for this year in the VECM model presented in the next sections.

6.3 Long run elasticities

Once we have identified the cointegrating equation through the Johansen method, including the dummy variable to account for the structural change in the cointegrating equation detected by the Gregory-Hansen test, and given the fact that the two variables included in the equation are expressed in their logarithms, it is then possible to estimate the long-run elasticities between the two variables. Table 4 shows that, in the long run, population has a positive and significant effect on per capita GDP; in turn, per capita GDP has a positive and statistically significant effect on population. Expressed in numerical terms, a 1 percent increase in population causes a 2.28% increase in per capita GDP and, conversely, a 1 percent increase in per capita GDP results in a 0.44 percent increase in population.

These results are consistent with the predictions of the revisionist school. Also, the effects found regarding the relationship of population and per capita GDP are consistent with the findings of Furuoka and Munir (2011) for the case of Singapore. Similarly, at least one of the positive effects found in our results (positive effect of population on per capita income) is similar to the result obtained by Darrat & Al-Yousif (1999) for the Mexican case.

Specifically for the Mexican case, the positive effect of population growth on economic growth could be explained by the success of the Mexican import substitution model during the 1950s to the mid 1970's, which increased the rate of economic growth to very high levels (about seven percent a year) during that period and therefore accommodated a high rate of population growth. Following the arguments put forward by Simon (1981), another important factor which could explain the positive effect of population growth on economic growth in the Mexican case was the very notable increase in the education level of the population and the labor force during the period under analysis. Finally, and following Headey and Hodge (2009), the relatively low population density prevalent in Mexico could have also been a factor contributing to the positive effect of population growth on economic growth found in the econometric results of this paper.

6.4 Short run elasticities

Table 5 shows the short run elasticities between the two variables. It can be seen that per capita GDP has a negative and statistically significant effect on population in the short run.

Finally, we can see in Table 5 that no significant effect of population upon per capita GDP was found in the short run.

6.5 Granger causality test

When analyzing the Granger causality results, we can see in Table 6 that population Granger-causes per capita income and that per capita income Granger-causes population. We conclude, therefore, that there is bidirectional causality (in the Granger sense) between the two series.

7. Conclusions and policy implications

The relationship between population growth and economic growth is of great interest both for demographers and for development economists. The economic literature developed around this issue encompasses three schools of thought with different arguments and findings about this relationship: The Malthusian school (negative effects), the revisionist school (positive effects) and the Transition Theory (transient effects). However, currently there is no consensus about which of these theories is correct.

Considering the case of Mexico, the objective of this study was to analyze the dynamic relationship between population growth and economic growth, through a cointegration analysis for the period 1960-2014. The Gregory-Hansen cointegration test confirmed the existence of a long run equilibrium relationship between population and economic growth in Mexico.

In the short run, it was found that economic growth has a negative effect on population growth. In the long run, it was found that population has a positive effect on per capita GDP and that per capita GDP positively affects population, i.e. there is a two-way relationship between these two variables.

Additionally, the Granger causality test indicated that per capita GDP is Granger-caused by population and population is Granger-caused by per capita GDP, thus revealing the presence of a mutually reinforcing relationship between these two variables.

In sum, the results found in this study suggest the existence of a bidirectional causality relationship between population growth and economic growth in Mexico. These findings add to the empirical literature about the relationship between these important variables, especially for the developing countries case.

Finally, although it can be risky to derive policy implications based on a single study, the econometric findings of this paper indicate that, in the Mexican case, there is a positive impact of population growth on economic growth. This, coupled with the fact that fertility rates and population growth have fallen substantially over the past two decades in the country, suggest the idea that Mexican population policy, which until now has been focused on reducing the birth rate, must be reconsidered towards a population policy that at least does not encourage the reduction of fertility, as this would result in lower population growth and therefore in a lower rate of economic growth and, therefore, in lower living standards for the population.

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Table 1: Literature review: main findings

Author(s)	Period	Countries	Method	Key Findings
Dawson & Tiffin (1998)	1950-1993	India	Cointegration analysis	Population growth does not cause per capita GDP growth nor viceversa
Darrat & Al-Yousif (1999)	1948-1996	Twenty developing countries	Granger causality and Error Correction Model.	o 14 countries (including Mexico): Unilateral positive effect of population growth on economic growth. o 2 countries: Unilateral negative effect of population growth on economic growth. o 4 countries: positive bidirectional effect.
Thornton (2001)	1921-1994	Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela	Cointegration analysis and Granger causality	Population growth does not cause nor is caused by per capita GDP
Furuoka & Munir (2009)	1961-2003	Thailand	Cointegration analysis and Granger causality	Unidirectional causality from population growth to economic growth
Furuoka & Munir (2011)	1960-2007	Singapore	Cointegration analysis and Granger causality	Positive bidirectional causality between GDP and population growth
Singha & Jaman (2012)	1960-2010	India	Granger causality test and Error Correction Model.	Population growth does not cause per capita GDP growth nor viceversa
Dao (2013)	1990-2008	Forty-five African countries	Cross-section regression model	Population growth negatively influences per capita GDP growth
Furuoka (2013)	1960-2007	Indonesia	Cointegration analysis and Granger causality	Unidirectional causality from population growth to economic growth

Table 2: Banerjee, Lumsdaine, and Stock Breakpoint Unit Root Test

Variable	Augmented Dickey-Fuller Test t-statistic	p-value	Lags	Unit root	Stationarity
LPCGDP	-4.150	0.128	1	Yes	Not stationary
D. LPCGDP	-6.293	< 0.01	0	No	Stationary
LPOP	-3.820	0.248	4	Yes	Not stationary
D. LPOP	-5.756	< 0.01	3	No	Stationary

Note: D denotes the first difference operator.
Source: Own estimates.

Table 3: Gregory-Hansen Test for Cointegration with Regime Shifts

Testing Procedure	Test Statistic	Breakpoint	Date	Asymptotic Critical Values		
				1 %	5 %	10 %
ADF	-5.98	26	1985	-5.47	-4.95	-4.68
Zt	-5.73	25	1984	-5.47	-4.95	-4.68
Za	-40.85	25	1984	-57.17	-47.04	-41.85

Source: Own estimates.

Table 4: Long-Run Elasticities

Endogenous Variables	Exogenous Variables	
	LPCGDP	LPOP
LPCGDP	-	2.280 (0.172)***
LPOP	0.439 (0.046)***	-

Notes: (1) Standard errors in parenthesis.
(2) *** indicates significance at the 1% level.
Source: Own estimates.

Table 5: Short-Run Elasticities

Exogenous Variables	Endogenous Variables	
	D.LPCGDP	D.LPOP
D.LPCGDP	0.189 (0.146)	-0.005*** (0.002)
D.LPOP	2.715 (2.613)	1.046*** (0.033)
DUMMY1985	-0.038 (0.022)*	0.002*** (0.0003)
CointEq	-0.169** (0.084)	-0.012*** (0.002)
Constant	-0.073 (0.088)	-0.001 0.001

Notes: (1) D denotes the first difference operator.
(2) Standard errors in parenthesis.
(3) ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Source: Own estimates.

Table 6: Granger Causality Tests

Causality Direction	Chi-square test statistic	Probability
$POP \rightarrow PCGDP$	17.576***	0.007
$PCGDP \rightarrow POP$	11.193*	0.083

Note: *** and * indicate significance at the 1% and 10% levels, respectively.

Source: Own estimates.