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Unlocking the Demographic Dividend: The Essential Role of Capital Accumulation in Latin America (1980–2023)

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ABSTRACT: This study examines the nexus between demographic transition and economic performance across seven Latin American economies over the period 1980–2023. Employing a Two-Way Fixed Effects panel data framework that simultaneously controls for country-specific heterogeneities and common time-varying shocks, the study isolates the within-country growth dynamics of key demographic and macroeconomic variables. Empirical results identify physical capital accumulation as the dominant and most statistically robust determinant of regional growth, with a semi-elasticity of 8.044 ($p < 0.01$) that remains stable across all model specifications. Life expectancy emerges as a second significant factor, yielding large negative coefficients (–40.278, $p < 0.01$) consistently across baseline and robustness checks, suggesting that rapid longevity gains generate short-run fiscal pressures that temporarily constrain growth. In contrast, demographic variables — including the fertility rate, age dependency ratio, and population size — do not attain statistical significance in the short-to-medium term, indicating that their influence on annual growth fluctuations is secondary to investment-driven factors. These findings suggest that a declining dependency ratio does not spontaneously trigger economic growth; its potential is unlocked only when synchronized with high-intensity capital formation. The study concludes that for Latin American nations to capture the demographic dividend before the strategic window closes, policy priorities must center on stimulating productive investment and enhancing financial deepening to translate demographic transition into sustained economic expansion.

KEYWORDS: Sustainable Development, Economic Growth, Physical Capital Accumulation, Demographic Dividend. Latin America, Fertility Rate, Panel Data Analysis

JEL Classification O47. J11. O11. C33

1 INTRODUCTION

While classical and neoclassical growth models primarily focus on capital accumulation and technology, empirical studies demonstrate that growth involves more complex and country-specific dynamics. While standard growth theories are focused on technological processes of growth (Solow, 1956), the influence of factors like age-structure or institutional differences may vary greatly between countries. In fact, when taking an increasing old age dependency as a factor for growth, the results vary across regions (Srdelić & Dávila-Fernández, 2025). These findings suggest that the effects of demographic variables are difficult to explain within a uniform framework.

Among the important notions in the study of the interplay between demography and the performance of the economy has been the Demographic Dividend Hypothesis. Demographic transition is the process by which high birth and death rates are replaced by low birth and death rates (Wei & Hao, 2010). The hypothesis is based on the falling dependency ratio, which is calculated as the proportion of children and elderly and the working-age population participating in the labor force, with fertility rates decreasing (Rizk, 2019). As lower fertility reduces the proportion of children and expands the working-age population, per capita income tends to increase (Bloom & Williamson, 1997; Lee et al., 2003; Lee & Mason, 2010).

Contrarily, the pressure on investment rates by demographic decline has been closely related to the long-term fall in real interest rates since the late 1990s. One might also interpret this as a sign of a structural condition in which excess saving causes a chronic shortfall of aggregate demand, thereby weakening output growth (Catalano & Pezzolla, 2016). However, while this structural shift is now widely considered to be positive for long-term economic growth, the implications of analysis, in particular for the developing nation, can be quite different. For example, Trong et al. (2024) in the study of ASEAN indicates that the short run effect of elderly population is on the decline national economy, while young population improves per capita income. On the other hand, in some countries of Africa where the process of demographic transition is in its infancy, its effect on the national productivity is barely noticeable (Han et al., 2023; Trong et al., 2024). Also, changes in demography can at times even strain public finances. For example, Weyerstrass and Neck (2013) illustrate how economic contraction associated with rising public spending to accommodate an aging population occurs regardless of fertility rates: with the case of the Slovenian government (Weyerstrass & Neck, 2013).

This paper examines the effect of shifting demography, a major but occasionally overlooked driver of economic growth. Since the demographic transition takes place in phases and, in particular, since this transition is taking place in the developing world, it is crucial to analyze this novel stage of demographic transition on a country level. Within this institutional setting, the paper seeks to empirically analyze the impact of a number of demographic variables—in particular the fertility rate—on per capita GDP growth. Latin American nations have been chosen as the study area.

In this regard, conventional sources of growth such as accumulations of human and physical capital remain the major sources of growth and development for the Latin American economy (Le Clech, 2025). Yet, there is a line of the literature that claims that the region has not yet begun to harvest the fruits of its "demographic transition" because of institutional and structural constraints (Bloom & Canning, 2004; Rofman & Apella, 2020) which also serves as a strong motivation for this investigation.

The demographic transition is the change from high birth rates and death rates to low birth and death rates. The LAC region is experiencing this certain stage of a faster pace than in Europe (García-García et al., 2024). Pérez-Brignoli documents that transition is different for each country in the region: Argentina and Uruguay were early transitioners in the late 19th century, while Mexico, Brazil and Chile were late transitioners in the 20th century (Flores et al., 2025; Zavala de Cosío, 2023).

Beyond demographic transition variables, this study also investigates life expectancy as a proxy for health capital and its short-run growth implications — a dimension that remains underexplored in the Latin American context despite the region's rapid longevity gains documented in Figure 2.

Utilizing panel data for a sample of Latin American countries, this study controls for inter-country structural differences and seeks to reflect changes over time within each country's context. In these terms, the findings from this research are expected to shed some new light on the relation between population makeup and economic growth. The remainder of the article is organized as follows: The second section explains the data and econometric methodology, the third section provides the empirical result and model selection testing, and the concluding section discusses the results and offers applicable policy suggestions.

2 LITERATURE REVIEW

The economic growth literature has been divided into two main branches from the classical economists to the present. The Classical and Neoclassical Growth Models have played down the importance of capital accumulation and labor growth since they treat technological progress as exogenous and hold that long-run per capita growth is attained by advancing technology. In contrast, Endogenous Growth Theories (Lucas, 1988; Romer, 1994), which developed since the 1980s, have treated technological progress and human capital as an endogenous component of the model and asserted that the growth rate can be altered through policy decisions. Barro (1991), on the other hand, placed this theory into an empirical framework and expanded the concept of human capital; including health indicators (such as life expectancy) along with education as critical components of growth in the model. Similarly, these two approaches constitute the theoretical foundation for the gross capital and life expectancy variables used in our study.

Early contributions on the effect of population growth on growth influenced the literature on the effects of demographic components on growth (Birdsall et al., 2001; Coale & Hoover, 1958; Malthus, 1798; Mankiw et al., 1992). Subsequent research has revealed that growth is strongly influenced not only by population size but also by demographic components such as the age structure of the population, fertility levels, and life expectancy(Bloom et al., 2003; Bloom & Williamson, 1997; Mason & Lee, 2011). This approach constitutes the theoretical basis for the dependency ratio variable used in the study.

The second basic tenet in demographic economics is that the potential for economic growth is greater when the working-age population is larger than the dependent population. Bloom et al. (2003) contend that this mechanism is not automatic but that it represents a window of opportunity that can be seized with right policies (health, education, and openness). This conjecture postulates that through a decrease in fertility, a dependent population (mainly child dependency) declines, which leads to an increase in the share of productive and working population in the total population and space for economic growth is created. This effect is generally via three channels: an increased labor supply; investment in health and education by families who have fewer children (Drèze & Murthi, 2001; Mahanta, 2016); and conversion of additional household savings due to decreased dependency into physical capital investment (Bloom & Williamson, 1997; Mason, 2005). Although the empirical evidence suggests that this effect is overwhelmingly interpreted through the experience from East Asian countries, there is still the challenge to conduct a holistic appraisal for that observed effect for regions with distinguishing economic and institutional characteristics such as Latin America. Certain work purports that the drops in fertility produce short-to-medium term dynamics through the household savings and education channels (Acemoğlu & Johnson, 2007; Ashraf et al., 2013). Within this framework, using a long time series for the period 1980–2023, our study seeks to contribute to the literature by testing the relevance and empirical implications of the demographic dividend theory in a regionally specific economic environment – in this case, that of Latin America.

Schultz (1985), one of the early investigations on the determinants of demographic transition, studied Swedish data for the period 1860 to 1910 and argued that the reduction in child mortality is the driver of the fertility decline. In addition, he found that the rise in female wages hastened the transition in fertility by increasing the opportunity cost (Schultz, 1985). Coale and Hoover (1958) when they considered the economic implication of the process, found that high fertility depresses rates of household saving and investment. In fact, while female labour participation and wages increase have restrictive effects on fertility in this respect, fall in fertility rate has positive impact on growth by the way of saving and investment (Coale & Hoover, 1958). Certainly, Wang et al. (1994) and Hondroyiannis and Papapetrou (2002) portrayed the idea of the fertility preference as being influenced by the mortality of infants and the market of labor and as having a direct effect on the process of growth.

Building on existing discussions, Williamson (2013) argues that the process is not limited to interacting with labor force participation, but that it induces a structural growth effect. In the view of Williamson, the dividend is a factor to be accounted for in life-cycle saving, investment deepening, foreign capital flows, schooling and various other macroeconomic variables (Williamson, 2013). We find those results in particular for Latin American countries. For example, Apella (2021) showed that the first demographic dividend is positively associated with GDP growth, but also drew attention to the seriousness of the need for advancing productivity in order to sustain income balance in the absence of long-term increase in productivity. As fertility rates in the region have steadily declined, the population structure has shifted from a predominantly young dependent base toward a larger share of working-age individuals (Aguirre, 2016). In a comparative study, Han et al. (2023) find that Latin America's capacity to utilize demographic advantages exceeds that of African economies, with estimated gains averaging 101.6 dollars.

Furthermore, a comparison across 91 developing countries from the cross-country analysis reveals that Brazil and Argentina stand at the forefront of South America in the pace of their demographic transitions (Crombach & Smits, 2022).

Another prominent study in this field is a panel data study for 16 Latin American countries. In terms of economic support, the analysis shows that the share of the population in need of care to the working-age population has a positive and significant relationship with the growth of GDP per capita (Apella, 2021). The decline in fertility initially creates a critical window of opportunity for GDP growth and savings by reducing child dependency and increasing the share of the working-age population to its peak. In the literature, the temporary window of opportunity generated by falling fertility rates is known as the first demographic dividend, while the later conversion of accumulated savings into higher productivity and investment is referred to as the second demographic dividend (Mason & Lee, 2011).

The first dividend derives directly from changes in age composition, with a shrinking child dependency and a large young population cohort in productive working age creating an opportunity for greater economic output (Berganza et al., 2020). The second dividend arises as people save more to finance longer periods of retirement (Lee & Mason, 2006). Increasing savings rates provide a flow of funds to capital markets, increasing the pool of resources for gross capital (investment) (Apella, 2021; Bloom et al., 2003). For the potential of Latin American economies, in particular, however, this potential output's sustainability rests on the ability to convert saving into physical and human capital. In this regard, in order to analyze the region's demographic transition over the past four decades and its mirrors on growth, a look at the overall demographic composition is needed.

3 DEMOGRAPHIC TRANSITION AND GROWTH DYNAMICS IN LATIN AMERICA

This section provides a descriptive setting for the macroeconomic and population trends that underlie the empirical analyses. In this regard, the economic growth, the demographic transition, and the evolution in dependency ratios in a selection of Latin American countries are studied in that order for the period 1980-2023. This graphical presentation is to demonstrate the need for a panel data approach and the investigation of short-term growth effects of the demographic variables.

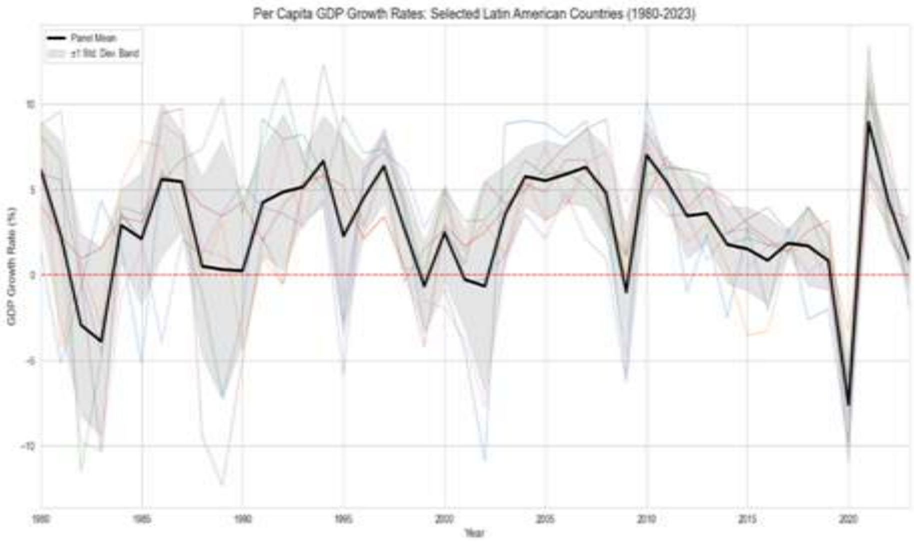

Fig. 1 Per Capita GDP Growth (1980-2023) Across Selected Developing Countries
Source: Author’s own elaboration based on World Bank (WDI) data.

Figure 1 illustrates the per capita growth trajectories of selected Latin American countries (1980–2023) alongside the panel average. Growth rates exhibit extreme susceptibility to macroeconomic shocks, such as the 1980s debt crisis, 1990s regional depressions, the 2008 financial crisis, and the 2020 pandemic (Barro, 1991). Individual national rates (thin lines) display significant volatility, confirming that growth outcomes are partially driven by short-run cyclical forces (Martin & Rogers, 2000).

The panel average (bold line) and the ±1 standard deviation interval reveal substantial cross-country heterogeneity. Despite common shocks inducing some co-movements, the varying speeds of recovery and growth peaks suggest that dynamics are shaped by country-specific institutional, structural, and demographic features. This imperfect synchronicity confirms the presence of unobserved individual effects (Baltagi, 2008), justifying the use of a Fixed Effects (FE) model. Furthermore, the cross-country variation implies that growth may be linked not only to conventional production factors but also to structural demographic variables, necessitating a temporal analysis of demographic transition components.

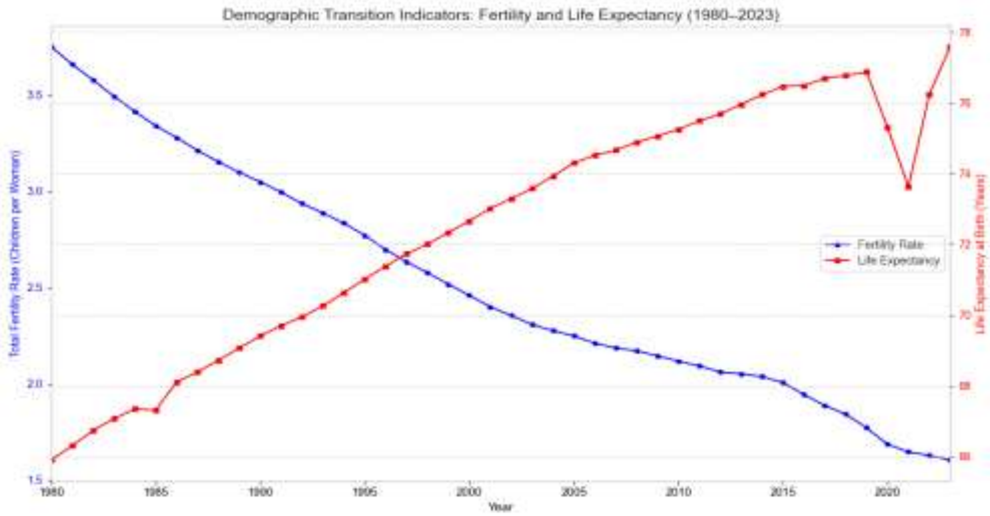

Fig. 2 Demographic Transition-fertility and life expectancy (1980-2023)
Source: Author's own elaboration based on World Bank (WDI) data.

Figure 2 depicts the demographic transition in Latin America over the period 1980–2023 through two primary indicators: The Total Fertility Rate (TFR) and Life Expectancy at Birth. These indicators reflect the changing demographic profile of the region over the past four decades. As shown in the figure, the TFR (blue line) declined steadily from approximately 3.7 children per woman in 1980 to 1.6 by 2023, falling below the replacement level of 2.1. Concurrently, Life Expectancy at Birth (red line) exhibited a continuous upward trend, rising from 66 years in 1980 to over 77 years by 2023. The notable, brief deceleration observed in 2020 captures the temporary impact of the COVID-19 pandemic on regional mortality rates. Overall, the simultaneous decline in fertility and the rise in longevity characterize the ongoing structural shift in Latin America's population age composition.

Thus, the demographic pattern exhibited in Figure 2 is illustrative of this for the entire country's development for the past four decades. This provides a solid economic rationale for controlling for demographic variables in the empirical part of the paper.

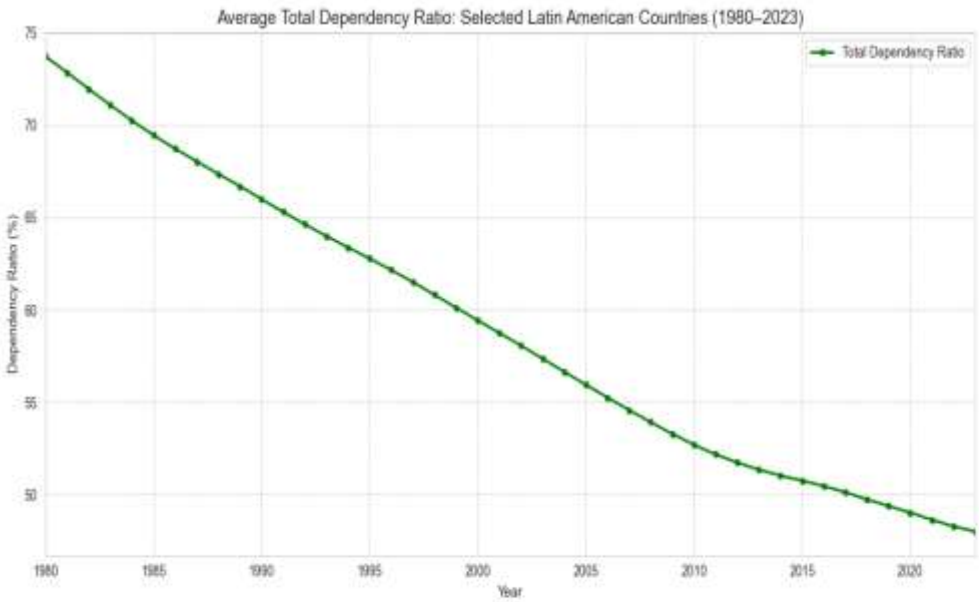

Fig. 3 Average Total Dependency Ratio (1980-2023)
Source: Author's own elaboration based on World Bank (WDI) data.

Figure 3 illustrates the decline in the average total dependency ratio from approximately 74% in 1980 to 48% in 2023. This declining trend reflects directly the decreasing fertility rates (see Figure 2). This decrease in the dependency ratio indicates that the working-age population (15-64) has grown much faster than the young and old population they must care for. In the theory, this stage is referred to as a window of demographic opportunity, when the consumption burden from the productive population declines, and hence, potential savings increase.

Yet, this favourable demographic path in Figure 3 is not by itself enough to generate economic growth. As a matter of fact, in the robustness analysis displayed in Table 6, the effect of the dependency ratio improvement on growth is not statistically significant until it is accompanied by physical capital investment (coefficient of 8.044). Therefore, the sustained drop in dependency ratios since 1980, while it provides a powerful growth leverage for the Latin American countries, it can be argued that investments and institutional quality are what determine whether or not this potential is transformed in economic output.

4. METHODOLOGY

4.1 Dataset and variables

The sample comprises Argentina, Brazil, Colombia, Mexico, Chile, Peru, and Uruguay, which were selected from the Latin American region following the criteria of data continuity and the full availability of variables. The period is 1980-2023, a total of 44 years, and the data were obtained from the World Bank's World Development Indicators (WDI) database. As all the variables are continuously observed, the panel data are organized into a balanced panel.

All the independent variables in the model were taken to the natural logarithmic (ln) form, in order to stabilise the variance and to interpret the coefficients as semi-elasticities, indicating the percentage point change in GDP growth rate associated with a one percent change in each independent variable. Economic growth rate of GDP per capita (gdp_growth) was the dependent variable. Unlike some demographic studies in the literature, growth rates allow this research to capture both short- and medium-term macroeconomic dynamics as well as cyclical fluctuations. Nonetheless, if one considers that the Latin American region is a highly diverse in a terms of economic activities, population growth and institutions, it can be argued that the sample of seven countries may have limited representation for the whole region.

4.2 Econometric methodology

From a methodological standpoint, a Two-Way Fixed Effects panel data model was chosen. This selection recasts the analytical lens away from between-country variation toward controlling for world and regional macro shocks (financial crises, commodity price shocks, global pandemics, etc.) prevalent during the 44-year period of this study. Two-way fixed effects provide more trustworthy estimates by simultaneously absorbing unobserved country-specific time-invariant heterogeneities and common time-varying shocks that affect all countries (Baltagi, 2008).

Dependent on the per capita rate of growth of economic activity used as the dependent variable, the analysis concentrates on short-term cyclical fluctuations and macroeconomic shocks response (Batrancea et al., 2021). Measuring at growth rates, rather than at level values of economic growth may more robustly capture the short-run dynamics. As a result, the standard errors were made aware of cross-sectional clustering and the tests of significance of the coefficients (t and F statistics) were better grounded. Logarithmic transformation of the independent and dependent variables. The main explanatory variables were entered in the model in logarithmic form. This makes it possible to interpret the coefficients as semi-elasticities and to mitigate heteroscedasticity in the series.

Table 1: Definition of Variables and Data Sources

Indicator	Description	Source
country	Seven selected Latin American countries	Author selection
year	Analysis period 1980–2023	-
gdp_growth	Annual percentage growth rate of GDP per capita	WDI[1]
fertility	Total fertility rate (births per woman)	WDI
gdp_ppp	GDP per capita, PPP (current international $)	WDI
population	Total population	WDI
age_dependency	Age dependency ratio (% of working-age population)	WDI
gross_capital	Gross fixed capital formation (% of GDP)	WDI
life_expectancy	Life expectancy at birth, total (years)	WDI

4.3 Model specification

In this paper, we use a panel data technique to analyze the demographic structure- per capita income growth relation for a group of Latin American countries. The following model, which expresses the interaction between demographic and macroeconomic variables, makes up the empirical framework of the analysis:

$$gdp\_growth_{i,t} = \beta_0 + \beta_1\, fertility_{i,t} + \beta_2\, gdp\_ppp_{i,t} + \beta_3\, gross\_capital_{i,t} + \beta_4\, population_{i,t} + \beta_5\, \text{life\_expectancy}_{i,t} + \beta_6\, age\_dependency_{i,t} + \lambda_t + \varepsilon_{i,t} \quad (1)$$

The variables of the model are defined as follows, with *i* and *t* representing the country and time indices, respectively. The dependent variable, gdp_growth_{it}, is the annual percentage growth rate of real GDP per capita. The main explanatory and control variables are taken in natural logarithms in the model. In particular, $lnfertility_{it}$ is the total fertility rate, $lngdp\_per\_capita_{it}$ is the GDP per capita in Purchasing Power Parity (PPP) basis and $lnage\_dependency_{it}$ the age dependency ratio. In order to correct for the accumulation of physical capital gross capital formation is included as $lngross\_capital_{it}$. In addition, life expectancy at birth, $lnlife\_expectancy_{it}$, is used as a proxy for health capital while $lnpopulation_{it}$ is included to account for scale effects related to the total population size. Lastly, the model includes time–fixed effects (λ_t), to capture global cyclical shocks common to all countries and an idiosyncratic error, ε_{it}.

In the empirical application, all explanatory variables were converted into their natural logarithmic values to control for scale differences, avoid nonstationarity in the panel series, as well as to enable an interpretation of the coefficients as semi-elasticities, given that the dependent variable gdp_growth enters the model in percentage terms rather than in logarithmic form. This last specification replaces the analysis of cross-country

[1] https://databank.worldbank.org/indicator/NY.GDP.PCAP.CD/1ff4a498/Popular-Indicators#

level differences with an analysis of dynamic fluctuations and common time shocks over the period of study. The use of a Two-Way Fixed Effects estimator for the empirical model is also meant to capture the impact of demographic and macroeconomic factors on growth, controlling for exogenous influences such as global financial cycles and regional crises. By substituting these adjustments, the final econometric model to be estimated is:

$$gdp\_growth_{i,t} = \beta_0 + \beta_1\, lnfertility_{i,t} + \beta_2\, lngdp\_ppp_{i,t} + \beta_3\, lngross\_capital_{i,t} + \beta_4 \ln population_{i,t} + \beta_5\, lnlife\_expectancy_{i,t} + \beta_6\, lnage\_dependency_{i,t} + \lambda_t + \varepsilon_{i,t} \qquad (2)$$

Importantly, this final model is no longer concerned with comparing countries at a given point of time, but on how each country changes over time around common temporal shocks. The model is estimated with a Two-Way Fixed Effects (TFE) method that accounts for the combined effect of demographic and macroeconomic factors on growth conditional on exogenous elements, including global financial cycles and regional turmoil.

The Fixed Effects specification is run on the basis of deviations from each unit specific long run mean because it controls for country specific time invariant characteristic and temporal shocks. Using this model, it is consistently shown that short term changes within the nation (e.g. fertility rates, dependency ratios, capital accumulation, population) influence GDP growth in this model.

4.4 Results

This section reports findings from panel data models. In order to have a deeper understanding of data structure, a descriptive statistics of the variables employed in the model were discussed before discussing the result of the regression for the period 1980–2023 in seven Latin American countries. The subsequent table offers a few summary statistics (mean, standard deviation, minimum, and maximum) for each of the indicators, so that we can examine the central tendencies and the volatility of these data.

Table 2 Descriptive Statistics

Variable	**Mean**	**Maximum**	**Minimum**	**Std. Dev.**	**Jarque-Bera (Prob.)**
gdp_growth	2.7663	13.363	-12.312	4.483	0.000
lnage_dependency	4.0643	4.555	3.756	0.166	0.000
lnfertility	0.8861	1.618	0.154	0.278	0.000
lngdp_ppp	8.9191	9.819	7.879	0.459	0.000
lngross_capital	2.9982	3.558	2.385	0.195	0.000
lnlife_expectancy	4.2811	4.397	4.094	0.062	0.000
lnpopulation	17.2668	19.168	14.898	1.207	0.000
Observations (N×T)	308	308	308	308	308

The data set consists of a balanced panel covering seven Latin American countries during the 1980–2023 period, totaling 308 observations. Descriptive statistics reveal that the growth rate of GDP per capita (gdp_growth), our dependent variable, averaged 2.76% during the sample period. However, a significant standard deviation of 4.48, with minimum and maximum values at -12.31% and 13.36%, suggests that growth results fluctuated widely across time and nations. This volatility highlights that economic growth in the region is highly transitory, frequently influenced by macroeconomic shocks and global cyclical swings.

The fertility rate (lnfertility), a principal demographic variable in this model, exhibits substantial variability across the panel with a mean of 0.88 and a standard deviation of 0.27. This heterogeneous composition provides a suitable empirical framework to analyze the effect of demographic shifts on income growth. The control variables also confirm this panel heterogeneity. Significant differences in GDP per capita (lngdp_ppp), capital accumulation (lngross_capital), and age-dependency (lnage_dependency) suggest large disparities in the socio-economic fabric of these nations. Notably, the physical capital accumulation term indicates that regional economies respond differently to investment levels. Conversely, life expectancy (lnlife_expectancy), acting as a proxy for health capital, remains relatively stable with a mean of 4.28, suggesting a degree of health convergence across the region.

This high cross-country and temporal heterogeneity motivates the inclusion of time dummies and country-specific fixed effects. The choice of the fixed-effects panel technique is methodologically appropriate to capture the dynamic features of the data. Furthermore, the Jarque-Bera test statistics ($p < 0.01$) indicate that the variables are non-normally distributed, confirming the suitability of fixed-effects estimation. Robust standard errors are implemented to handle potential heteroscedasticity. Finally, the correlation matrix in Table 3 is presented to examine pairwise linear associations and check for multicollinearity among the variables.

Table 3 Correlation matrix

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
(1) gdp_growth	1						
(2) lnfertility	-0.013	1					
(3) lnage-dependency	0.306	0,949	1				
(4) lngdp_ppp	-0.033	-0.560	-0.296	1			
(5) lngross_capital	0.314	0.103	-0.112	0.118	1		

(6) lnlife_expectancy	-0.012	-0.590	0.193	0.052	0.274	1	
(7) lnpopulation	-0.029	0.083	-0.149	0.202	0.331	0.293	1

Upon inspection of the correlation matrix, physical capital accumulation (lngross_capital) exhibits the strongest positive association with the dependent variable, gdp_growth, at 0.314, consistent with the regression results. Among the independent variables, the strongest correlations are observed between lnfertility and lnlife_expectancy (–0.590) and between lnfertility and lngdp_ppp (–0.560), reflecting the well-documented co-movement between economic development, health improvements, and declining fertility during demographic transition. Notably, lnfertility and lnage_dependency display a high positive correlation (0.949), which is theoretically expected, as both indicators are structural expressions of the same underlying demographic process. However, they capture conceptually distinct dimensions: fertility measures the pace of the demographic transition, while the age dependency ratio captures its current macroeconomic burden on the working-age population. The robustness checks in Table 6, which estimate alternative specifications with and without each demographic variable separately, further corroborate that the core results remain stable across different model configurations. Finally, a battery of tests, presented in Table 4, was performed to select the most appropriate panel data specification.

Table 4 Model selection tests

Test	**Statistic** (X^2/F)	**df**	**P-value**	**Interpretation**
Poolability F-test	6.756	(49,252)	0.000	Pooled OLS rejected
Hausman Test	57.133 (X^2)	6	0.000	Random Effects rejected

Notes: The poolability test examines whether fixed effects are jointly zero. The Hausman test evaluates the correlation between regressors and individual effects.

A set of diagnostic tests was performed on the panel data to select the appropriate estimator to study the determinants of Latin American economic growth. In the first stage of the model selection, the Poolability F-test against the null hypothesis (H_0: Pooled OLS model) was rejected at the 1% level of significance (F = 6.756, $p < 0.01$). This result demonstrates that the classical Pooled OLS model that ignores heterogeneity across countries and over time is biased and confirms the need to include unit- or time-specific effects in the model. In the second stage, the Hausman test was used to select among FE and RE. The null hypothesis of no relationship between the error terms and explanatory variables was rejected given the large Chi-square value ($X^2 = 57.133$) and statistical significance ($p < 0.001$). This means that the estimator in Random Effects becomes biased and inconsistent, so that there arises a methodological obligation to use the Fixed Effects model if one wants to ensure the consistency of coefficient estimates. Bearing in mind the joint effect of global cyclical movements and external shocks - e.g., commodity price volatility, global financial crises - on the economies of Latin America, these test results are supportive of the empirical validity of the Two-Way Fixed Effects model that accounts for both unit and time effects. Accordingly, the empirical findings presented in Table 5 are based on this model architecture, which provides the most consistent estimations by controlling for unobserved cross-country heterogeneity and time-dependent common shocks.

Table 5 Fixed effects regression results with country and time effects

	Coefficient	**Std. Err.**	**T-stat**	**P-value**
const	358.71**	154.43	2.3228	0.0210
lnfertility	2.4165	3.4737	0.6957	0.4873
lngdp_ppp	-2.1071	1.7447	-1.2077	0.2283
lngross_capital	8.0441***	1.9368	4.1534	0.0000
lnage_dependency	-7.4802	6.0125	-1.2441	0.2146
lnpopulation	-9.2994	6.5491	-1.4200	0.1569
lnlife_expectancy	-40.278***	12.473	-3.2292	0.0014
Estimator	Fixed Effects (Entity + Time)	Observations: 308		
Adjusted R-squared	0.4788	R-squared (Overall) : 0.57849		
F-statistic (robust)	6.9058	Prob > F: 0.0002		

The estimation results in Table 5 indicate that physical capital accumulation (lngross_capital) is the strongest and most statistically significant contributor to per capita growth in the analyzed Latin American context. The estimated semi-elasticity of 8.044 ($p < 0.01$) indicates that a 1% increase in gross fixed capital formation is associated, ceteris paribus, with an 8.044 percentage point increase in the GDP per capita growth rate. This underscores the critical importance of infrastructure and tangible asset investments for regional development.

A second statistically significant result is observed for life expectancy (lnlife_expectancy), which yields a large negative coefficient of –40.278 ($p < 0.01$). This finding suggests that within-country increases in life expectancy are associated with significant short-run reductions in GDP per capita growth, potentially reflecting the immediate fiscal pressures of expanding non-productive age cohorts and rising public health expenditures.

This result becomes interpretable within the two-way fixed effects framework, where country fixed effects absorb time-invariant structural advantages of longevity, leaving only the within-country variation to identify the short-run effect.

Regarding shifting demography, the results do not lend strong statistical support to either the "demographic dividend" or the "demographic burden" perspective in the short-to-medium term. The age-dependency ratio yields a negative but statistically insignificant coefficient of –7.480 ($p > 0.10$), and total population size similarly carries a negative and insignificant coefficient of –9.299 ($p > 0.10$). While the fertility rate yields a positive but statistically insignificant coefficient of 2.417 ($p > 0.10$), this implies that any potential demographic dividend remains secondary to the dominant influence of physical capital in the short-to-medium term. Initial income (lngdp_ppp) also fails to attain statistical significance (–2.107, $p > 0.10$), suggesting that conditional convergence dynamics are not strongly captured within the annual within-country variation emphasized by this specification.

Methodological checks confirm the model's validity. The significant Hausman test (Chi-square = 57.133, $p < 0.001$) justifies the use of fixed effects for controlling country-specific institutional and historical heterogeneities. The overall R-squared of 0.578 indicates that the selected regressors, combined with country and time fixed effects, explain a substantial portion of regional growth variation, which is a strong result given the well-documented stochastic nature of annual growth rates in panel data settings.

Table 6 Robustness check: Alternative Fixed Effects specifications

Variable	**Model 1: Full Model**	**Model 2: Without Age Dependency**	**Model 3: Without Fertility**
const	358.706 (154.426)	210.283 (105.407)	348.865 (154.999)
lnfertility	2.416 (3.474)	-0.033 (3.358)	—
lnage_dependency	-7.480 (6.012)	—	-5.597 (5.768)
lngross_capital	8.044 (1.937)	7.933 (1.955)	8.053 (1.948)
lngdp_ppp	-2.107 (1.745)	-2.193 (1.756)	-2.103 (1.748)
lnpopulation	-9.299 (6.549)	-3.511 (4.263)	-9.320 (6.614)
lnlife_expectancy	-40.278 (12.473)	-35.294 (12.496)	-39.199 (12.419)
Observations	308	308	308
Countries	7	7	7
Time periods	44	44	44
R^2 (Within)	0.5011	0.5614	0.5595
Robust F-statistic	6.7558	6.9057	6.8210
Prob > F	0.0000	0.0000	0.0000

Table 6 presents the sensitivity analysis, illustrating the robustness of our empirical findings across alternative specifications using a two-way fixed effects estimator. We successively excluded the age-dependency ratio and the fertility rate to assess whether removing these demographic factors would alter the baseline results. The most consistent finding across all specifications is the dominant importance of physical capital accumulation. The lngross_capital variable remains positive and statistically significant in all three models, with coefficients of 8.044 (Model 1), 7.933 (Model 2), and 8.053 (Model 3), and robust standard errors remaining stable around 1.937–1.955. This consistency confirms that the impact of gross fixed capital formation on growth is empirically robust regardless of which demographic regressors are included.

Regarding demographic attributes, both lnfertility and lnage_dependency display interesting dynamics across specifications. In the full model (Model 1), lnfertility carries a positive coefficient of 2.416 (SE = 3.474) but shifts to a negligible negative coefficient of –0.033 (SE = 3.358) in Model 2 when age-dependency is excluded. Conversely, lnage_dependency consistently carries negative coefficients of –7.480 (SE = 6.012) in Model 1 and –5.597 (SE = 5.768) in Model 3. Neither of these demographic variables attains statistical significance at conventional levels, which is consistent with the redistribution of explanatory weight often induced by partial multicollinearity between closely linked demographic indicators. Crucially, their overall lack of statistical significance across specifications confirms that the demographic transition's influence on short-to-medium-term growth fluctuations remains secondary to macroeconomic investment drivers.

A highly noteworthy result is observed for life expectancy (lnlife_expectancy), which yields exceptionally large negative coefficients across all three models, specifically –40.278 in Model 1, –35.294 in Model 2, and –39.199 in Model 3. Consistent with the baseline results in Table 5, these coefficients are statistically significant at the 1% level across all robustness specifications, with robust standard errors remaining stable around 12.419–12.496. This robust pattern indicates that when global time-varying shocks are strictly controlled, increases in life expectancy exert a strong, statistically significant depressing effect on within-country growth variation over the short-to-medium term, potentially reflecting the immediate fiscal pressures of expanding non-productive age cohorts or health-related public expenditures.

Control variables including initial income (lngdp_ppp) and population size (lnpopulation) are consistently negative across all models. The initial income variable yields coefficients ranging from –2.103 to –2.193 with standard errors around 1.745–1.756, pointing toward conditional convergence, though it does not reach statistical significance. Population size also carries negative coefficients, moving from –9.299 in Model 1 to –3.511 in Model 2. The robust F-statistics remain highly stable and meaningful across all specifications—ranging from 6.7558 (Model 1) to 6.8210 (Model 3) with a p-value of 0.0000—confirming the joint statistical significance and consistent explanatory power of the two-way fixed effects specifications. Overall, this sensitivity analysis corroborates that the core findings are robust to alternative model configurations, firmly positioning physical capital accumulation as the primary engine of growth among the selected Latin American economies.

5. DISCUSSION

This research examined the demographic change and growth nexus for seven emerging Latin American nations during 1980–2023 using a Two-Way Fixed Effects model. The model's fixed effects ensure that unobserved institutional, geographical, and historical demographic trends do not bias the results, following established traditions in growth literature to address cross-country heterogeneity. Results show that, as classical economic theory predicts (Solow, 1956), physical capital exerts a positive and significant impact on growth. As the baseline estimate of 8.044 ($p < 0.01$) in Table 5 indicates, physical investments remain the primary determinant of regional growth. This is consistent with recent literature focusing on Latin American savings rates (Stampe et al., 2025). Conversely, idiosyncratic variables, including population size, are statistically insignificant due to the model's emphasis on within-country variation. Because population structures evolve slowly, their explanatory power for short-run fluctuations may be limited. Additionally, the small panel size (n=7) might have affected the power of significance tests when robust standard errors were applied.

The estimation results show that the effect of fertility is positive but statistically insignificant (2.417, $p > 0.10$). Although this positive coefficient might initially appear counterintuitive, it is consistent with the short-run macroeconomic dynamics captured by the two-way fixed effects framework: within a given country, years of relatively higher fertility may coincide with periods of stronger household consumption and broader economic activity, producing a weak positive co-movement with growth rates at the annual frequency. Importantly, this does not contradict the 'demographic dividend' hypothesis, which operates through long-run structural channels — namely, the gradual expansion of the working-age population share following sustained fertility decline — rather than through short-run annual fluctuations. While Bloom and Williamson (1997) note that transitioning to low fertility can free resources for capital accumulation over the longer term, our results suggest that this structural process is not yet detectable within the short-to-medium-term within-country variation emphasized by this specification. The statistical insignificance further reflects the slow-evolving nature of demographic variables, whose effects on growth unfold over decades rather than years and are therefore unlikely to be captured through annual panel variation.

The findings conform to the basic predictions of neoclassical growth models (Solow, 1956), highlighting the paramount importance of productive capacity expansion in Latin American nations. Indeed, Srdelić and Dávila-Fernández (2025) emphasize that the economic potential of demographic transformation can only be realized through capital accumulation and investment. Regarding the age dependency ratio, lnage_dependency yields a consistently negative but statistically insignificant coefficient across all specifications: –7.480 ($p > 0.10$) in the baseline model (Table 5), –7.480 (SE = 6.012) in Table 6 Model 1, and –5.597 (SE = 5.768) in Model 3. While the negative direction aligns with the demographic burden hypothesis — suggesting that a higher share of dependent population constrains productive capacity by diverting resources from investment to consumption (Bloom et al., 2003) — the lack of statistical significance across all frameworks indicates that this effect does not translate into measurable short-to-medium-term growth fluctuations within the two-way fixed effects estimator. This is consistent with Stampe et al. (2025), who suggest that the window of demographic opportunity does not automatically translate into growth without high-density physical capital formation.

A particularly noteworthy and robust result is observed for life expectancy (lnlife_expectancy), which yields large, negative, and statistically significant coefficients across all specifications. In the baseline two-way fixed effects model (Table 5), life expectancy carries a coefficient of –40.278 ($p < 0.01$), and this finding is consistently replicated across all robustness specifications in Table 6, with coefficients of –40.278 (Model 1), –35.294 (Model 2), and –39.199 (Model 3), all significant at the 1% level with stable standard errors around 12.4–12.5. This cross-specification robustness indicates that the negative short-run effect of life expectancy on GDP growth is not an artifact of model choice but a structurally consistent finding. Once country fixed effects absorb time-invariant structural advantages associated with longevity — such as baseline health infrastructure and institutional quality — the residual within-country variation in life expectancy captures a fiscal burden channel: rapid longevity gains generate short-run pressures on public health expenditures and pension systems, temporarily depressing growth. This interpretation is consistent with Weyerstrass and Neck (2013), who document that rising life expectancy generates fiscal pressures regardless of fertility trajectories, and with the broader literature suggesting that the growth benefits of longevity improvements materialize primarily over longer time horizons than those captured by annual panel variation.

Regarding fertility, although Bloom and Williamson (1997) and Bloom et al. (2003) argue that falling fertility frees resources for savings, the evidence (lnfertility = 2.416, $p > 0.10$ in Table 5; –0.033, $p > 0.10$ in Model 2 of Table 6) suggests this effect is currently secondary. In the analyzed region, the demographic dividend is effectively eclipsed by macroeconomic investment factors in the short-to-medium run. While the importance of population structure for growth is well-documented, this study's emphasis on within-country variation provides a crucial disaggregation. Literature examining demographic impacts typically captures them through long-run level variables (Barro, 1991; Mankiw et al., 1992). Due to the inherent nature of Fixed Effects models, demographic variables evolving slowly over time may show less impact on annual growth rates than on structural shifts.

Consequently, our findings indicate that regional growth is more affected by short-run macroeconomic factors than by the long-run social effects of demographic transition. This is corroborated by the substantial capital coefficient, indicating that the 'demographic window' can be transformed into growth only through physical investment. The strategy adopted in prior work on capital formation is to specify the investment rate as the dependent variable and demographic characteristics as explanatory factors (De Gregorio & Lee, 2002).

The overall R-squared of 0.578 indicates that the included variables, fixed effects, and time dummies capture most of the growth process. Our model explains more than half of the variation, even though annual growth is exogenously affected by macroeconomic shocks and global cycles. In panel-based growth literature, high R-squared values are difficult to obtain because growth is stochastic and generated by multidimensional dynamics. Considering the evidence as a whole, growth is more responsive to physical capital accumulation than to direct demographic variables. This implies that while demographic transitions are fundamental preconditions, growth realization is determined by investment rates and the alignment of the working cohort to productive capital.

The main contribution of this paper is empirically showing how demographic changes interact with growth dynamics through both macroeconomic channels and dependency burdens. This is consistent with recent literature stressing population structures for saving behavior

(Stampe et al., 2025). In high-volatility areas like Latin America, the effect of demographic structure is endogenously linked to capital intensity. This suggests that the 'demographic dividend' hinges not just on population makeup, but on the pace at which this transition aligns with physical investment. Using a two-way fixed effects model, this paper focused on internal processes while controlling for unobserved differences. Thus, while population factors change at a glacial pace, their combination with capital accumulation remains a key growth driver. The demographic opportunity window is not a gift, but a potential realized through continuous investment in productive capability.

6. CONCLUSION

Based on the entire sample from 1980 to 2023, we investigate the causal relationship between demographic transition and economic growth in the seven largest Latin American countries. The results consistently demonstrate that physical capital accumulation is the dominant driver of growth in the region. As expected, structural factors such as population size and age dependency ratios carry negative coefficients within the fixed effects specification, but a possible reason for their insignificance in the within-country model is that regional growth dynamics are more sensitive to macroeconomic variables that can be captured more closely by region-level data. This highlights that in the destabilizing environment of Latin America, short-to-medium period changes are driven more by gross capital formation than by slow-changing demographic movements.

The final point of this paper is that the ‘demographic dividend’ is not a sufficient explanation for an economic miracle in the case of Latin American economies. The opportunity for exploitation of the strategic space created by falling dependency ratios must be translated into a sustainable level of output by means of high capital intensity and strong saving mechanisms. With this window of opportunity beginning to close for the region, it is essential that policymakers respond by giving priority to the structural reforms that raise labor productivity and induce financial deepening to mobilize physical investments. Furthermore, the robust negative effect of life expectancy on short-run growth across all specifications underscores that rapidly increasing longevity generates measurable fiscal pressures in the short-to-medium term, highlighting the need for pension and healthcare system reforms to be pursued alongside investment-oriented policies.

For the Latin American context, where the regional environment is particularly unstable, building more dynamic models that account for institutional quality and technological adoption in tandem with foreign direct investment and demographic cycles will be fundamental to both understanding and developing the literature.

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