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IMPACT OF POPULATION AGING ON THE ECONOMIC GROWTH RATE: ANALYSIS AMONG GROUPS OF COUNTRIES MEMBERS OF THE ECLAC AND OECD

IMPACTO DO ENVELHECIMENTO DA POPULAÇÃO NA TAXA DE CRESCIMENTO ECONÔMICO: ANÁLISE ENTRE GRUPOS DE PAÍSES MEMBROS DA CEPAL E DA OCDE

IMPACTO DEL ENVEJECIMIENTO DE LA POBLACIÓN EN LA TASA DE CRECIMIENTO ECONÓMICO: ANÁLISIS ENTRE GRUPOS DE PAÍSES MIEMBROS DE LA CEPAL Y LA OCDE

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Abstract

Objective: to study the impact of population aging on the economic growth rate in ECLAC and OECD member countries.
Methodology: The data sample consisted of 53 countries, 19 from ECLAC and 34 from the OECD, from 2002 to 2014. The research was based in the literature recommendation, which indicates that population aging negatively affects real GDP growth, which is the model dependent variable. The main independent variable will be the proportion of people over 65 years old.
Relevance: Population aging is a worldwide phenomenon. There are many factors, theoretical and empirical, but the literature still lacks information that allows us to understand perfectly how this affects the economic growth of countries. In developed countries, aging has affected the real Gross Domestic Product, but there are signs that it may also be affecting growth in developing countries.
Main results: They indicate that aging has negatively affected growth in developed countries, such as those of the OECD. For those belonging to ECLAC, no statistically significant relationship was detected between the variables. The probable explanation is that these countries still have some demographic bonus, which minimizes the negative impact on economic growth.
Contributions: Increase the debate on the impact of population aging on economic growth and the effects on countries' public finances in this scenario.

Key words: population aging, rate of economic growth, demographic bonus, public finances.

Resumo

Objetivo: estudar o impacto do envelhecimento populacional na taxa de crescimento econômico nos países membros da CEPAL e da OCDE.
Metodologia: Amostra de dados composta por 53 países, 19 da CEPAL e 34 da OCDE, de 2002 a 2014. Pesquisa baseada na recomendação da literatura, que indica que o envelhecimento da população afeta negativamente o crescimento do PIB real, que é a variável dependente do modelo. A principal variável independente será a proporção de pessoas com mais de 65 anos.
Relevância: Envelhecimento populacional é um fenômeno mundial. Existem muitos fatores, teóricos e empíricos, mas a literatura ainda carece de informações que permitam entender perfeitamente como isso afeta o crescimento econômico dos países. Nos desenvolvidos, o envelhecimento afetou o PIB real, mas há sinais de que ele também pode estar afetando o crescimento nos países em desenvolvimento.
Principais resultados: Indicam que o envelhecimento afetou negativamente o crescimento nos países desenvolvidos, como os da OCDE. Para os pertencentes à CEPAL, não foi detectada relação estatisticamente significante entre as variáveis. A provável explicação é que esses países ainda possuem algum bônus demográfico, o que minimiza o impacto negativo no crescimento econômico.
Contribuições: Aumentar o debate sobre o impacto do envelhecimento da população no crescimento econômico e os efeitos nas finanças públicas dos países nesse cenário.

Palavras-chave: envelhecimento populacional, taxa de crescimento econômico, bônus demográfico, finanças públicas.

Resumen

Objetivo: estudiar el impacto del envejecimiento de la poblaciónón en la tasa de crecimiento económico en la OCDE y la CEPAL.
Metodología: La muestra de datos consistió en 53 países, 19 de la CEPAL y 34 de la OCDE, de 2002 a 2014. La investigación indica que el envejecimiento de la población afecta negativamente el crecimiento real del PIB, la variable dependiente del modelo. La principal variable independiente es la proporción de personas mayores de 65 años.
Relevancia: el envejecimiento es un fenómeno mundial. Hay muchos factores, pero la literatura aún carece de información que nos permita comprender perfectamente cómo esto afecta el crecimiento de los países. En los desarrollados, el envejecimiento ha afectado el PIB real, pero hay indicios de que también puede estar afectando en los países en desarrollo.
Resultados principales: el envejecimiento ha afectado negativamente el crecimiento en la OCDE. En la CEPAL, no se detectó una relación estadísticamente significativa entre las variables. Todavía estos países tienen algún bono demográfico, lo que minimiza el impacto negativo en el crecimiento económico.
Contribuciones: Aumentar el debate sobre el impacto del envejecimiento de la población en el crecimiento económico y los efectos sobre las finanzas públicas de los países en este escenario.

Palabras clave: envejecimiento de la población, tasa de crecimiento económico, bonificación demográfica, finanzas públicas.

1. Introduction

The paper aims to point out the impact of population aging on the rate of economic growth. Population aging is a worldwide phenomenon (Tafner & Giambiagi, 2010, Giambiagi, 2017). According to Nagarajan, Teixeira and Silva (2016) there are many factors, theoretical and empirical, that contribute to this phenomenon, but the literature still lacks information that allows us to understand perfectly how it affects the economic growth of nations. The aging of individuals is attributed to two fundamental factors: new techniques available to people for health treatment and reduced fertility rates, which have been observed in developed countries since the 1970s, and, more recently, also in developing countries. Although it is desirable to extend people's lifespan, the issue is worrying, since, once the country has a high elderly population concerning the total population, there is a trend to reduce productivity and savings gaps, which impacts directly on the country's economic growth (Nagarajan et al., 2016).

According to Camarano (2013), population aging can have a negative effect on economic growth, both by reducing the country's productive capacity, by decreasing its economically

active population, but also by increasing government expenditures on public health directed to this population. Still according to Camarano (2014), a decrease in the fertility rate alone does not make the country have an elderly population but if associated with this rate there is a decrease in mortality rate and an increase in life expectancy for the nation's individuals, it is of great importance.

In the case of Brazil, the *Instituto Brasileiro de Geografia e Estatística* [IBGE] (2014), public organization responsible for managing and surveying Brazilian data and statistics, has pointed out the rapid and accentuated aging of the population. It is expected that in 2050 there will be more than three times the number of elderly people, in absolute terms, than currently, as a consequence of the growth ratio of this part of the population (IBGE, 2014). According to Tafner and Giambiagi (2010), it is essential that the concern with the demographic issue be observed, so that appropriate conditions for public spending may occur sustainably. There is a growing concern in many countries, especially Brazil, upon the impact of primary spending on public accounts, especially social security, as the payment of benefits is still directly related to the aging issue and the consequent aging of individuals. As people live longer, the number of beneficiaries is increasing, which has become a problem for countries' economies, for many do not have the corresponding increase in real GDP capable of supporting the increase in public expenditure (Tafner and Giambiagi, 2010).

Brazil, despite being a country belonging to the group of developing countries in Latin America and being relatively young, features public expenditure characteristics of a developed country and has a premature aging population. This situation is not comfortable for the country, which is still developing, with the need to increase GDP and decrease public spending, to balance the country's public budget, because the social security deficit is the main item of primary expenditure in the federal budget (Tafner, 2017).

"As a result of this, in the coming years - which includes the next government period that starts in 2019 - the country will continue to live with two phenomena: a) a significant increase in INSS, expenditures; and b) early retirements, between 50 and 55 years old, which are still very significant" (Tafner, 2017, p.59).

INSS, the *Instituto Nacional do Seguro Social*, is the organization responsible for the payment of pensions and other benefits of Brazilian workers who contribute to social security (insurance that guarantees a pension to the taxpayer when he stops working).

Table 1 shows that expenditures with public pension continued to grow in the years of economic recession much faster than GDP growth. The Organic Law of Social Assistance

(LOAS) originated the Benefit of Continued Provision of Social Assistance (BPC) that replaced the Monthly Lifetime Income (RMV), an endangered benefit, maintained only for those who were already beneficiaries until December 1995.

Table 1 - Real growth in primary federal expenditures, except transfers to states and municipalities (% p.y.)

Component	1994/2015	2016	2017/*
Personal	1,5	-0,6	5,2
INSS + LOAS/RMV	5,2	6,9	5,4
Others (except LOAS/RMV)	5,8	-11,1	-3,9
Total	4,3	-1,5	2,1
GDP	2,7	-3,5*	0,5

* Authors' estimate
source: Tafner (2017, p. 59)

2. Theoretical Reference

2.1. Factors and Trends in Population Aging in the World

Population aging in developed countries may have broad economic implications (Berk & Weil, 2015). Still, the twentieth century has been marked in the large part by a present expansion in living standards in much of the world, as it has kept pace with changes in the world's population (Fernald & Jones, 2014).

The demographic issue has been studied for years as a fundamental element in the development of a nation. In the 1860s, life expectancy at birth in Stockholm was just 28 years and 45 years for Sweden as a whole (Giambiagi, 2017). Currently, it is known that Scandinavian countries have one of the highest life expectancy in the world and the demographic landscape has changed significantly since then. It is observed that population aging is a worldwide, gradual phenomenon and has been noticed in several nations on the planet, both developed and developing ones (Giambiagi, 2017). This tendency to longevity comes from two simultaneous effects: advances with techniques that prolong the health and well-being of the individual in the so-called third age and the paradigm shift in the behavior and understanding of women about motherhood, number of children and participation in the labor market (Nagarajan et al., 2016, Giambiagi, 2017).

According to Maestas, Mullen and Powell (2016), the aging of the population has been widely accepted as a harmful factor to economic growth, although there is still no conclusive

empirical evidence on the extent of its effects on countries populations, especially in developing ones.

Barro (1996) states that the growth rate of an economy may increase due to higher schooling and life expectancy at birth, decreased fertility and government spending, maintenance with improvements in the democratic rule of law and controlled inflation. According to the author, these factors conjoint allow an improvement in the population's standard of living, and, for certain values of these variables, that growth may be negative according to the initial level of real GDP per capita. Although growth is stimulated by the coefficient mentioned above, Barro (1996) believes that in nations that have lived through extreme dictatorships and still experience low levels of growth, the expansion of political rights at first provides an increase in growth. However, once democracy is achieved, this increase in rights can reduce economic growth, given the growing concern about social programs and income redistribution that accompany the democratized nations. Additionally, maintaining investments in infrastructure, spending on research and development, education quality and expansion of the technological frontier will be major factors in the distribution of income and wealth among the population.

According to Bloom and Finlay (2009), growth performance in East Asia from 1965 to 1990 occurred due to several factors such as free trade, high savings rates, accumulation of human capital and changes in macroeconomic policy. However, according to the authors, these factors were only partly responsible for the growth performance at the time. The demographic issue, which had not yet been studied by countries, was an absent factor in understanding the region's growth. Beginning in 1990, major economic reforms took place in East Asia in response to financial crises.

For Bloom and Finlay (2009), Asian countries acted on policies to compensate for the possible negative effects of aging populations in the future ahead. In this context, behavioral changes occurred due to the expansion of female participation in the workforce, made possible by the decrease in the fertility rate. Savings increased with the increase in life expectancy, which allowed the accumulation of physical and human capital and technological advancement (Bloom & Finlay, 2009).

In East Asia, according to the study by Bloom and Finlay (2009) there was a constant increase in life expectancy. As a result, the researchers believe that increasing the age limit and decreasing the incentives to retire can increase the participation of individuals over 65 in the economically active population. There may also be an increase in the workforce if the

government of the countries reduces the demands of immigration policies, which would be innovative in the region (Bloom & Finlay, 2009).

In the research by Maestas et al. (2016) the period of 1980 - 2010 were analyzed to measure the impact of an aging population on the US per capita production. It was noticed that increases of 10% in the population over 60 years brought a decrease in the growth rate of GDP per capita by 5.5%. Still, according to Maestas et al. (2016), the significant change in the North American age pyramid highlights the potential to impact the behavior of the economy as a whole, as well as the sustainability of government programs, which will result in a decline in consumption in families, companies and the government. The authors (Maestas et al., 2016) note that, although the potential macroeconomic and fiscal effects of population aging are widely perceived and many predictions have been made on economic performance, there are still few empirical studies of the observed consequences of aging on economic growth.

This knowledge gap has been highlighted by several authors (Nagarajan et al., 2016, Maestas et al., 2016), and, although countries have instruments to predict the demographic changes that are occurring in the world, it is not at all possible to foresee and predetermine the essential economic adjustments for families, businesses and governments.

According to Maestas et al. (2016), it is difficult to predict the direction of the development of the economy without making conjectures and adjustments that can diminish or aggravate the implications of predicted changes in demography, as it is also complex to assess how the government's political interference should be to minimize the macroeconomic effects and fiscal aspects of the aging of individuals in society. Also according to Maestas et al. (2016), his research sought to answer whether the aging of individuals can influence the consumption patterns of a given society, for it was realized that in the 1980s the changes in the age structure of the American population were due much more to changes in the rates of fertility and mortality than the population's behavior.

The study by Maestas et al. (2016) estimated that for the decades of 2020 and 2030, economic growth will slow down by around 0.68% and 1.28%, respectively. However, from the year 2030 to 2050, the elderly population will grow by only 2%, in contrast to the study by the National Research Council (2012) which predicts a decrease in GDP growth per capita of 0.33 to 0.55% in relation to the growth forecast with a long-term rate of GDP per capita of 1.88%. The difference between positions is that the National Research Council believes aging will influence the population's workforce growth and not its productivity. For the authors, there

is a similarity between positions, for they believe that the impact of population aging on the growth of the economically active population is related to the estimates of the effects on the aging of individuals (Maestas et al., 2016).

Finally, despite the estimates made by Maestas et al. (2016), the authors understood that there are still not enough studies to predict greater effects of the aging of the American population on per capita income and economic growth for the next decades, without taking into account productivity, improvements in capital and how the older workforce can affect the productivity of the younger workforce. According to the aforementioned authors, these issues need to be deepened and should be considered as part of the federal tax policy in the USA to face the magnitude of the changes that have occurred in the country's age structure.

2.2. Effects of Population Aging in Brazil

IBGE (2014) confirms that aging is a worldwide phenomenon, notably in developed countries, where the demographic transition has been completed but has also been occurring in developing countries. Brazil is running out of its demographic bonus, the period in which the economically active population is larger than the unproductive population, which according to forecasts by the World Health Organization [WHO] (2015), will occur around the year 2025. The so-called demographic bonus is when the population's growth of a given region is associated with its demographic rates. It translates into the relationship between life expectancy, birth and death rates. By decreasing the mortality rate life expectancy increased and brought an increase in the index of the working-age population, indicating an improvement in the quality of life. Thus, there was a demographic transition: change in the age structure of the population with the expansion of the young adult group, from 15 to 64 years old, concerning inactive people (Alves, Vasconcelos & Alves de Carvalho, 2010). A study by Costanzi and Ansiliero (2017) showed that after the year 2060 Brazil will have more than ten million people in its population over 55 years of age. This may impact Social Security expenditure by around 19.3% of GDP and increase the negative effects on Social Security results in medium and long terms.

Research on the aging of the Brazilian age pyramid (Giambiagi & Tafner, 2010) has shown that the decrease in the proportion of the economically active population concerning the PEA takes place decade after decade. The WHO projects that by the year 2025, Brazil will appear in sixth place in the world’s ranking of elderly individuals (UN, 2018). Although relatively young, the country is aging rapidly, as projected by the United Nations [UN] (2018) and IBGE (2014).

Camarano (2014), in his collection on the demographic issue, exhaustively discusses several aspects of the increase in the elderly population in Brazil, which necessarily goes through the tendency to premature aging of the population and impacts development in the country. The author notes that the aging of the population has grown on the one hand, and on the other, the economically active population has decreased, with a reduction in the country's productive capacity.

It is observed that the population in several countries has been increasing in the middle and median ages. According to Giambiagi (2017), the median ages of Brazil and Uruguay in 2010 are similar to that of the United States in 1980. This means that in 30 years, Brazil as of 2010, may have the same proportion of elderly people as the USA.

As a result of this phenomenon, public spending on this population has increased in Brazil, which hindered the development of public policies, for there is not enough space for public investment. The gap between the growth rates of the population over 60 years of age and the population at working age widens more and more, which illustrates a strong trend towards population aging in Brazil (Tafner, 2017).

According to Tafner, Botelho and Erbisti (2015), the theme is widely known by Brazilian governments, but nothing is done to adjust public accounts in response to the important demographic changes that have occurred. There are problems in the labor market, due to incipient investments in the economy, which is not growing at sufficient levels to withstand the pressure on public debt.

According to Costanzi and Ansiliero (2017), the population aging process may put pressure on Social Security expenditures. There is a need to think of solutions to correct this issue and allow people to remain in the labor market before they become retired, enjoying pension benefits and retirement (Tafner, 2017).

Tafner (2017) points out that as the growth rate of the Brazilian population over 60 grows close to 4% per year, it is permissible, by proxy, to assume that there will be a considerable expansion in the number of retirees. Thus, Social Security expenditure has been pressured by the following factors: the number of beneficiaries and their relative value, and Brazilian legislation, which still allows early access to the granting of benefits.

Two factors are preponderant in Brazilian aging: health actions and disease prevention practiced by governments for decades. As a result, life expectancy has increased (Veras, 2018). In this case, access to health through health plans and new technologies has been the alternative

for this portion of individuals. Given these facts, the concern with public spending, such as health, is relevant for both the government and the population. For Marinho, Cardoso and Almeida (2014) there is a positive association between health consumption, the elderly and life expectancy at birth. And this relation needs to be rethought in Brazil due to two phenomena: relevant growth in INSS expenditures and early retirements, in the 50 to 55 age brackets, which can still be seen in the country (Tafner, 2017).

Based on the review of the presented literature, the proposed arguments and the identification of the problem of population aging the following hypotheses were formulated:

Hypothesis 1: Population aging has a negative effect on the economic growth of underdeveloped and developed countries.

Hypothesis 2a: Population aging has a negative effect on economic growth in OECD countries.

Hypothesis 2b: Population aging has a negative effect on economic growth in ECLAC countries.

3. Methodology

3.1. Template

The research was based on the literature recommendation, which indicates that population aging impacts negatively the growth of the real Gross Domestic Product (Nagarajan et al., 2016), which is the model-dependent variable. The main independent variable will be the proportion of people over 65, the aging population. The sample of data was composed of 53 countries: 19 belonging to ECLAC and 34 to OECD. The period studied was from 2002 to 2014; and the data was collected on the OECD and ECLAC websites (http://data.oecd.org and https://www.ECLAC.org, respectively). Brazil is part of the ECLAC group of countries. Firstly, the population aging variable (*popid*) was tested, without considering which group the country belonged to, ECLAC or OECD - Hypothesis 1.

To improve the tests, binary variables (dummies) were added. If *popid* negatively influences growth in OECD countries, the test was performed with 1 for OECD, 0 for ECLAC. In the hypothesis that ECLAC countries had their growth negatively influenced by *popid*, 1 was tested for ECLAC, 0 for OECD. In all tests, the objective was to identify the relation between economic growth and an aging population. To test H1, Model 1 was estimated: $cresc = \beta 0 + \beta 1$ *popid* + Controls + ε (1). In this model, $\beta 1$ (population aging) is believed to negatively influence economic growth in all panel countries (OECD + ECLAC). In hypothesis 1, the model may or

may not confirm the impact of population aging on economic growth as indicated in previous studies.

In addition to the control variables, in a second step, binary variables (dummies) were added to test the relation between growth and aging and to confirm or not hypotheses 2a and 2b, namely:

Model 2a: $cresc = \beta 0 + \beta 1\ popid\_oecd + Controls + \varepsilon$ (2)

Model 2b: $cresc = \beta 0 + \beta 1\ popid\_eclac + Controls + \varepsilon$ (3)

In hypothesis 2a, the model confirms the negative impact of population aging on economic growth in OECD countries, as diagnosed by previous studies. In hypothesis 2b, the model would also confirm the negative influence on economic growth in the countries belonging to ECLAC. It should be noted that Brazil belongs to the ECLAC group of countries in the studied model, despite having public expenditure concerning GDP growth compatible with developed countries.

The models were run on a panel with fixed effects as recommended by the literature (Mankiw, 2015) since the data refers to the total population and not to a sample of countries. Control variables used were lack of security, excessive bureaucracy and level of education. Panels A, B, and C were prepared with the fixed effects regression models:

Panel A - Explanatory variable *Popid* + controls

Panel B - Explanatory variable *popid*_oecd + controls

Panel C - Explanatory variable *Popid*_eclac + controls

3.2. Variables of Interest

According to Berk and Weil (2015) there is a vintage effect of aging on populations. It means that as workers age, technology accompanies this decline since the education of this human capital occurred in the past and mirrors the aging of a given society.

Berk and Weil (2015) expose a second effect of aging that is linked to the knowledge of the teachers who transmit it. According to the author, these preceptors print less current information, which can mean a technological delay in the workforce. There would be a need for continuous technological updating on the part of workers in general, and especially of teachers, the first transmitters of knowledge and responsible for maintaining the latest technology.

In the model studied, the dependent variable is economic *growth* and the explanatory variable (of interest), population aging, hereinafter referred to as *popid*, from OECD and ECLAC countries. Binary variables (dummies) were added to the data to estimate the relation between growth and aging.

3.3. Control Variables

Control variables were also inserted in the model. According to the literature, these variables may or may not be associated with the explained variable. For the studied sample, the individual's initial education level, life expectancy at birth, birth rate, lower public expenditure, democratic rule-of-law state, inflation under control, and improvements in commercial activities were used as controls (Barro, 1996).

Jones (2002) suggests that economic growth can be controlled by the country's level of technological development as the percentage of workers, scientists and engineers involved in research and development increases. This would cause growth counting the increase of the stock of ideas, favorable to the continuous development of the economy. In this way, the spirit of global research would be the motivator for improving the economic performance of each nation.

Thus, the control variables that added the necessary information to the study of the impact of aging on the real GDP growth of the countries will be described in this part. To limit the influence of outliers on the model, its range in the modeling was tested, variables were winsorized.

Public security (lack of public security), had its data extracted from the World Development Indicators [WDI] (2016), such as the number of intentional homicides per 100,000 (one hundred thousand) inhabitants of a given region. According to that institution, intentional homicides are those that result from domestic, interpersonal violence, armed conflicts over land resources, gangs and armed groups.

The *Gini* variable is the Gini coefficient found through data from WDI (2016) to measure the degree of concentration of income between individuals or families within an economy. When the Gini coefficient is equal to 0 (zero) there is perfect equality, this way, the people or groups of that region have the same income, while the index that equals to 100 (one hundred) shows total inequality, meaning the wealth concentrated in the hands of a single individual (Samuelson & Nordhaus, 2005)

The education variable of the workforce, named *workforce schooling*, is defined by the WDI (2016) as the percentage of the population that completed primary education as the highest

level of education. In the model, it was observed that the population of OECD countries has a level of education far beyond elementary education, with very small percentages of the population with only that level, unlike ECLAC countries, where that same level is much higher since the variable is measuring the minimum, elementary education. Thus, it is clear that the schooling of the workforce in OECD countries is much higher.

The *corruption* variable concerns the perception of corruption by specialists and entrepreneurs and is measured by the Corruption Perception Index (IPC), prepared by Transparency International (2016). Thus, the perceived levels of corruption in a country's public sector are based on observations between different groups of professionals. The index ranged on a scale from 0 to 10, with 0 (zero) for countries with very high perceived corruption and 10 (ten) for countries with very low perceived levels of corruption. In the model, control variables were inserted that refers to the countries' way of doing business. They are called procedure, time, cost and minimum paid-in capital. The data used in the model were collected from the Doing Business Database (2016) and relate to opening companies for professionals who want to open a business.

The *procedure* variable means the number of procedural (bureaucratic) steps that the owners of the investment need to do with government agencies, professionals or notaries to complete the opening of a business.

The *time* variable is based on the average duration that government agencies, professionals and notaries instruct the company owner to complete the procedural steps related to the registration of a business. The economic growth of nations can be directly impacted by the time involved in the bureaucracy of opening a business. Depending on the country, it may take twice as long to complete the bureaucracy.

In the model, the *cost* variable includes all official expenditures based on professional services and taxes required by the bureaucracy to complete the opening of a business. The variable indicates a percentage of the per capita income of the country's economy, as a way of recording its value.

The variable minimum paid-in capital, named *minimum capital*, is the minimum amount that the business owner needs to spend to deposit in a financial institution or notary, to pay in the firm's share capital. In general, each nation's trade law specifies the amount of that deposit. Like the cost variable, the minimum capital is a percentage of the per capita income of the country's economy.

4. Results Analysis

4.1. Descriptive statistics

This section describes the averages of the variables in the analyzed sample, to compare the countries belonging to the OECD and ECLAC country groups.

Table 2: Descriptive statistics with the averages of the variables analyzed from oecd and eclac member countries

	OECD		ECLAC			
Variables	**Average**	**Standard deviation**	**Average**	**Standard deviation**	**Difference**	**P value**
Growth	2,21	2,64	4,02	3,09	1,81	0,0000***
Popid	14,29	4,04	8,09	3,89	-6,20	0,0000***
Corruption	20,41	25,67	11,29	15,51	-9,12	0,0000***
Public Security	3,53	7,24	21,29	16,07	17,77	0,0000***
Procedure	6,50	3,28	10,42	3,44	3,92	0,0000***
Time	21,05	21,96	43,76	27,80	22,71	0,0000***
Cost	7,23	7,48	33,85	24,91	26,62	0,0000***
Minimum capital	20,38	25,27	12,12	23,79	-8,27	0,0002***
Workforce schooling	23,81	14,99	36,05	15,18	12,24	0,0000***
Gini	34,64	8,43	48,79	6,79	14,16	0,0000***
Popid ECLAC	0,00	0,00	8,09	3,89	8,09	0,0000***
Popid OECD	14,29	4,04	0,00	0,00	14,29	0,0000***

Significant: *p<0,10, **p< 0,05, ***p< 0,01
Source: Elaborated by the author

Table 2 shows the average, the standard deviation, the difference in the averages and the p-value of the variables that affect economic growth in OECD and ECLAC countries.

ECLAC countries have grown more than OECD countries. Cardoso (2013) comments that this scenario is probably the result of the international commodity boom that occurred between 2003 and 2010, which would have mitigated the impact of population aging on growth. The *popid* variable indicates an older population in OECD countries, while the ECLAC group of countries indicate that the population is generally younger.

Regarding the variable lack of security, it is clear that this is a more serious problem in countries belonging to the ECLAC group. This difference shows that ECLAC countries probably have a lower level of social capital, which may indicate a profile that is less consistent with good practice in organizational cultures, with a tendency to practice obscure business and, consequently, a higher crime rate. This factor can negatively influence the economic growth of the countries mentioned (Reis, 2016).

The education variable indicates that education in OECD countries tends to be better than in ECLAC countries, as this variable indicates the percentage of individuals who have completed elementary school as the highest level of education. The higher rate at ECLAC means that schooling in these countries is worse than in OECD countries, as the education offered in OECD countries is of a better quality, and thus enables individuals to be better qualified for the labor market than those in the ECLAC group.

Regarding the Gini coefficient, a higher average of income concentration is perceived in the countries of the ECLAC group. A higher concentration of income indicates that wealth is not evenly distributed across the country, and there is greater income inequality in ECLAC countries compared to OECD countries. The effect of this variable on growth is uncertain since inequality can be positive or negative for economic growth (Reis, 2016).

The variables procedure, cost, time and minimum paid-in capital relate to the bureaucracy to open a business. When comparing the tables between the two groups of countries, differences are observed. In the ECLAC group procedure (quantity), cost, time (days) and minimum capital to open a business are, on average, 10.42; 33.85%, 43.76 days and 12.12%, respectively. In the OECD group, the same results are on average 6.50; 7.23%; 21.05 days and 20.38%, respectively. It can be seen, therefore, that on average the values in ECLAC are higher than in the OECD countries. Thus, there is a greater complexity to open a business in ECLAC countries, due to excessive bureaucratization that compromises business and the performance of institutions in those nations.

Regarding the corruption variable, in the countries of the two groups, the level of perception of the level of corruption was measured. On average, in countries belonging to ECLAC (11,29) the perception is lower than in OECD countries (20,41), which probably suggests that in the latter, people are more aware of the presence and the negative effects of corruption. Too much bureaucracy created by official institutions harms business and contributes to a worse perception in ECLAC countries, unlike OECD countries. The socio-political environment fails to be attractive, effective and efficient, and translates into lower economic growth, affects the economy, threatening investments and reducing productivity (Reis, 2016).

4.2. Results

The results of the research were found by the analysis of multiple linear regressions. The independent variable *popid* was considered in one model (A) and the other two models (B) and (C), *popid* associated with the OECD binary variables (dummy) and the ECLAC dummy, respectively.

It can be seen that the OECD countries are having economic growth negatively impacted, since population aging is a reality in these countries, while in the ECLAC group of countries this situation has not yet materialized, either because the nations still have demographic bonuses to enjoy, either because there is also the positive result of commodities (Cardoso, 2013).

However, it was not possible to obtain all the information on the control variables during the analyzed period, with the loss of some observations. So, to resolve this issue, the same model with more than one specification was used to achieve a greater number of observations and allow greater robustness to the results.

With this, the models used in this study made it possible to ascertain the effect of population aging on economic growth in OECD and ECLAC member countries, observing the internal characteristics of each analyzed country.

Next, in Tables 3 and 4, the panels show the results of the effect of population aging on the economic growth of countries belonging to the OECD and ECLAC and their relation with all control variables (public security, Gini coefficient, schooling of the workforce, corruption, and the doing business variables: procedure, time, cost and paid-in minimum capital).

Note that the averages of the variables corruption, lack of security, education of the workforce, corruption and bureaucracy to start a business are not determinants to influence the negative growth in OECD countries. Except for the time variables, which are significant in two panels (A and B) of the regression model, and the variable paid-in minimum capital, with significance in panel B, the influence occurs by population aging (*popid*), combined in both groups of countries (panel A), and associated with the OECD binary variable (dummy) (panel B), which does not occur when submitted to the ECLAC dummy (panel C).

Table 3: result of the estimate of the hypothesis regression model 1
This table presents results about the estimation of the model: *growth = β0+ β1 popid + Controls + ε*

PANEL A - Results of the effects of the joint model with the control variables of the countries belonging to ECLAC and OECD.

VARIABLES	Coefficient	P Value
Popid	-1,1871	0,007***
Corruption	-0,0014	0,901
Public Security	0,01303	0,949
Workforce schooling	0,01804	0,691
Gini	-0,05301	0,697
Procedure	-0,08786	0,669
Time	0,04912	0,015**
Cost	0,02632	0,687
Minimum capital	0,01577	0,170
Constant	20,10	0,017**
Nº OBS	236	
R²	0,4062	

Significant: *p<0,10, **p< 0,05, ***p< 0,01
Source: Elaborated by the author

Table 4: Result of the estimate of the hypothesis regression model 2a and 2b
This table presents results about the estimation of the model: Model 2a: *growth = β0+ β1 popid_oecd + Controls + ε* e Model 2b: *growth = β0+ β1 popid_eclac + Controls + ε*

PANEL B - Results of the model's effects with the control variables of OECD countries.

VARIABLES	Coefficient	P Value
Popid_OECD	-1,1302	0,020**
Corruption	0,00003	0,998
Public security	-0,0608	0,830
Workforce schooling	0,01712	0,832
Gini	-0,00024	0,999
Procedure	-0,0831	0,697
Time	0,0403	0,024**
Cost	0,0887	0,235
Minimum capital	0,0234	0,091*
Constant	17,51	0,075*
Nº OBS	213	
R²	0,4785	

Significant: *p<0,10, **p< 0,05, ***p< 0,01
Source: Elaborated by the author

PANEL C - Results of the effects of the model with the control variables of the countries belonging to ECLAC.

VARIABLES	Coefficient	P Value
Popid_ECLAC	2,6236	0,567
Corruption	-0,0468	0,697
Public security	-0,0346	0,367
Workforce schooling	-0,0486	0,511
Gini	-0,0560	0,896
Procedure	-1,4611	0,486
Time	0,0854	0,351
Cost	0,0881	0,808
Minimum capital	0,0202	0,501
Constant	-4,59	0,932
Nº OBS	23	
R^2	0,2669	

Significant: *p<0,10, **p< 0,05, ***p< 0,01

Source: Elaborated by the author

4.2.1. Effect of joint population aging in OECD and ECLAC countries

In Table 3, in the *popid*-only scenario, the results indicate that population aging is negatively and significantly related to the 1% level with the economic growth of the countries analyzed. When we study only the least developed countries (table 4), however, we do not detect this effect (the variable is not statistically significant), which indicates that they are not yet significantly affected by population aging. The table below summarizes the results:

Table 5: Results

HYPOTHESES	RESULTS
Hypothesis 1: Population aging has a negative effect on the economic growth of underdeveloped and developed countries. - With effect	
Hypothesis 2a: Population aging has a negative effect on economic growth in OECD countries. - With effect	
Hypothesis 2b: Population aging has a negative effect on economic growth in ECLAC countries. - No effect	

Source: Elaborated by the author

5. Conclusions

In this study, the interpretation of the relation between the aging of individuals, their relationship with economic growth and how it affects the development of nations was pursued. Previous studies are not yet conclusive on the subject.

This research showed that in a scenario of world population aging, without distinguishing which group of countries a particular nation would be related to, the effect is negative and significant on the growth of the economy.

When a distinction is made between the underdeveloped and developed country groups, the population aging variable showed another behavior. Regarding the ECLAC group, there still hasn't been a negative effect on economic growth in these countries.

However, in the OECD group the results revealed a negative and significant effect of the aging of individuals and their influence on the GDP growth of these countries.

The period studied, 2002 to 2014, was a limitation of the research, for more time is needed to identify changes in the population pyramid. To deepen research on the impact of aging on real GDP growth, it would be interesting to study the behavior of spending on public accounts such as pensions, health and economic crises, which are very important factors in the growth versus aging relation. Thus, given the limitation found in this study, for future research it will be interesting to carry out studies that include more developing countries and other continents, over a longer period, to verify whether the future results will have significant changes or if they will seem as those found in this study.

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