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Factors Influence on Changes of Population Growth in Sri Lanka: From 1970 to 2019

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ABSTRACT

This research held in Sri Lanka since the population growth has changed during 1970 – 2019 period due to various factors. Factors influence on changes of population growth rate in any country is caused to create social and economic problems. Then, if it has changed what factors are influencing, should be studied. Therefore, this research aims to identify the reasonable factors behind the changes in Sri Lankan population growth rate through around a half-century. Secondary data from the Department of Census and Statistics (DCS) and annual data from 1970 to 2019 from official websites of the United Nations were used for the main analysis. Data processing and analysis were performed by using descriptive-quantitative method and multiple regression analysis. The result of this research indicates that changes of population growth rate in Sri Lanka is significantly affected by crude birth rate, crude death rate and infant mortality rate. The multiple regression analysis had fitted a good model that explains 95.5 percent of total variability of the population growth rate. The findings show that the decline of the population growth rate was highly influenced by the decline of the crude birth rate. Therefore, the researcher recommends that Sri Lankan government should take an action to aware of the people to increasing the fertility rate of Sri Lanka. It should be implemented awareness programs related to fertility and reproductive health among both males and females in reproductive age groups and make policies to re-structure the education system in Sri Lanka.

KEYWORDS*: Factors Influence, Population growth rate, Crude birth rate, Crude death rate, Infant mortality rate*

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1 INTRODUCTION

One of the most important branches of the social sciences discipline is population studies. Especially among developing countries are concerned, Sri Lanka also has controlled the population using different strategies. Thus, maintenance of population in the country has become important as a major factor influencing the economic and social development of the country. Identifying the nature of the population and understanding the population variability over time is essential for planning development plans and formatting political and government policies. Ministry of Foreign Affairs Sri Lanka, Department of Census and Statistics, Registrar General Department, Central Bank of Sri Lanka are some of the main local institutions which provide the information related to population statistics in Sri Lanka. As a developing country, the Department of Census and Statistics conducts a national census every ten years.

In the population study, mainly focuses on the nature and variation of the human population. In considering the term "Population", it can be described as the whole number of people occupying an area, such as a country or the world, and also it is continually being modified through changes within a specific period. Above mentioned modifications are measured by using various measurements. Under that situation, the growth of the population is measured and expressed by using the population growth rate. Among those measurements, this research aims to study the changes in population.

In studying the Sri Lankan population growth have to observe and study the main region where Sri Lanka is located. South Asia is a subregion of the Asian continent. As a part of the Asian continent, South Asia had a high population growth rate. According to the World Bank Development Index compiled from officially recognized sources, South Asia's population growth (annual%) by 2020 was recorded at 1.1497%. The following table indicates the population growth rates in South Asian countries.

Table 1: Annual Population Growth Rate (PGR) of South Asian Countries

Country	PGR (%)
Afghanistan	2.34
Pakistan	1.45
Nepal	1.24
India	1.19
Bhutan	1.09
Bangladesh	1.05
Sri Lanka	0.80
Maldives	-0.07

Source: World Bank Annual Report, 2019

Before the 19th century, Sri Lankan population growth was very rapid but after the 19th century, it has declined. According to the existing data, population growth rates can be stated as 2.376, 1.858, 1.418, 0.817, 0.811, and 0.612 respectively 1965, 1975, 1985, 1995, 2005 and 219 (United Nations 2022). According to the data included in the Department of Census and Statistics publication, in hundred years Sri Lankan population had increased by 430%, the mean rate of the increase is about 18.3% per decennium. The mean rate of increase during the first fifty years had been 13.5% per decennium as against 23.2% in the second half of the century. The average annual intercensal rate of growth never exceed 2 percent until 1946. The annual increase was rapidly continued after the Second World War with the declining mortality and the high level of fertility. Due to the occurred changes in fertility, mortality, and international migration levels, the population growth in Sri Lanka had changed (De Silva 2012). Since the first census of 1871, the Sri Lankan population had grown eight times. In 1871 the population was 2.4 million, it had increased to 20 million in 2010. However, the current population growth of Sri Lanka is low. Changing of the population growth of the country is not uniform. The population of Sri Lanka could attain its peak by

2031 with a size of 21.1 million (De Silva 2007). Furthermore, De Silva, revealed that, the population growth would reach to zero from 2021 to 2036 then the total population size could be around 21 million (United Nations 2022). In this review, the Sri Lankan population was expected to reach 21.41 million at the end of the 20th century. According to the current population projections after the decline of the growth, the population would reach its peak around 2037 at 22.19 million. Since 2000 Sri Lankan population growth had been below 1.00%. From 2019 to 2020 the population had grown by 0.42%. In 1946 the population aged under 15 years was 37% of the total population, it had increased to 42% in 1963 and decline to 31% in 1991 (Abeykoon 2011). Sri Lanka had managed the lowest fertility among the other South Asian countries (Abeykoon 2011). To maintain that lowest fertility Sri Lanka had followed some population policies in controlling fertility. By considering the time between 1980 and 2015, the changing of population growth of Sri Lanka was not uniform and it was indicated an irregular behavior (Kumarasinghe & Wickramasinghe 2018). It says that the Sri Lankan population had increased from 14.8 million to 20.4 million within the period of thirty years. Further, it mentioned that with time the elderly population had been increased. It had been proven by using data collected from the Department of Census and Statistics as in 1980 the percentage of the elderly population was 6.6% and in 2012 it was 12.4% (Department of Census and Statistics 2014).

After studying the population growth, it should be found out the factors that determine the population growth. The population growth depends on fertility, mortality, and net migration. Therefore, basically these components can be considered as population growth factors. However, there were a lot of indirect factors behind the population growth. Fertility can simply be defined as the number of live births generated by a woman or a group of women within her or their reproductive period. It always differs from the childbearing capacity of a woman which is identified as fecundity. According to the normal behavior of fertility, it is always less than the childbearing capacity of women or fecundity. There were many reasons behind this matter. They may be related to economic, social, cultural, attitudinal, or some other aspects.

Mortality is one of the three main parameters determining the population growth of a country or a region. Mortality is a geographic phenomenon changing from place to place and it is some kind of phrase changing from time to time. Mortality means deaths occurring in a population. It is defined as the permanent disappearance of all forms of life at any time after birth. Migration is also one of the important population parameters which are used to calculate population growth. Net migration which is identified as the difference between immigration and emigration is used to calculate the size and the growth of the population of a given country or a region. Even though migration had different interpretations it can be defined as a permanent change of the usual residence of a person or a group of people (Lee 2009; Manel 2018).

When it comes to Sri Lanka, fertility had increased rapidly due to some reasons as the development of health facilities and social factors and the decline of maternal and infant mortality rates (De Silva et al. 2010). According to the 2006/07 Sri Lankan Demographic and Health Survey and the 2012 census report the total fertility had slightly increased to 2.3 and 2.4, respectively (De Silva et al. 2010). However, during the period from 1963 to 1970 the fertility rate had been declined due to the changes in the proportion of women marrying and fertility reduction. During the last five decades with the development of educational level and per capita income high fertility had become low (Abeykoon 2011). The total fertility rate also had declined from 5.32 children per woman in 1953 to 3.45 in 1981,

dropping further to 2.26 during the 1988-93 period and to a further 1.96 in 1995-2000 (De Silva 2007). In the 1950s and 1960s, the fertility level of Sri Lanka was at a high level with a Total Fertility Rate (TFR) of 5.3. However, by 1994 the replacement level of fertility had been reached as TFR had decreased to 2.1 children per woman and the decline continued. The DHS 2000 reported a TFR of 1.9 children per woman (De Silva et al. 2010). Taking these facts into consideration, the current research was concluded to find out statistically the significant factors for the changes of population growth in Sri Lanka.

2 MATERIALS AND METHODS

To identify how the population growth rate has changed over time, data from 1970 to 2019 were collected. The, focus was on the factors behind the changes of population growth of Sri Lanka over time.

2.1 Data

Mainly, the reports of the national census were chosen to collect the relevant data. However, begins a still-developing country, Sri Lanka conducts a census every ten years. Under that situation to collect data regarding the period from 1970 to 2019 have only four census reports. Especially, the annual type of data was considered. They were collected from the official website of the World Bank and also the United Nation population prospect in 2019. Only population data from 1970 to 2019 were used. The population data after 2019 are not available from both sources - Department of Census and Statistics and United Nations Population Prospectus.

2.2 Study Area

The study area includes the whole country. As in figure 1 indicates, there are 9 provinces and 25 districts in Sri Lanka. According to World bank data in 2019 Sri Lanka's total population has become 21.8 million. The Western province (28.7%) has the highest record of population while the Northern Province recorded the lowest value (5.21%) (Census report 2012).

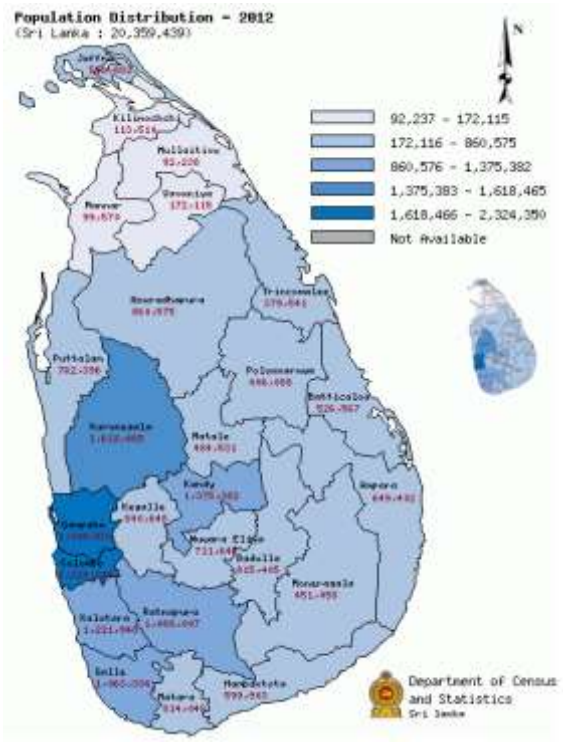

Figure 1: Map of Sri Lanka

Source: Department of Census and Statistics, 2012

2.3 Method of Data Analysis

To achieve the target objectives the collected data were analyzed by using both descriptive and parametric statistical analyzing methods. Data has been tabulated and displayed as graphs to give a clear picture of the studied data. A regression analysis has been applied to identify the factors behind the changes of population growth rate in Sri Lanka. These analyses were done by using statistical software called SPSS.

Regression analysis

Multiple linear regression analysis was done using one dependent variable and five independent variables. The dependent variable and all independent variables of the regression analysis were shown in the table 2.

Table 2: Measuring variables

The dependent variable	The independent variables
The annual population growth rate	The annual crude birth rate of Sri Lanka The annual crude death rate of Sri Lanka The annual infant mortality rate of Sri Lanka The annual GDP growth rate of Sri Lanka The annual inflation rate of Sri Lanka

Further, there were two main categories of the factors as direct and indirect factors which are affected on the changing of population growth rate. The Figure 2 provides a clear picture of the relationship between dependent and independent variables showing the direct and indirect factors.

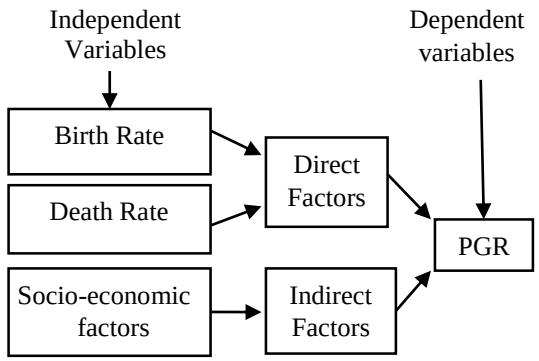

Figure 2: Conceptual Framework
Source: Compiled by the researcher, 2022

3 RESULTS AND DISCUSSION

3.1 Summary measures of Population growth rate

The average values for population growth rate are 1.12 percent in terms of mean and 0.9 percent in terms of the median. The average level of the population growth rate is 1.12 percent with an average dispersion level of 0.53 percent. The median level of the population growth rate is 0.9 percent with an average dispersion (interquartile range) level of 0.85 percent. The following figure shows that the population growth rate has been gradually decreased from 1970 to 2019.

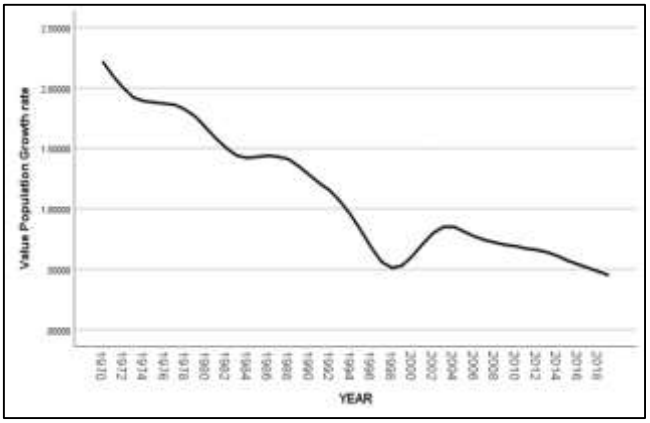

Figure 3: Behavior of Population Growth Rate
Source: Department of Census and Statistics (DCS), 1970-2019

In considering independent variables, the crude birth rate of Sri Lanka during the period of 1970 to 2019 was gradually decreased. It is indicated through from the following summary measures and the figure 3.

The average values for crude birth rate are 21.6126 (22 births per 1000 people) in terms of mean and 19.3990 (19 births per 1000 people) in terms of the median. According to the following figure 4, it is expressed that during the half-century from 1970 to 2019. Sri Lankan crude birth rate was decreasing.

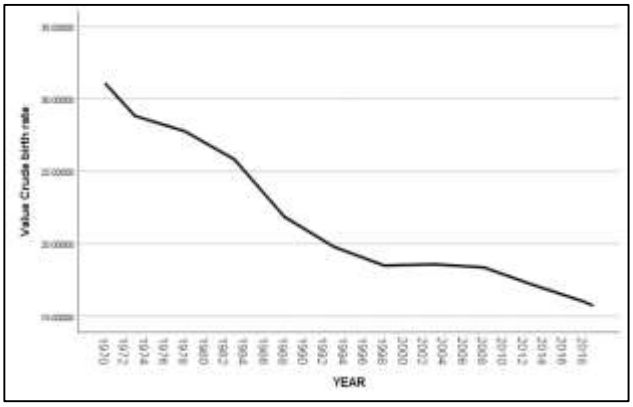

Figure 4: Pattern of Crude Birth Rate
Source: Department of Census and Statistics, 1970 – 2019

3.2 Summary measures of Crude death rate

The average (mean) level of the crude birth rate is 6.4408 (6 deaths per 1000 people) with an average dispersion (standard deviation) level of 0.3269. Following figure 5 shows that the crude death rate has been decreased from 1970-1985 and then has increased until 1998. After 1998, the crude death rate has decreased rapidly till 2003; after that it has increased slowly.

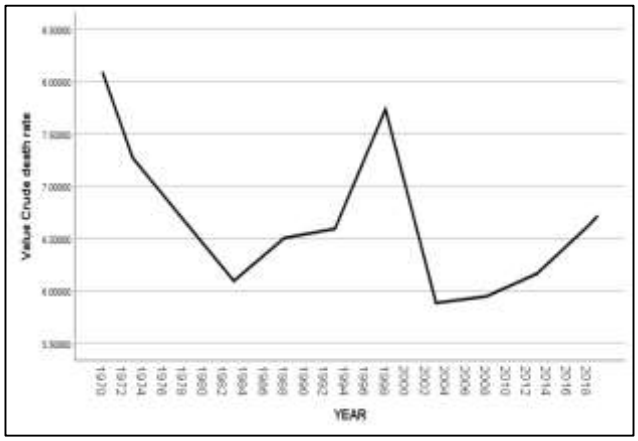

Figure 5: Pattern of crude death rate
Source: Department of Census and Statistics, 1970 - 2019

3.3 Behavior of Infant mortality rate

The figure 6 shows that the infant mortality rate of Sri Lanka has rapidly decreased from 1970 to 2019. Decreasing the deaths of infants is a good situation for a developing country. Although the infant mortality rate is decreased, the population growth rate is not increased because fertility has decreased gradually in the country.

3.4 Behavior of Gross Domestic Price Growth Rate (GDPGR) and Inflation Rate (IR)

The line graph in the following figure 7 shows that the gross domestic price growth rate has changed from 1970 to 2019. It can be seen as a zigzag pattern with ups and downs. There are some negative points. It implies a negative growth of the gross domestic price of Sri Lanka.

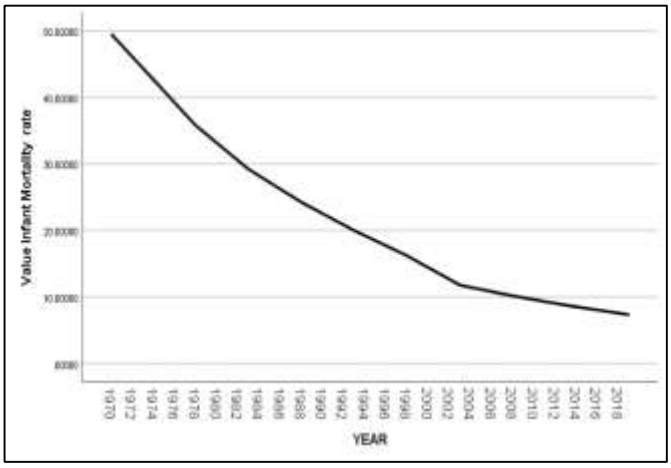

Figure 6: Pattern of infant mortality rate
Source: DCS, 1970 – 2019

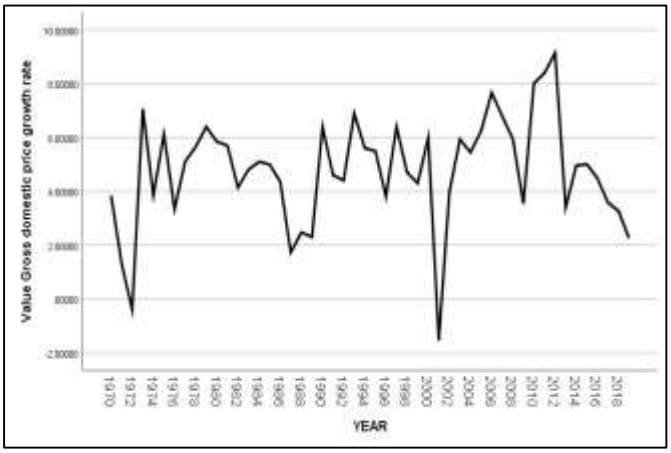

Figure 7: Pattern of GDPGR in Sri Lanka
Source: DCS, 1970 – 2019

The figure 8 indicates that the Inflation Rate (IR) of Sri Lanka has been changed with a lot of variation from 1970 to 2019.

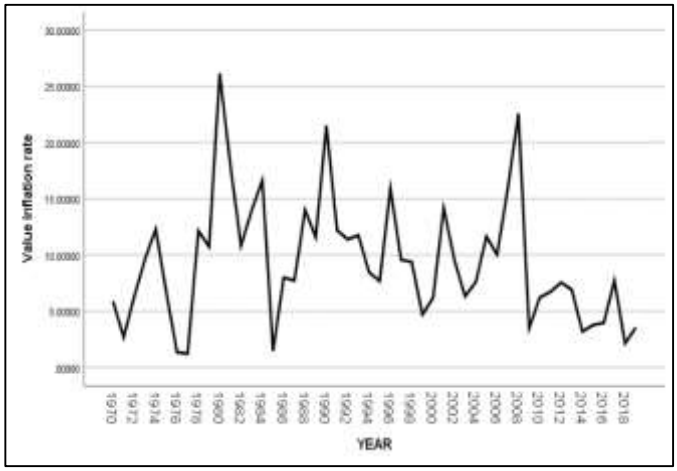

Figure 8: Behavior of IR
Source: DCS, 1970 – 2019

After analyzing the considered variables descriptively, steps regarding the multiple regression model have been done respectively. First identifying the relationship between the dependent and independent variables was done using the scatter plot and correlation analysis. According to the table 3; results of the correlation analysis, the crude birth rate and the infant mortality rate displays a strong linear positive relationship with the population growth rate. Correlation coefficients revealed that there might be linear, positive relationships between the crude death rate and the population growth rate, between the gross domestic price growth rate and the population growth rate, and also between the inflation rate and the population growth rate.

Table 3: Results of the correlation analysis

		PGR	CBR	CDR	IMR	GDPGR	IR
PGR	Pearson Correlation	1	.976	.335	.967	-.170	.067
	Sig. (2-tailed)		.000	.017	.000	.237	.642
CBR	Pearson Correlation	.976	1	.355	.983	-.137	.075
	Sig. (2-tailed)	.000		.011	.000	.341	.604
CDR	Pearson Correlation	.335	.355	1	.471	-.292	-.099
	Sig. (2-tailed)	.017	.011		.001	.040	.496
IMR	Pearson Correlation	.967	.983	.471**	1	-.189	.064
	Sig. (2-tailed)	.000	.000	.001		.189	.660
GDPGR	Pearson Correlation	-.170	-.137	-292*	-.189	1	.125
	Sig. (2-tailed)	.237	.341	.040	.189		.386
IR	Pearson Correlation	.067	.075	-.099	.064	.125	1
	Sig. (2-tailed)	.642	.604	.496	.660	.386	

Source: Results of the data taken from the DCS, 1970-2019

According to the results of correlation analysis, out of the considered independent variables, only three variables have a linear relationship with the population growth rate. The multiple regression model was constructed by using the crude birth rate, the crude death rate, and the infant mortality rate. Although, all independent variables (including annual GDP growth rate of Sri Lanka and annual inflation rate of Sri Lanka) did not significantly influence the annual population growth rate (refer Table 05), these two independent variables (annual GDP growth rate of Sri Lanka and annual inflation rate of Sri Lanka) could not be excluded from the regression model. Because, the correlation analysis of all variables indicated that the probability values of these variables, [annual GDP growth rate of Sri Lanka ($p = 0.045$), and annual inflation rate in Sri Lanka ($p = 0.048$)] are slightly influence on the model. The following regression model is the basic model including all independent variables which influence the annual population growth rate in Sri Lanka.

Annual Population growth rate = 1.805 + 0.535 * Crude Birth Rate – 0.871 * Crude Death Rate + 0.345 * Infant Mortality Rate – 0.436 * Annual GDP growth Rate + 0.236 * Annual Inflation Rate

However, these two independent variables were not included to the best fitted model.

The constructed best fitted regression model can be tested as follows.

3.5 The overall significance of the initial model

Hypothesis

H_0: The model is overall not significant.
H_1: The model is overall significant.

According to the p-value (0.000) of the F-test, it is below the threshold level (α-value = 0.05). Therefore, the null hypothesis is rejected, and it can be concluded that at least one coefficient is significant in the initial regression model. It means that the initial regression model is overall significant at a 5% significance level.

Table 4: Results of the significance of coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Constant	0.302	0.759		0.398	0.092
	CBR	0.057	0.026	0.494	2.181	0.034
	CDR	-0.139	0.076	-0.085	-1.829	0.044
	IMR	0.022	0.010	0.521	2.169	0.035

Source: Compiled by the researcher using DCS data, 1970 – 2019

According to the above table 4, all coefficients are significant at the 5% significance level. After identifying the significance of coefficients, the goodness of fit of the initial regression model was checked as follows.

Table 5: Significance of the coefficients of the regression model

R	R Square	Adjusted R Square	Std. error of the Estimate
0.978	0.957	0.954	0.11314

Source: Compiled by the researcher using DCS data, 1970 - 2019

The goodness of fit of the regression model is evaluated by the R^2 value. As in table 5, the adjusted R^2 value is 95.4 percent. Therefore, the initial regression model including the crude birth rate, the crude death rate, and the infant mortality rate, explains 95.4 percentage of the total variability of the population growth rate. It is a sufficient level to consider it as a well-fitted model.

3.6 Checking the assumption of the initial model

Checking multicollinearity problem

In order to, the check the multicollinearity assumption, VIF values, and tolerance values of each independent variable were checked.

Table 6: VIF values for the initial regression model

Source: Compiled by the researcher using DCS data, 1970 – 2019

Collinearity Statistics		
Variable	Tolerance	VIF
CBR	0.018	55.220
CDR	0.426	2.346
IMR	0.016	61.999

Regarding the VIF (table 6), if VIF values of independent variables are less than 5. There is no issue of multicollinearity. And, if the tolerance values are greater than 0.2, there is no problem of multicollinearity. Regarding the initial model, VIF values of the crude birth rate and the infant mortality are higher than five. The tolerance values are also less than 0.2. It implies that the initial regression model has the problem of multicollinearity.

By using the principal component method this problem can be solved. It can be done by making a new variable and by using the problematic variables. Therefore, a new variable called a common factor was created to represent both the crude birth rate and the infant mortality rate. The following table shows the results of the second model after taking common factor.

3.7 The overall significance of the new mode

Table 7: Results of the overall significance of the new model

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	13.178	2	6.589	525.844	0.000
	Residual	.589	47	.013		
	Total	13.767	49			

Source: Compiled by the researcher using DCS data, 1970 – 2019

According to the p-value (0.000) of the F-test (table 7), it is below the threshold level (α-value = 0.05). Therefore, the null hypothesis is rejected, and it can be concluded that at least one coefficient is significant in the second regression model. It means that the second regression model is overall significant at a 5% significance level.

3.8 Significance of coefficients

Table 8: Results of the significance of coefficients (new model)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.995	.347		5.757	.000
CDR	-.135	.054	-.084	-2.521	.015
Common Factor	.535	.018	1.010	30.469	.000

Source: Compiled by the researcher using DCS data, 1970 – 2019

As shown by the table 8, the p-value (0.000) is less than the significance level (0.05), all regression coefficients were significance at 5% significant level. After solving the multicollinearity issue the variables of the regression model have been significant. Then it can be checked the goodness of fit of the second regression model. It has been identified by the R squared value. The value of R squared shows in the following table 9.

Table 9: Model summary of the new model

R	R Square	Adjusted R Square	Std. Error of the Estimate
.978	.957	.955	.11193

Source: Compiled by the researcher using DCS data, 1970 - 2019

The goodness of fit of the regression model is evaluated by the R^2 value. As in table 11, the adjusted R^2 value is 95.5%. Therefore, the second regression model including crude death rate and the common factor (crude birth rate & infant mortality rate) explains 95.5 percentage of the total variability of the population growth rate. It is a sufficient level for considering as a well-fitted model.

In order, the check the multicollinearity assumption, VIF values, and tolerance values of each independent variable are checked. Considering both VIF values and tolerance values, regarding the second regression model there cannot be identified the issue of multicollinearity. Since the VIF values of the crude death rate and the common factor are less than five and the tolerance values of both two variables are greater than 0.2. test the Residual Diagnostic. Therefore, the Jarque-Bera test has been performed to check the normality assumption. The figure 9 indicates the descriptive results and the value of Jargue-Bera test.

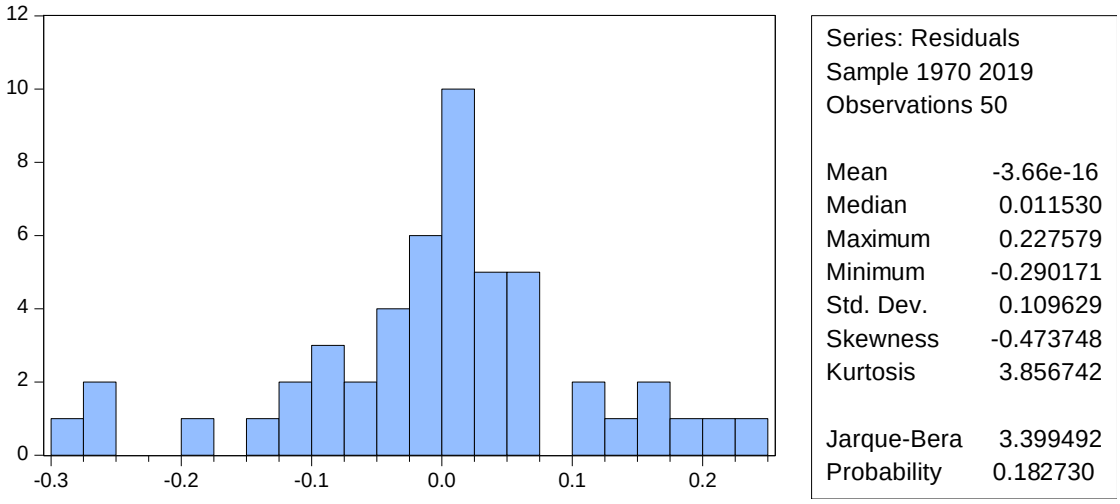

Figure 9: Histogram and Jarque-Bera test results
Source: Compiled by the researcher using DCS data, 1970 – 2019

Since the p-value (0.18273) of the Jarque-Bera is greater than the alpha-value (0.05), it can be concluded that the residuals follow a normal distribution at a 5% significance level. The next assumption is homogeneity of variances. According to the results of heteroskedasticity test (F-statistic – 4.295) the p-value (0.0029) is smaller than the significance level (0.05). It means the population variances differ for the residuals. Hence, the assumption of homogeneity of variances is not satisfied with a constructed regression model. Serial correlation LM test was used to check assumption of absence of autocorrelation (randomness). The p-value of the serial correlation test and F-statistics were 0.0000 and 253.7957 respectively. The P-value is below the significance level (0.05). As a result, the assumption of the randomness of residuals is not satisfied with the constructed second regression model. Furthermore, considering the Durbin-Watson value it can be said that there is autocorrelation. If the Durbin-Watson value (0.226) is less than 2 and close to zero, then there can be seen a positive autocorrelation.

3.9 The constructed multiple linear regression model

Population growth rate = 1.995 + 0.535 * Common Factor – 0.135 * Crude Death Rate

According to the regression model equation, when the common factor is increasing in 0.535 and the crude death rate is decreasing in 0.135 the population growth rate is changing in one unit. Here, the common factor means the combination of the crude birth rate and the infant mortality rate. The main objective of the study has been achieved from the multiple regression analysis.

4 CONCLUSIONS

In considering the population of census years in 1971, 1981, 2001, and 2012, the population data revealed that an increasement of the population of Sri Lanka. However, the point is that, the rate of population growth has been reduced. During the period between 1981 and 2001 population growth rate of Sri Lanka was 1.16%. During 1981-2012 it was 1% and during the period 2001-2012 the growth rate was 0.7% (Department of Census and Statistics 2012). Therefore, it can be summarized that the population growth rate of Sri Lanka has declined over the time. In addition to that, the population pyramids also have explored that the population of Sri Lanka has become stable. In considering the gender composition of the population, male population was higher as in 1917 and in1981 than the female population. That situation had changed in 2001 and 2012 as the female population was higher than males. When it comes to the population distribution

according to religion, it is especially can be identified that the population of Muslims was increased with a higher percentage than other religions. The Census data reveals that the population distribution in rural areas was higher than in urban areas.

To achieve the main objective of the study, a regression analysis was done. To identify the factors behind the population growth rate changes, some assumed variables were measured. According to the correlation analysis only CBR, CDR, IMR were significant as having a relationship with PGR. However, out of those indirect three variables only the infant mortality rate has a relationship with the population growth rate. Although it can be considered that the economy of a country may affect the population growth of the country, practically people may limit their decision of having children due to their economic capability. Furthermore, if the government of a country makes a policy by determining to reduce the fertility rate, then there would be an impact on having children for a family. Otherwise, practically people may not think about this matter due to their economic level. Since the GDPGR and IR were not significant, these variables were not included in constructing the regression model. Therefore, the best fitted multiple regression model was constructed using only significant factors. According to the model, it can be proved that the crude birth rate, the crude death rate, and also the infant mortality rate affected the changes of the population growth rate in Sri Lanka. Furthermore, it can be concluded that the crude death rate has a negative relationship with the PGR while other variables have a positive relationship. It means that when CDR is high the PGR goes low and when CDR is low the PGR goes high. A reason for the decline of the population growth rate of Sri Lanka can be identified as the decline of the crude birth rate. Normally, the high rate of crude deaths affects to reduce the population growth rate. The infant mortality rate of Sri Lanka has also reduced. As a still-developing country, it is a positive fact. As suggestions the government of Sri Lanka can motivate people to have more children in their families, confirming that the economy of the country is stable enough for the future generation and giving some economical aids for families with more children who are economically unstable.

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