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The effect of economic growth and misery index on income inequality in Iran (Autoregressive Distributed Lag (ARDL))

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Abstract

Improving people's quality of life and increasing the level of public welfare are among the goals defined by different governments around the world. In meeting such goals, reducing income inequality is one of the factors that play a major role. Therefore, it is of high significance to figure out the factors related to income inequality. The present study was conducted to investigate the relationship between income inequality, economic growth and misery index in Iran, and in this regard, time series data related to the years 1971-2019 have been used. The income inequality index in the present study is the Gini coefficient and to estimate the research model, Autoregressive Distributed Lag (ARDL) method has been used. The results indicated that increasing as the misery index increases, income inequality in Iran will increase as well. Moreover, the ratio of real government spending to real GDP and economic growth have a positive effect on increasing inequality and the ratio of total real investment to real GDP and a dummy variable for revolution has a negative effect on income inequality.

Keywords: income inequality, economic growth, misery index, real investment, Autoregressive Distributed Lag (ARDL)
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1 Introduction

Today, income inequality is one of the unfavorable issues of social life and all human societies aim to reduce this inequality as their goal. Economic inequality is often associated with poverty, crime, and social unrest, and income inequality is one of the causes of political instability and even civil war [7]. As the misery index and income inequality are social issues, the government is required to be asked to adopt measures in this regard. Achieving an acceptable level of the income distribution, assessing the consequences of development policies in distribution, knowing the status and welfare of individuals in society, and finally planning to promote social justice all depend on recognizing the current state of income distribution and knowing about the individuals' status in different income groups, and this is not possible unless the theoretical framework of income distribution, income inequality indicators, and factors affecting income inequality are investigated. The results of such studies are required to be used and this leads to redistribution of income in favor of people in the lower income deciles so that the main part of the inadequacies in economic sectors, inflation, high unemployment, poverty and demographic change will be reduced. If the factors affecting the distribution of income and social welfare are identified, one can take steps to achieve the goal of achieving social justice. Since

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the government, the planning institutions and executive bodies do give special attention to achieving social justice (as one of the transcendent, religious, and political ideals of the Islamic Republic of Iran), it is, thus, required to conduct serious and practical studies on the issues of income distribution and social welfare to provide appropriate policy solutions to achieve social justice and reduce poverty and improve the distribution of income and social welfare. Comparing the statistics of Iran with those of other countries indicates that our country is among the countries with high-income inequality. Moreover, by observing the trend of income inequality in Iran, one can conclude that income inequality has been increasing over recent years. According to UN statistics, from 2011 to 2016, the Gini coefficient in Iran was 0.43, but in 2018 it reached 0.58, indicating that income distribution has worsened. Even Iran's ranking in income distribution indicates the unfair distribution of income in the country; the World Bank, in its 2017 report, reported that Iran's ranking was 88 among 127 countries in the world. Thus, it is required to have a new attitude and approach toward income inequality. Two of the most important factors affecting income inequality are inflation and unemployment. In the present study (the relationship between the misery index and income inequality in Iran), instead of inflation and unemployment, the misery index is used, and it is attempted to investigate the relationship between this index and income inequality.

2 Theoretical Foundations and Review of the Related Literature

2.1 The relationship between economic growth and income inequality

In the literature, the relationship between growth and income inequality can be divided into three distinguished periods. The first period includes the 1940s and 1950s, in which economists considered growth and industrialization as the main solution to poverty reduction, yet they fail to give due attention to its adverse distributive consequences. The second period, which begins in the mid-1950s and lasts until the mid-1970s, emphasizes the conflict between growth and income inequality and the need for government intervention to manage the growth process. The third and final period began in the mid-1970s and continues to the present day. In this period, the possibility of the trade-off of income inequality and economic growth has been taken into account. In 1955, for the first time, Simon Kuznets proposed a theory (the following formula) according to which G income inequality increases during the first Y phases of economic growth, then is stabilized, and finally decreases during the later phases (i.e. in an inverted U-shape) [2].

$$G = \alpha_0 + \alpha_1 Y + \alpha_2 Y^2 + U_t.$$

It was also indicated that the distribution of personal income in less developed countries is more unequal than that of developed countries. Kuznets has also added that the share of higher-income groups in developing countries was larger than that of developed countries. This means that the highest-income families in the top 5 percent of the classification in developing countries received more than 30 percent of the total income, while in developed countries, this proportion was only 20 to 25 percent. Although the share of lower-income groups was smaller in some developing countries, the difference was not significant; that is, the share of middle groups in such countries was relatively smaller than that of developed countries. In the 1960s and 1970s, Kuznets' hypothesis was further investigated based on international data, including a study conducted by Harvey Oshima [17]. He divided the countries into four categories: underdeveloped, less developed, semi-developed and fully developed, and concluded that inequality in developed countries is low and their income distribution increases in proportion to the increase in per capita income. He has also added that income inequality increases in the third class, where it peaks, yet it decreases in the fourth class. Kravis [11] has also examined the Kuznets' hypothesis. With cross-sectional data from the 1960s, Ahluwalia [1] concluded that economic growth is not a significant factor in income inequality. Chang [7] and Sarel [20] have indicated that economic growth is inversely associated with income inequality, that is the faster the growth, the lower the income inequality. In the economic literature, there are different views on the relationship between economic growth and income inequality. Thus, economics has failed to give a clear answer to this relationship. Experimental studies have achieved different results based on the type of method applied and the field of study. The most important indices for measuring income inequality and its characteristics are as follows:

The stability test of the parameters in different modes (linear and nonlinear segments) can be modeled as follows:

$$y_t = \phi(t)' z_t + \theta(t)' z_t G(\gamma, c, s_t) + u_t$$

$$\phi(t) = \phi + \lambda_\phi H_\phi(\gamma_\phi, c_\phi, t^*)$$

Computational formula	Index
$G = \frac{2cov(y,r_y)}{n\bar{y}}$	Gini Coefficient
$V = \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2$	Variance
$c = \frac{\sqrt{V}}{\bar{y}}$	Coefficient of Variation
$\upsilon_1 = \frac{1}{n}\sum_{i=1}^{n}\left[\log\left(\frac{y_i}{\bar{y}}\right)\right]^2$	Logarithm of Variance
$\upsilon_2 = \frac{1}{n}\sum_{i=1}^{n}\left[\log(y_i) - \frac{1}{n}\sum_{i=1}^{n}\log(y_i)\right]^2$	Logarithmic Variance
$A = 1 - \frac{1}{\bar{y}}U^{-1}\left(\frac{1}{n}\sum_{i=1}^{n}U(y_i)\right)$	Atkinson
$D = 1 - \frac{\frac{1}{n}\sum_{i=1}^{n}U(y_i)}{U(\bar{y})}$	Dalton
$T = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\bar{y}}\log\left(\frac{y_i}{\bar{y}}\right)$	Theil
$H = \left(\frac{y_i}{n\bar{y}}\right)^2$	Herfindahl

$$\theta(t) = \theta + \lambda_\theta H_\theta(\gamma_\theta, c_\theta, t^*)$$

$$u_t \approx iid(0, \sigma^2)$$

$$t^* = \frac{t}{T}$$

For this purpose, a high nonlinear regression approximation is used assuming the stability of the parameters as the following equation:

$$y_t = \beta_0' z_t + \sum_{j=1}^{3}\beta_j' z_t\,(t^*)^j + \sum_{j=1}^{3}\beta_{j+3}' z_t\,(t^*)^j\,G(\gamma, c, s_t) + u_t^*$$

This can be done for the other three transfer functions as the following equation:

$$H(\gamma, c, t^*) = \left(1 + exp\left\{-\gamma\prod_{k=1}^{K}(t^* - c_k)\right\}\right)^{-1} - \frac{1}{2}, \quad \gamma\rangle 0$$

For $k = 1, 2, 3$ and by which $\gamma_\theta = \gamma_\phi$

2.2 The relationship between government spending and income inequality

The effect of government spending on income inequality is expected to be toward reducing income inequality. However, with a micro view toward this issue, it can be argued that the effect of government spending on income distribution will depend on the distribution of these spending between sectors, regions and income groups. Capital expenditures can have a positive effect on the income distribution status by increasing health and education from the labor productivity circle. In other words, government spending can help reduce inequality by increasing the income capacity of individuals and households (some government social spending, such as elementary school spending, can intermittently affect income distribution). Blejer, and Guerrero [5] and Chu, Davoodi and Gupta [8] argue that government expenditures may, for different reasons, such as the method of financing government expenditures, the combination of government expenditures, and the distribution of these expenditures (across sectors) have favorable or unfavorable effects on distribution of income that can ultimately lead to income inequality. As a result, because of such ambiguities, different theoretical perspectives can be offered.

2.3 The relationship between investment and income inequality

Throughout the history of economic thought, the accumulation of real physical capital reserves has been expressed as prescribing more sophisticated methods of production and greater productivity, and creating an additional future flow of income for the society. The purpose of any enterprise or community in making an investment decision is to

guarantee the well-being of its owners or the people of that community. Thus, all economic agents attempt to have productive activities to increase their welfare of the society. The purpose of investing is, thus, to increase production, wealth and prosperity and to be on a higher indifference curve. Schultz and Lal maintain that when capital is easily transferred and operated with the aim of profit, it can also create suitable employment and show people the signs of economic reform. They also prepare and offer themselves in accordance with new and desirable jobs of investments. Based on this theory, the increased share of employees, among low-income groups, can increase the total income of this group in the long run. Investment usually occurs in areas where higher profits are expected. If profitability rate is low in an area, that area will remain undeveloped. Thus, the forces within the market in a capitalist economy operate in such a way that they increase regional inequalities instead of reducing them. Regional inequalities will, thus, develop when one region develops at the cost of the underdevelopment of another. If, for reasons such as special attention to deprived and underdeveloped areas, a large amount of government investment flows to these areas, the implementation of investment will attract quality production agents and a relative increase in their price. This increased income will have its effect on other workers close to the skill level used and then on other investments, which will then be extended to other areas, reducing inequality. That is, investment reduces income inequality.

2.4 Review of the related literature

In a study using data from the provinces of Canada in 1996, 2001 and 2006 and using the method of spatial econometrics, Breau [6] investigated inequality in Canada with a regional perspective. The results indicate that factors such as economic development, industrial structure, population density, unemployment rate and the distribution of educational facilities are important factors determining inequality in Canada. Zhang and Ben Naceur [13] investigated the financial development, inequality and poverty. For this purpose, in their study, access, depth, efficiency, stability and financial liberalization are considered. The three main findings of their study are as follows. First, four of the five dimensions of financial development (access, depth, efficiency, and stability) can significantly reduce inequality and poverty.

Second, financial liberalization tends to intensify and worsen inequality and poverty. Third, the development of banking shows a significant effect on income distribution relative to the development of the stock market. Herrera [9] investigated inequality as a determining factor in the persistence of poverty. For this purpose, their study was conducted in four sections. The first section presents data on poverty and inequality in the world, and this unacceptable fact was discovered that more than 10% of the world's population is in extreme poverty and the wealth of only 8 individuals equals the wealth of half of the world's population. In the second part, the background of poverty and inequality is investigated in order to understand and determine the relationship between them. In the third section, empirical evidence on the relationship between poverty and income inequality is presented for 18 countries that have suffered from this relationship. Finally, in the fourth section, the results show that the reduction of persistent poverty will only be successful if the various types of income inequality are reduced or limited. Neaime and Gaysset [15] have investigated the effect of financial intervention and stability on poverty and income inequality in MENA (middle east and north Africa) countries. For this purpose, they used data from eight MENA member countries during 2002-2015. They have applied the generalized method of moments (GMM) and generalized least squares (GLS). The results indicated that while financial intervention reduces income inequality, population and inflation increase income inequality. Moreover, financial intervention has no effect on poverty, while population, inflation and trade openness significantly increase poverty. In a study, Santos Pereira et al. [19] answered the question of whether renewable energy has an effect on income distribution and increased risk of household poverty? For this purpose, three key issues were investigated. A. Did different levels of households enjoy different effects of promoting renewable energy? B. What are the consequences of promoting renewable energy on household income? And C. Does the promotion of renewable energy reduce the risk of poverty and social exclusion? Analysis of combined data from European countries using the co-integration test of Kao residuals and ARDL approach showed that given the increased costs of renewable energy, both income distribution and household poverty risk were significantly and directly associated with the promotion of renewable energy in the short and long terms.

Arabi and Khodaparast Mashhadi [3] investigated some of the most important indicators of social welfare and measured changes in income inequality including Gini coefficient, decile ratio, parasite coefficient, social welfare index, real per capita household expenditure, urban and rural consumption gap and rural poverty line by using the statistics of household expenditures and incomes during the years 2005-2011. The results have indicated that the trend of income inequality based on the calculated indicators in rural areas in the country and that of North Khorasan province have fluctuated, and in 2011, it has significantly decreased. Moreover, the social welfare indicators of rural areas during the years being reviewed have had a decreasing trend in North Khorasan province and the country, and compared to the whole country, the villages of North Khorasan province have had a worse status in terms of household welfare.

Raghfar et al. [18] investigated the relationship between economic growth and poverty and inequality in Iran during the first to fourth development programs. For this purpose, the elasticity of poverty to economic growth and inequality were measured, and finally, the way benefits of growth are distributed was investigated using the Kakwani and Son's poverty equivalent growth rate (2008). Analysis of poverty changes in urban, rural and the whole country showed that the net effect of growth on poverty is negative. However, the net effect of inequality has had positive and negative fluctuations. Khalesi and Piraei [10] investigated the relationship between economic growth and income inequality between the provinces of Iran. For this purpose, seasonal time series data related to 2000-2010 and a self-correlation vector model have been used and inter-provincial income inequality has been obtained once using the Gini coefficient and once using the Theil index. The results indicate that inter-provincial income inequality reduces economic growth in the short run, only part of this reduction will disappear in the long run. Economic growth increases inter-provincial income inequality in the short run and decreases it in the long run. Mohammadzadeh et al. [12] investigated the effect of inequality and poverty on public health indicators.

For this purpose, a sample including 34 countries was analyzed using the panel data approach during the period 1995 to 2012. The results indicated that income inequality and poverty on the one hand reduce public health and on the other hand increase the share of people in health care payments. Nasrollahi et al [14] estimated the effect of income inequality on the Sustainable Development Index by using evidence from Iranian provinces. For this purpose, research data were collected during the period 2008-2014. FGLS model was used to analyze the data. The results showed that the relationship between income inequality and the combined index of sustainable development is negative. Moreover, the effect of two variables i.e. GDP growth rate per capita and energy intensity on the model's dependent variable was respectively positive and negative and statistically significant, respectively. While the other two variables i.e. industry structure and urbanization rate are not significant.

3 Method

In this study, for data analysis, the Autoregressive Distributed Lag (ARDL) was used. An important advantage of this model among co-integration method is that this method can be used regardless of whether the model variables are static ($I(0)$) or static ($I(1)$) or become static with one time differentiation ($I(1)$). The generalized (expanded) ARDL model is as follows [16]:

$$\alpha(L,P)y_t = \alpha_0 + \sum_{i=1}^{k} \beta_i(L,q_i)x_{it} + u_t; \quad i = 1,2,...,k \tag{3.1}$$

Thus, L, P, q_i, y_t, x_{it}, α_0, u_t are respectively the lag operator, the lag vector of the dependent variable, the lag vector of each of the explanatory variables, the dependent variable, the explanatory variables vector, y-intercept and the random disturbance sentence. Also, the interrupt factor is defined as follows:

$$\alpha(L,P) = 1 - \alpha_1 L^1 - ... - \alpha_p L^p \tag{3.2}$$

Thus:

$$\beta_i(L,q_i) = \beta_{i0} + \beta_{i1}L + \beta_{i2}L^2 + ... + (\beta_{iq_i}L_i^q) \tag{3.3}$$

Thus, α and β_i respectively represent the interrupt vector of the dependent variable and the interrupt vector of each explanatory variable. Moreover, Schwarz Bayesian Criterion (SBC), which saves in determining the number of interrupts, is usually used to determine the optimal number of interrupts for each variable. In addition, to estimate the long-run relationship in the first phase, the existence of a long-term relationship between the variables is tested. Thus, if the sum of the estimated coefficients related to the intervals of the dependent variable is less than one, the dynamic pattern tends towards a long-run equilibrium. Therefore, for the convergence test, it is required to test the hypothesis of Equation (3.4). The quantity of t-statistic required to conduct this test is also calculated as Equation (3.5) [16]:

$$H_0 : \sum_{i=1}^{m} \alpha_i - 1 \geq 0$$

$$H_1 : \sum_{i=1}^{m} \alpha_i - 1 < 0 \tag{3.4}$$

$$t = \frac{\sum_{i=1}^{m} \hat{\alpha}_i - 1}{\sum_{i=1}^{m} S\hat{\alpha}_i} \tag{3.5}$$

By comparing the computational t-statistic and the critical quantity developed by Banerjee, Dolado and Mester [4] at the desired confidence level, it can be seen that there is a long-run equilibrium relationship between the model variables. If the existence of a long-term stable relationship between the model variables is proved, in the second phase, long-term coefficients are estimated and analyzed, and inferences are made about their values. Also, in this study, in order to investigate the effect of misery index, economic growth and investment on income inequality in Iran, Equation (3.6) was used:

$$Gini_t = \alpha_0 + \alpha_1 Mis_t + \alpha_2 GRY_t + \alpha_4 IY_t + \alpha_5 GY_t + \alpha_6 D1 + \alpha_7 D2 + U_t \tag{3.6}$$

Gini represents the income inequality coefficient (Gini coefficient), Mis stands for the misery index (sum of inflation and unemployment rates), GRY stands for the ratio of real government expenditures to real GDP, IY is short for the ratio of total real investment to real GDP, GY stands for economic growth, D1 is for the dummy variable for the Islamic Revolution (zero for the years before the revolution, and one for the years following the revolution), D2 stands for the dummy variable of the war years, and U represents the disturbance sentence. Moreover, the required data were collected from the Central Bank and the Statistics Center of Iran during the period 1971-2019. Finally, Microfit was used to analyze the data.

4 Results and Discussion

Table 1: The results of unit root statistic test

	Algebraic operators	**variable**	**Computational Dickey–Fuller**	**Table Dickey–Fuller**	**Test result**
Unit root	y-intercept y-intercept and trend	GINI	−3.755 −3.867	−2.95 −3.55	Static in unit root
In the first order difference	y-intercept y-intercept and trend	MIS	−3.930 −3.864	−2.95 −3.55	
Unit root	y-intercept y-intercept and trend	GRY	0.069 −2.01	−2.95 −3.55	Static in the first order difference
In the first order difference	y-intercept y-intercept and trend	DGRY	−8.400 −9.320	−2.95 −3.55	
Unit root	y-intercept y-intercept and trend	IY	−0.646 −3.129	−2.95 −3.55	Static in the first order difference
In the first order difference	y-intercept y-intercept and trend	DGY	−3.553 −4.864	−2.95 −3.55	
Unit root	y-intercept y-intercept and trend	GY	−0.269 −3.460	−2.95 −3.55	Static in the first order difference
In the first order difference	y-intercept y-intercept and trend	DIY	−5.715 −5.902	−2.95 −3.55	

Given the results of the staticity test, because the variables used are not all static at in unit root $I(0)$, the method used is ARDL according to the above topics. After selecting the maximum interval, the optimal interrupts were determined by selecting the Schwartz-Bayesian criterion from criteria such as Akaike, Hannan–Quinn and adjusted

coefficient of determination, the optimal intervals were determined. As the highest value of Schwartz-Bayesian criterion was obtained in interval 2 (68.899), the maximum optimal interval was considered to be 2. The following table 2 provides the estimation results of the short-term ARDL model.

Table 2: The estimation results of short-term ARDL model

Variable	Coefficient	t-statistic	Probability value
GINI (−1)	0.466	3.84	0.000
GINI (−2)	0.234	2.68	0.009
MIS	0.138	3.15	0.003
MIS (−1)	0.107	D2.21	0.030
GRY	0.090	2.83	0.006
IY	−0.031	−2.56	0.011
GY	0.255	2.91	0.007
D1	−0.023	−2.45	0.019
D2	−0.041	−2.34	0.027
C	1.183	3.09	0.005
ECM (−1)	−0.721	−5.39	0.000

R squared= 0.918

DW-statistic= 1.974

$R - Bar$-Squared= 0.895

F-Stat= 13.02[0.00]

Schwarz Bayesian Criterion= −68.89

Test	F-statistic	LM statistic
Auto-integration	0.0451 (0.833)	0.064 (0.799)
Correct subordinate form	0.046 (0.833)	0.067 (0.795)
Normality of residual sentences	No applicable	5.085 (0.179)
Homogeneity variance test	2.263 (0.142)	2.247 (0.134)

The above findings show that based on F test, the significance of the whole regression is confirmed. Moreover, based on the value of R^2, the estimated model enjoys a suitable fit. In addition, according to DW statistics, there is no serial correlation between disturbance sentences. Moreover, the results of auto-integration, subordinate form, normality and homogeneity variance tests show that the classical hypotheses are valid. In addition, the above results show that the coefficient of the MIS variable is positive and statistically significant. This means that in the short run, with the increase in the misery index, income inequality increases in Iran. Moreover, the coefficient of the GRY variable is positive and statistically significant. This means that in the short run, income inequality in Iran increases as the ratio of government spending to real GDP increases. Also, the coefficient of IY variable is negative and is statistically significant. In other words, in the short run, by increasing the ratio of total real investment to real GDP, income inequality decreases in Iran. Moreover, the coefficient of GY variable is positive and statistically significant. This means that in the short run, as economic growth increases, income inequality increases in Iran. Also, the ECM (-1) coefficient has a negative sign and is statistically significant. This means that after a period, the short-term relationship approaches a long-term relationship by 0.72 units. Finally, since the computational value of Banerjee, Dolado and Mester [4] is equal to -8.1 and its absolute value is larger than its critical value at the level of 95% (-3.43), it can be concluded that there is a long-term relationship among the investigated variables. The following table 3 shows the estimation results of the long-term ARDL model.

The table 3 findings show that the coefficient of MIS variable is positive and statistically significant. This means that in the long run, as misery increases, income inequality increases in Iran. Also, the coefficient of the GRY variable is positive and statistically significant. In the long run, income inequality increases in Iran as the ratio of government spending to real GDP increases. In addition, the coefficient of IY variable is negative and statistically significant. In the long run, by increasing the ratio of total real investment to real GDP, income inequality decreases in Iran. Moreover, the coefficient of GY variable is positive and statistically significant. This means that in the long run, with increasing economic growth, income inequality increases in Iran.

Table 3: Estimation results of the long-term ARDL models

Variable	Coefficient	t-statistic	p-value
MIS	0.141	2.34	0.017
GRY	0.113	6.24	0.000
IY	−0.051	−2.03	0.010
GY	0.268	4.67	0.000
D1	−0.182	−2.44	0.018
D2	−0.047	−2.04	0.033
C	1.191	3.09	0.006

5 Conclusion and Recommendations

In this study, it was attempted to investigate the effect of misery index, economic growth, investment and government spending on income inequality in Iran. For this purpose, research variables were collected from the Central Bank and the Statistics Center of Iran during the period 1971-2017. Moreover, ARDL model and Microfit were used to analyze the data. The results indicated that in the short and long terms, as poverty rate increases, income inequality increases in Iran as well. Also, in the short and long terms, as the ratio of government spending to real GDP increases, income inequality increases in Iran as well. In addition, in the short and long terms, income inequality in Iran decreases as the ratio of total real investment to real GDP increases. Finally, in the short and long terms, as the economic growth increases, income inequality in Iran increases. Given the results of the present study, the following recommendations can be provided:

- The government is required to adopt policies that reduce unemployment and inflation to ultimately reduce income inequality;
- The government is required to accelerate development to move from the first phases of the Kuznets curve and gradually reach the phase of inequality stabilization and finally reduce it;
- The Government spending is required to be organized in such a way that more budget is spent on the poor and middle class groups of society; and
- The government is required to adopt policies that increase private sector investment, and this is possible when the role of the private sector increases in the economy.

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