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Investigating the Effect of Sanctions on Casual Relationship between Corruption, Income Inequality and Poverty in Iran

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ABSTRACT

The purpose of the present study is to investigate the effect of sanctions on causal relationship between corruption, income inequality and poverty in Iran during 1984 to 2020. For this purpose, a number of embezzlement concluded cases in the courts of general jurisdiction and Control of Corruption indicator (COC) as the representative of corruption indicator, Atkinson index and Gini index as the representative of income distribution and the indicators of per capita income and poverty line (calculated based on Linear Expenditure System (LES)) as the representative of poverty status were firstly gathered and calculated. According to the obtained results, income distribution is not an effective variable on poverty and vice versa, but it is a significant variable for the cause of corruption. However, poverty line under sanctions is a good representative of income distribution causality. Corruption and poverty cannot properly explain the distribution of income. However, the control of corruption has been the cause of income distribution. Also, corruption (poverty) is an effective variable for poverty causality (corruption) and the significance level of this relationship is higher under sanctions.

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1- Introduction

The issue of poverty and its relationship with governance variables is important in terms of different economic aspects. In most countries, incompetence of economic sectors, recession, severe unemployment, demographic changes and other socio-economic factors have exposed low-income households to poverty and deprived disadvantaged classes from government assistance and other community amenities. Therefore, a new attitude towards poverty and its economic and social factors have been adopted by economists in recent decades. In this regard, corruption is one of the most important variables affecting poverty and income inequality. As Huntington puts it, corruption refers to those public sector employees who ignore accepted norms, rules and custom for non-organizational interests. In other words, corruption is an illegitimate tool to satisfy illegal demands from administrative system (Huntington & Fukuyama, 1968). Scott believes that corruption is a behavior in which a person plays a governmental role to pursue his/ her private interests and achieve greater prosperity or a better position outside the formal framework of his/her duties (Scott, 1972). Hart et al have defined corruption as utilizing government property for gaining personal interest (Hart, Shleifer, & Vishny, 1997).

The number of revealed corruption-related crimes is one of the major challenges of Iran which has been significantly increased in recent years. According to official reports, although only two cases of embezzlement were reported in 1990s and 2000s with a total value up to $ 800 million, administrative corruption has significantly increased in 2010s with 13 large corruption cases and a total value up to $ 14 billion and a growth of over 1500% compared to 1990s and 2000s (The Iranian Students News Agency[1] (ISNA), 2017). The spread of such amount of corruption in administrative and bureaucratic system of the country can have irreparable economic and social consequences. The statistic investigations have shown that macroeconomic indicators including economic growth, employment, unemployment, poverty,

[1] Https://Bit.Ly/2o5vvni

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inflation and income distribution have become less favorable in 2010 compared to previous decades (Statistical Center of Iran, Iran Statistical Yearbook, 2017). In this regard, the following questions can be raised: is there a relationship between corruption and the indicators of income distribution and poverty in the country? Since the volume of international and unilateral sanctions on Iran has increased in the 2010s, does such a widespread growth in the volume and value of corruption cases in Iran have a relationship with sanctions? Therefore, the purpose of the present study is to investigate the effect of sanctions on causal relationship between corruption, income inequality and poverty in Iran during 1984 to 2020. For this purpose, the indices of per capita income, poverty line, administrative corruption and control of corruption, Atkinson and Gini have been utilized to investigate their interactions through Toda-Yamamoto Causality Test.

2- Literature Review

Numerous studies – (Grossman & Helpman, 1997; Mauro, 1995, 1998, 2002; Pellegrini & Gerlagh, 2004)-have been conducted to investigate the effect of corruption on economy in terms of the effect it has on economic growth. One of the early studies on economic field of crime was conducted by Fleisher (Fleisher, 1963). In that study, he investigated the relationship between crime and unemployment and concluded that there was a direct relationship between crime rates and unemployment. In terms of causes and motivations for committing a crime, Becker has proposed a theoretical model with purely economic analysis to evaluate the rational behavior of criminals. As Becker put it, criminals behave rationally and engage in criminal activity with lucrative motives (Becker, 1968). On the word of Ehrlich, education is a factor for increasing the expected legal income of individuals on one hand and decreasing crime rate on the other hand (Ehrlich, 1973). He then has concluded that occurrence of crimes have a positive relationship with income inequality, especially crimes against property. Johnston has stated that corruption is in the interest of "wealthy people", especially when their share is high. Disproportionately,

corruption is borne by low-income people. Individuals in low-income groups spend much of their income compared to individuals of high-income groups (Johnston, 1989). Tanzi has argued that corruption disrupts the role of government in income distribution. Since only individuals with favoritism links can take best and most beneficial government projects, it is less likely for the government to improve the distribution of income in society (Tanzi, 1998).

According to the cross-country panel data, Easterly and Levine have stated that increased corruption is an important channel of decreasing ethnic diversity of growth (economic) (Easterly & Levine, 1997). In their study, Rajeev and Nelson have shown that government size has a direct effect on corruption so that corruption is increased with an increase in government size (Goel & Nelson, 1998). Gupta et al. have conducted a study on investigating the relationship between corruption, income distribution and poverty and concluded that high and increasing corruption intensifies income inequality and poverty and decreases economic growth, efficiency of tax system, efficiency of government expenditure and human capital formation (Gupta, Davoodi, & Alonso-Terme, 2002)

Li, Xu & Zou and Chong & Calderon have found an inverse U-shaped relationship between corruption and income inequality by data obtained from a combined group of countries including low-income, middle-income and high-income countries. They found a positive relationship between corruption and income inequality in high-income countries and a negative relationship in low-income countries. They argued that increasing income inequality with increase in corruption does not necessarily mean increasing poverty with increase in corruption. They also found a linear and positive relationship between corruption and poverty (Chong & Calderón, 2000; Li, Xu, & Zou, 2000). Karstedt has also drawn on the direct relationship between income inequality and corruption. In the countries investigated, there was also a nonlinear relationship between income inequality and corruption. Additionally, administrative corruption decreases significantly after reaching to the specific point of income inequality

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(Karstedt, 2003). Chetwynd et al have used two economic and governmental models to explain how corruption affects poverty. In the economic model, corruption affects poverty by affecting economic growth factors. Corruption avoids encouraging domestic and foreign investment, distorts public funds for personal purposes and extends bribe activities that act bribery without taxpaying and as a result, declines the tax revenue. Ultimately, corruption drives talents from productive activities to non-productive activities. In other words, corruption impedes market competitiveness by decreasing economic investment and market distortion and leads to inefficiency of the economy. In the governmental model, corruption affects poverty by affecting governmental factors. As an example, corruption destroys the capital needed by the government to deliver high quality public services and diverts public capital from basic needs to capital projects where bribes are likely to occur. Corruption destroys government performance, diminishes government-provided services, declines public trust and social capital, and decreases funds needed to support economic growth plans. Therefore, corruption decreases the government's capability for helping citizens and poor people and affects poverty through posing serious challenges to government activities (Chetwynd, Chetwynd, & Spector, 2003).

You and Khagram investigated the direct relationship between inequality and corruption and argued that poor people cannot control and monitor wealthy people and the matter leads to increase in the probability of wealthy people's abuse from their position for gaining personal interests. As a result, inequality increases corruption (Jong-Sung & Khagram, 2005). Song & Khagram and Oriaku & Ogwu have confirmed the mutual relationship between inequality and corruption in their studies (Jong-Sung & Khagram, 2005; Nwala, Oriaku, & Ogwu, 2005). Dincer and Gunalp showed that corruption has increased poverty and inequality in the United States during a specific period (Dincer & Gunalp, 2008). Wu & Zhu showed that corruption has a significant negative effect on the economic growth and income inequality (Wu & Zhu, 2011). Dobson & Dobson concluded that

increasing corruption has led to an increase in income inequality (Dobson & Ramlogan-Dobson, 2012). Justice has identified the positive and significant effect of corruption on poverty in Kenya and Botswana (Justice, 2014). Godinez and Ling investigated the relationship between administrative corruption and foreign direct investment and concluded that increasing corruption has led to a significant decrease in foreign investment attraction in these countries (Godinez & Liu, 2015).

Moradi et al. (2023) showed that the indicators of the rule of law and corruption control in both groups of selected countries and in all frameworks have significant negative and positive effects on income inequality, respectively. The political stability index also shows that in the first two quarters in both groups of countries, it has a negative and significant effect on income inequality (Gini coefficient), which can mean that with political instability, the incentive for poor investment and consumerism in these societies can be strengthened, resulting in reduced production and income inequality. While in the third quarter in both groups of countries studied, the political stability index has a positive and significant impact on income inequality, meaning that as political stability increases, the income distribution becomes more equal (Moradi, Jafari, & Fatahi, 2023).

Mansouri et al. (2022), show that the Human Development Index of Khuzestan province reached a high level from 1375 with a value of 64/0 from the average level in 1385 to 1395, which is an acceptable growth in this index. The Human Development Index without oil in Khuzestan province is also lower than the similar national index and shows the worse situation in Khuzestan province than in the country in this regard (Sayed Amin Mansouri, Afghah, Aghaei Jannat-Makan, & sharifzadeh ahvazi, 2022).

Ershadi et al. (2022), show that the two provinces of Alborz and Tehran have the highest two-dimensional Development Index in the country, and the provinces of Sistan and Balochistan with the lowest index suffer from the highest development inequality in the country. based on the correlation matrix between the two dimensions of

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education and economics there is a 75% correlation. So it can be concluded that in general, provinces with better educational indicators also rank higher in the economy (Ershadi Zadh, Afghah, & Mansouri, 2022).

Mansouri and Afghah (2018) show taht the household dimension is the most important factor in increasing the minimum livelihood of all commodity groups. In other income groups, the poverty line has also increased. The study of the poverty line to income ratio shows that the poverty line rate is higher than the income to the sixth income group, and in the seventh, eighth income groups, on average, and only in the ninth and tenth income groups, the income rate is higher than the poverty line (Satyed Amin Mansouri & Afghah, 2018).

Afghah and Mansouri (2015) showed that increased security in society was the most important factor in the decline of the underground economy and hidden moral crimes. Bureaucratic corruption is the most influential variable of the increase in hidden moral crimes and illiteracy is the most influential variable of the increase in the underground economy. In addition, the increase in hidden moral crimes increases murder, theft and harassment, and the increase in the underground economy increases drinking, liquidity and energy consumption (Afghah & Mansouri, 2015).

3- Introducing data and variables

The statistics used in the present study have been obtained from the websites of Statistical Center of Iran, Central Bank of Iran and the World Bank. In the study, data related to Worldwide Government Index (WGI) have been obtained from the World Bank, data related to crime and corruption obtained from Statistics Department of Judiciary and other statistical data have been obtained from the websites of Statistical Center of Iran and Central Bank of Iran during 1984 to 2020.

In general, the data include the following cases:

1. Average annual income of urban households during 1984 to 2020 according to the type of income in each of the annual income groups;

2. Gini index during 1984 to 2020;
3. Percentage of literacy rate during 1984 to 2020;
4. The number of concluded cases of embezzlement, bribery and counterfeiting in court of general jurisdiction as the index for data related to administrative corruption (embezzlement, bribery, counterfeiting) during 1984 to 2020;
5. The data related to control of corruption (COC) index during 1984 to 2020;
6. Gross domestic product at fixed prices of 2004 in billion Rials during 1984 to 2020;
7. The index of poverty line in the study of (Mansouri & Afghah, 2015) in Rials during 1984 to 2020.

Accordingly, the variables used in the present study are as follows:

3-1- Poverty indices

1. **Per capita Income (IP):** Gross domestic product (GDP) at fixed price of 2004 in billion Rials divided by population (Statistical Center of Iran).
2. **Poverty Line (PL):** in the present study, Stone–Geary utility function (1954) and Linear Expenditure System (LES) have been used to measure the poverty line. The demand function or consumption expenditure equations (E) of Stone–Geary are defined as follows:

(1) $$E_{it} = p_{it} q_{it} = p_{it} \gamma_{it} + \beta_i (I - \sum_{i=1}^{n} \gamma_{it} p_{it})$$

Where, (q_{it}) is the amount of production, (p_{it}) is price and (γ_{it}) is the minimum livelihood and $\sum_{i=1}^{n} \beta_i = 1$. If ($\sum_{i=1}^{n} \beta_i = 1$), then obtained consumption expenditure equations are linear with respect to price (P)

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and income (I) variables and are nonlinear with respect to parameters. According to this method, the demand equations have been derived from the linear expenditure system and the minimum livelihood (γ_{it}) is constant for the whole period. Therefore, according to the definition, the relative poverty line equals the expenditures on minimum livelihood consumption of each commodity group during 1984 to 2020 which would be as follow:

$$Z_t = \sum_{i=\backslash}^{n} \gamma_{it} p_{it} \quad (2)$$

Urban households' expenditures statistics obtained from commodity items, urban households' income, price index of consumer goods and services for eight commodity groups at the base price of 2004 have been used to calculate the poverty line. The Iranian household product portfolio includes two groups. One group is related to food and tobacco and the other is related to non-food items including clothing and footwear, housing, furniture and accessories, household supplies and services, healthcare, transportation and communications, leisure, entertainment and cultural services and goods and miscellaneous household services.

3-2- Indices of income distribution

1. **GINI index:** GINI index is one of the most important indicators of income inequality, which is expressed as a ratio and has a value between zero and one. The closer the value to one, the greater is the inequality in the countries and when its value is close to zero, the distribution of income is more balanced.
2. **Atkinson index (ATK):** It is a criterion for inequality that is called average paid income according to Atkinson's (1970) defined concept:

(3)

$$I_{\varepsilon}=\left\{1-\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\mu}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}\right\} \quad if \quad \varepsilon\neq 1$$

$$I_{\varepsilon}=\left\{1-\left[\prod_{i=1}^{n}\left(\frac{y_i}{\mu}\right)\right]^{\frac{1}{n}}\right\} \quad if \quad \varepsilon=1$$

Where, y_i is income for individual, μ represents the average of income and E measures the degree of inequality. The range of E is from zero to infinity. Whatever the degree of E rises, Atkinson indices have a greater effect on the variables of low and high incomes. ATK index equals to zero when incomes are equal and inequality is increased by approaching the index to 1.

3-3- Corruption indices

1. **Administrative corruption (AC):** This index is equal to the number of concluded cases of embezzlement, bribery and counterfeiting in court of general jurisdiction.
2. **Corruption Control (CC):** This indicator measures the extent of corruption (the use of public power to gain private interests). The range of changes in this index is between -2.5 and + 2.5, which higher values indicate better control of corruption and lower values indicate poorer control of corruption in countries.
3. **Sanction Virtual Variable (D2):** The criterion for this virtual variable is Zivot & Andrews stationary test, which considers the structural break in unit root test. For this purpose, structural failure has been identified since 2010 using the poverty line variable (LP). Therefore, the timing of sanctions' effect has been adjusted as 0 and 1 before and after the year of 2010, respectively.

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4- Toda-Yamamoto Causality Test (TY)

Toda and Yamamoto proposed a simple method in the form of estimating a modified VAR model to investigate the Granger causality relationship. They argue that the method is valid even in the presence of a co-integration relationship between variables. In this method, the number of optimal intervals (k) of the VAR model should first be determined. Then, the degree of maximum convergence (dmax) is determined and a VAR model with the number of (k+dmax) intervals is formed. The process of selecting time intervals is valid when K≥dmax. If the following two-variable model is considered, the Toda-Yamamoto causality test can be stated as follows:

$$Y_t = \alpha_0 + \beta_{1i}\sum_{i=1}^{k} Y_{t-i} + \beta_{2j}\sum_{j=k+1}^{d\max} Y_{t-j} + \gamma_{1i}\sum_{i=1}^{k} x_{t-i} + \gamma 2j\sum_{j=k+1}^{d\max} x_{t-j} + \varepsilon_{1t}$$

(4)

$$x_t = \alpha_1 + \lambda_{1i}\sum_{i=1}^{k} x_{t-i} + \lambda_{2j}\sum_{j=k+1}^{d\max} x_{t-j} + \sigma_{1i}\sum_{i=1}^{k} Y_{t-i} + \sigma_{2j}\sum_{j=k+1}^{d\max} Y_{t-j} + \varepsilon_{2t}$$

The used T-statistic of the present study would be the parent statistic that has an asymptote distribution of x^2 with freedom degree equaling to the number of zero constraints (Toda & Yamamoto, 1995). According to Zapata and Rambaldi, the advantage of this method is that there is no need to know co-integration features of system by utilizing from this method and only VAR model rank and the degree of maximum convergence of variables are sufficient to perform this test (Zapata & Rambaldi, 1997).

5- Model estimation and data analysis

5-1- The results of stationary test

Since most macroeconomic time series variables are non- stationary, it is necessary to make sure that variables are stationary according to co-integration theory in econometrics in order to avoid false regression in regression analysis. For this purpose, the variables of the present study were evaluated through Phillips-Peron (PP) test. The results of Phillips-

Peron stationary test have been represented in Table (1). As it can be seen from Table (1), all variables have become stationary with one time of differentiation, except the poverty line variable. As indicated in Table (2), Zivot & Andrews stationary test showed that the structural break in 2010 is reason of poverty line variable's non- stationary state and the variable is at stationary level.

Table 1. the results of Phillips-Perron (PP) test
Source: Research Results.

Variable	Prob	Result	Variable (first order differential)	Prob	Result
AC	0.78	Non-Stationary	**d(AC)**	0.00	Stationary
CC	0.61	Non-Stationary	**d(CC)**	0.08	Stationary
ATK	0.26	Non-Stationary	**d(ATK)**	0.00	Stationary
PL	1.0	Non-Stationary	**d(PL)**	0.3	Non-Stationary
IP	0.23	Non-Stationary	**d(IP)**	0.00	Stationary
GINI	0.08	Non-Stationary	**d(GINI)**	0.00	Stationary

Table 2. the results of Zivot & Andrews stationary test for differentiation of variables
Source: Research Results.

Variable	Trend and intercept Model	Result
d(PL)	0.00	Stationary

6- The results obtained from investigating the causality of poverty, income distribution and corruption indices

6-1- The first step: Estimation of VAR model

The results of investigation and estimation of short-run VAR model between poverty, income distribution and corruption indices in two stages, determining the optimal interval based on Schwarz and Akaike statistics and VAR model estimation are presented:

- **VAR relationship between per capita income (IP) and administrative corruption (AC)**

As it can be seen from the estimated results of Table (3), D2 variable of sanctions had a significant positive effect on corruption and had no significant effect on per capita income. In other words, sanctions have affected the causality of per capita income on administrative corruption.

Table 3. estimation of VAR model for capita income (IP) and administrative corruption (AC)
Source: Research Results.

Lag	0	1	2	3	4
AIC	42.7	40.2	39.7	39.8	39.6
VAR	$AC = \underset{t-stat}{1.4}AC(-1) \underset{8.03}{-0.7}AC(-2) \underset{-2.4}{-0.6}AC(-3) \underset{-2.05}{+0.85}AC(-4) \underset{3.8}{-55.5}IP(-1) \underset{-2.9}{+53}IP(-2) \underset{1.6}{-34}IP(-3) \underset{-1.1}{-4.4}IP(-4) \underset{-0.23}{+93656} \underset{4.3}{+176316}D2 \underset{3.9}{}$ $R^2 = 0.89 \quad F = 17.5$ $IP = \underset{t-stat}{-0.0018}AC(-1) \underset{-0.75}{-0.0018}AC(-2) \underset{-0.5}{+0.004}AC(-3) \underset{1.1}{+0.0008}AC(-4) \underset{0.26}{+1.6}IP(-1) \underset{6.4}{-1.1}IP(-2) \underset{-2.6}{+0.5}IP(-3) \underset{1.2}{-0.26}IP(-4) \underset{-1.1}{+506} \underset{1.8}{+850}D2 \underset{1.4}{}$ $R^2 = 0.98 \quad F = 15$				

- **VAR relationship between per capita income (IP) and corruption control (CC)**

As it can be seen from the estimated results of Table (4), D2 variable of sanctions had a significant positive effect on per capita income, but had no significant effect on corruption control. In other words, sanctions have affected the causality of corruption control on per capita income.

Table 4. estimation of VAR model for per capita income (IP) and corruption control (CC)
Source: Research Results.

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**16.5**	**14.74**	**13.95**	**14.3**	**14.62**
VAR	$IP = \underset{t\text{-}stat}{1.4}\,IP(-1) \underset{6.5}{-0.8}\,IP(-2) \underset{-3.6}{-2735}\,CC(-1) \underset{-2.5}{+1064}\,CC(-2) \underset{0.8}{+441} \underset{1}{+1138}\,D2_{2.1}$ $R^2 = 0.97 \quad F = 84$ $CC = \underset{-0.19}{-8.9e-06}\,IP(-1) \underset{-0.8}{-3.7e-05}\,IP(-2) \underset{5}{+1.2}\,CC(-1) \underset{-1.9}{-0.6}\,CC(-2) \underset{-0.7}{-0.07} + 0.13D2_{1.1}$ $R^2 = 0.85 \quad F = 15$				

- **VAR relationship between per capita income (IP) and GINI index**

As it can be seen from the estimated results of Table (5), D2 variable of sanctions had a significant positive effect on per capita income, but had no significant effect on GINI index. In other words, sanctions have affected the causality of income distribution on per capita income.

Table 5. estimation of VAR model for per capita income (IP) and GINI index
Source: Research Results.

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**10.6**	**9.3**	**8.8**	**9.2**	**9**

VAR	$\underset{t-stat}{IP} = 1.4\underset{11.3}{IP(-1)} - 0.56\underset{-3.7}{IP(-2)} - 2227\underset{-0.2}{GINI(-1)} + 26236\underset{2..4}{GINI(-2)}$ $-9161 + 849\underset{1.8}{D2}$ $R^2 = 0.96 \quad F = 135$ $\underset{t-stat}{GINI} = -3.4e-06\underset{-1.4}{IP(-1)} + 2.8e-06\underset{0.97}{IP(-2)} + 0.3\underset{1.5}{GINI(-1)} - 0.05\underset{-0.3}{GINI(-2)}$ $+0.3\underset{2.9}{-} 0.005\underset{-0.6}{D2}$ $R^2 = 0.33 \quad F = 2.5$

- **VAR relationship between per capita income (IP) and Atkinson index (ATK)**

As it can be seen from the estimated results of Table (6), D2 variable of sanctions had no effect on causality of per capita income, on Atkinson Index and vice versa.

Table 6. estimation of VAR model for per capita income (IP) and Atkinson index (ATK)
Source: Research Results.

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**17**	**14.6**	**14.5**	**14.6**	**14.9**
VAR	$\underset{t-stat}{ATK} = 0.3\underset{1.6}{ATK(-1)} + 0.3\underset{1.5}{ATK(-2)} - 4.7e-05\underset{-1.4}{IP(-1)} + 3.3e-05\underset{1}{IP(-2)} + \underset{1.6}{0.2}$ $R^2 = 0.53 \quad F = 7.2$ $\underset{t-stat}{IP} = -469\underset{-0.6}{ATK(-1)} - 303\underset{-0.37}{ATK(-2)} + 1.3\underset{9.5}{IP(-1)} - 0.4\underset{-3.2}{IP(-2)} + \underset{1.3}{716}$ $R^2 = 0.96 \quad F = 138.4$				

- **VAR relationship between poverty line (PL) and administrative corruption (AC)**

As it can be seen from the estimated results of Table (7), D2 variable of sanctions had no effect on causality of per between poverty line, on administrative corruption and vice versa.

Table 7. estimation of VAR model for poverty line (PL) and administrative corruption (AC)
Source: Research Results.

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**44.4**	**40**	**40.1**	**40.4**	**40.1**
VAR	$\underset{t-stat}{PL} = \underset{4.03}{0.9}PL(-1) + \underset{0.97}{0.3}PL(-2) - \underset{-0.84}{0.2}PL(-3) + \underset{0.18}{0.07}PL(-4) + \underset{2.44}{0.01}AC(-1)$ $- \underset{-2.4}{0.01}AC(-2) + \underset{0.7}{0.003}AC(-3) + \underset{0.5}{0.002}AC(-4) + \underset{0.18}{34.1} + \underset{3.1}{1839.7}D2$ $R^2 = 1, F = 493$ $\underset{t-stat}{AC} = \underset{-3.6}{-49.4}PL(-1) + \underset{3.5}{73.2}PL(-2) + \underset{1.6}{29.8}PL(-3) - \underset{-3.4}{79.3}PL(-4) + \underset{7.9}{1.4}AC(-1)$ $- \underset{-1}{0.3}AC(-2) - \underset{-2.9}{0.9}AC(-3) + \underset{4}{0.9}AC(-4) + \underset{1.5}{16847} + \underset{3.6}{134696.1}D2$ $R^2 = 0.9, F = 16.6$				

- **VAR relationship between poverty line (PL) and corruption control (CC)**

As it can be seen from the estimated results of Table (8), D2 variable of sanctions had an effect on causality of per between poverty line, on corruption control and vice versa.

Table 8. estimation of VAR model for poverty line (PL) and corruption control (CC)
Source: Research Results.

Lag	0	1	2	3	4
AIC	19.3	14.8	15.3	15.9	16.1
VAR	$\underset{t-stat}{PL} = \underset{22.6}{1.05}PL(-1) \underset{-0.22}{-196.1}CC(-1) + \underset{0.3}{143} + \underset{2.3}{1420.6}D2, R^2 = 1, F = 685.3$ $\underset{t-stat}{CC} = \underset{-3}{-1.9}PL(-1) + \underset{8.3}{1.05}CC(-1) + \underset{0.6}{0.04} + \underset{3}{0.25}D2, R^2 = 0.9, F = 33.4$				

- **VAR relationship between poverty line (PL) and GINI index**

As it can be seen from the estimated results of Table (9), D2 variable of sanctions had a significant positive effect on poverty line, but had no significant effect on GINI index. In other words, sanctions have affected the causality of income distribution on poverty line.

Table 9. estimation of VAR model for poverty line (PL) and GINI index
Source: Research Results.

Lag	0	1	2	3	4
AIC	12.3	9	9.4	9.7	10
VAR	$\underset{t-stat}{PL} = \underset{32.9}{1.1}PL(-1) \underset{-1.1}{-11531.3}GINI(-1) + \underset{1.08}{4739.5} + \underset{2.6}{1190.1}D2, R^2 = 1, F = 1754.7$ $\underset{t-stat}{GINI} = \underset{2.3}{1.3}PL(-1) + \underset{1.1}{0.2}GINI(-1) + \underset{4.4}{0.32} \underset{-2.7}{-0.02}D2, R^2 = 0.4, F = 5.5$				

- **VAR relationship between poverty line (PL) and Atkinson index (ATK)**

As it can be seen from the estimated results of Table (10), D2 variable of sanctions had no effect on causality of poverty line, on Atkinson Index and vice versa.

Table 10. estimation of VAR model for poverty line (PL) and Atkinson index (ATK)
Source: Research Results**.**

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**19.5**	**14.8**	**15.1**	**15.4**	**15.7**
VAR	$\underset{t-stat}{PL} = 1.15\,PL(-1) \underset{52.8}{} - 706.8\,\underset{-1}{ATK(-1)} + \underset{1.1}{384}, R^2 = 1, F = 1835.5$ $\underset{t-stat}{ATK} = -3.1\,\underset{-0.7}{PL(-1)} + 0.6\,\underset{3.6}{ATK(-1)} + \underset{2.3}{0.2}, R^2 = 0.4, F = 10.2$				

- **VAR relationship between GINI index and administrative corruption (AC)**

As it can be seen from the estimated results of Table (11), D2 variable of sanctions had no effect on causality of GINI index, on administrative corruption and vice versa.

Table 11. estimation of VAR model for per capita income (IP) and administrative corruption (AC)
Source: Research Results**.**

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**18.8**	**17.8**	**18**	**18.4**	**18.7**
VAR	$\underset{t-stat}{GINI} = 0.4\,\underset{2.1}{GINI(-1)} + 2.9\,\underset{1.3}{AC(-1)} + \underset{3.5}{0.5}, R^2 = 0.3, F = 5.3$ $\underset{t-stat}{AC} = 45879.02\,\underset{0.05}{GINI(-1)} + 0.8\,\underset{8.3}{AC(-1)} - \underset{-0.01}{5184}, R^2 = 0.75, F = 42.2$				

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- **VAR relationship between GINI index and corruption control (CC)**

As it can be seen from the estimated results of Table (12), D2 variable of sanctions had no effect on causality of GINI index, on corruption control and vice versa.

Table 12. estimation of VAR model for per capita income (IP) and corruption control (CC)
Source: Research Results.

Lag	0	1	2	3	4
AIC	-6.5	-9.0	-8.5	-7.9	-7.4
VAR	$\underset{t-stat}{GINI} = 0.1\,GINI(-1) + \underset{0.4}{0.04}\,CC(-1) + \underset{5.7}{0.4}, R^2 = 0.7, F = 21.4$ $\underset{t-stat}{CC} = -5.4\,GINI(-1) + \underset{-2.06}{1.08}\,CC(-1) + \underset{8.02}{2.2}, R^2 = 0.82, F = 39.5$				

- **VAR relationship between Atkinson index (ATK) and administrative corruption (AC)**

As it can be seen from the estimated results of Table (13), D2 variable of sanctions had a significant positive effect on administrative corruption, but had no significant effect on Atkinson index. In other words, sanctions have affected the causality of income distribution on administrative corruption.

Table 13. estimation of VAR model for poverty line (PL) and administrative corruption (AC)

Source: Research Results.

Lag	**0**	**1**	**2**	**3**	**4**
SIC	**24.5**	**23.3**	**23.2**	**23.4**	**23.4**
VAR	$\underset{t-stat}{ATK} = 0.4\,\underset{1.7}{ATK(-1)} + 0.5\,\underset{2.1}{ATK(-2)} - 0.3\,\underset{-1.2}{ATK(-3)} - 0.2\,\underset{-0.8}{ATK(-4)} + 2.4\,\underset{0.3}{AC(-1)}$ $+ 3.7\,\underset{0.3}{AC(-2)} + 2.6\,\underset{0.2}{AC(-3)} - 7.9\,\underset{-1.1}{AC(-4)} + \underset{1.8}{0.3} - 0.08\,\underset{-1}{D2}, R^2 = 0.6, F = 3$ $\underset{t-stat}{AC} = 55778.9\,\underset{1.1}{ATK(-1)} + 150091.1\,\underset{2.8}{ATK(-2)} + 101914.001\,\underset{1.7}{ATK(-3)} + 45467.2\,A$ $+ 0.8\,\underset{4.5}{AC(-1)} - 0.3\,\underset{-1.05}{AC(-2)} - 0.3\,\underset{-1.4}{AC(-3)} + 0.4\,\underset{2.3}{AC(-4)} - \underset{3.6}{117977} + \underset{3.2}{59281.3}\,D2, R^2 = 1, F$				

- **VAR relationship between Atkinson index (ATK) and corruption control (CC)**

As it can be seen from the estimated results of Table (14), D2 variable of sanctions had a significant positive effect on Atkinson index, but had no significant effect on corruption control. In other words, sanctions have affected the causality of corruption control on income distribution.

Table 14. estimation of VAR model for poverty line (PL) and corruption control (CC)
Source: Research Results.

Lag	**0**	**1**	**2**	**3**	**4**
AIC	**-1.7**	**-3.4**	**-3.3**	**-3.2**	**-3.0**

VAR	$\underset{t-stat}{ATK} = \underset{1.8}{0.5}\,ATK(-1) + \underset{1.8}{0.5}\,ATK(-2) - \underset{-0.5}{0.12}\,ATK(-3) - \underset{-0.2}{0.1}\,CC(-1) - \underset{-0.2}{0.1}\,CC(-2) + \underset{1.5}{0.54}\,CC(-3) + \underset{0.9}{0.2} + \underset{1.8}{0.23}\,D2, R^2 = 0.8, F = 6$ $\underset{t-stat}{CC} = \underset{0.4}{0.12}\,ATK(-1) + \underset{1.3}{0.4}\,ATK(-2) + \underset{0.7}{0.2}\,ATK(-3) + \underset{2.8}{0.9}\,CC(-1) - \underset{-0.8}{0.32}\,CC(-2) + \underset{0.5}{0.2}\,CC(-3) - \underset{0.2}{0.5} + \underset{1.3}{0.2}\,D2, R^2 = 0.9, F = 11.8$

6-2- Investigating the results of Toda- Yamamoto causality test

- **The Relationship between causality of corruption and the income distribution on Poverty**

Table (15), represents the results of parent test (χ^2) for investigating the causality of poverty variable with corruption and income distribution variables based on estimated relations of VAR model at the confidence level of 95%.

Table 15. the results of causality test for poverty
Source: Research Results.

Independent Variable	Effective variable	(χ^2) for Sanction Model	Prob	Result
Per capita Income	Gini Coefficient	3.6	0.16	insignificant
		5.9	0.05	significant*
	Atkinson index	3.9	0.27	insignificant
	Corruption	0.7	0.9	insignificant
		20.6	0	significant*
	COC	6.2	0.04	significant*
		7	0.02	significant*
Poverty Line	Gini Coefficient	6.4	0.02	significant*
		1.1	0.3	insignificant
	Atkinson index	0.9	0.3	insignificant

	Corruption	**0.5**	**0.5**	insignificant
		7.7	**0.1**	significant**
	COC	**0.05**	**0.8**	insignificant

***Significant at the level of 5%, **Significant at the level of 10%**

According to the obtained results of the present study, GINI index is not the cause of per capita income under normal condition, but is its cause under sanctions condition. In contrast, Atkinson index is the cause of per capita income neither under normal condition, nor under sanctions condition. Also, GINI index is the cause of poverty under normal condition, but is not its cause under sanctions condition. In contrast, Atkinson index is the cause of per capita income neither under normal condition, nor under sanctions condition.

On the other hand, investigating the causality of corruption on poverty indices showed that administrative corruption is not the cause of per capita income and the poverty line under normal condition, but is their cause under sanctions condition. Also, corruption control is the cause of per capita income both under normal and sanctions conditions, but is not the cause of poverty under normal and sanctions conditions.

- **The Relationship between causality of poverty and corruption on income distribution**

Table (16) represents the results of parent test (χ^2) for investigating the causality of income distribution variable with corruption and poverty variables based on estimated relations of VAR model at the confidence level of 95%.

Table 16. the results of causality test for income distribution
Source: Research Results.

Independent Variable	**Effective variable**	**(χ^2) for Sanction Model**	**Prob**	**Result**
Gini Coefficient	**Per capita Income**	**3.4**	**0.18**	insignificant

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	Poverty Line	**0**	**0.99**	insignificant
		5.5	**0.02**	significant*
	Corruption	**1.8**	**0.18**	insignificant
	COC	**23.2**	**0**	significant*
Atkinson index	**Per capita Income**	**0.75**	**0.8**	insignificant
	Poverty Line	**0.4**	**0.5**	insignificant
	Corruption	**2.7**	**0.6**	insignificant
	COC	**3.9**	**0.3**	insignificant

***Significant at the level of 5%, **Significant at the level of 10%**

According to the obtained results of the present study, the causality of per capita income on GINI was non-significant under any conditions. In other words, per capita income is not a good index for investigating income distribution. Also, poverty line is not the cause of GINI index under normal condition, but is its cause under sanctions conditions. According to the results, administrative corruption can be the cause of GINI index neither under normal condition, nor under sanctions condition. In contrast, corruption control is the cause of GINI index under both conditions. Also, no significant relationship was found between poverty and corruption indices with Atkinson's income distribution index under both conditions.

- **The Relationship between causality of poverty and income distribution on corruption**

Table (17) represents the results of parent test (χ^2) for investigating the causality of corruption variable with poverty and income distribution variables based on estimated relations of VAR model at the confidence level of 95%.

Table 17. the results of causality test for corruption
Source: Research Results.

Independent Variable	**Effective variable**	(χ^2) / (χ^2) **for Sanction Model**	**Prob**	**Result**
Corruption	**Gini Coefficient**	**0**	**0.9**	insignificant
	Atkinson index	**26.7**	**0**	significant*
	Per capita Income	**4.8**	**0.11**	insignificant
		8.7	**0.07**	significant**
	Poverty Line	**0.4**	**0.5**	insignificant
		18.9	**0**	significant*
COC	**Gini Coefficient**	**4.3**	**0.04**	significant*
	Atkinson index	**7.1**	**0.06**	significant**
	Per capita Income	**1.7**	**0.4**	insignificant
	Poverty Line	**0.76**	**0.4**	insignificant
		8.8	**0**	significant*

***Significant at the level of 5%, **Significant at the level of 10%**

According to the obtained results of the present study, GINI index is not the cause of administrative corruption but Atkinson index is the cause of administrative corruption. In other words, income distribution is the cause of administrative corruption in terms of Atkinson index. Investigating the poverty indices showed that per capita income and poverty line are not the cause of corruption under normal condition, but they are the cause of corruption under sanctions condition. Also, income distribution indices of GINI and Atkinson are the cause of corruption control under both conditions. Among poverty indices, per capita income and poverty line are not the cause of corruption control under normal conditions, but poverty line can be the cause of corruption control under sanctions condition.

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7- Finding

Result of research show that:

- sanctions have affected the causality of per capita income on administrative corruption.
- sanctions have affected the causality of corruption control on per capita income.
- sanctions have affected the causality of income distribution on per capita income.
- sanctions had no effect on causality of per capita income, on Atkinson Index and vice versa.
- sanctions had no effect on causality of per between poverty line, on administrative corruption and vice versa.
- sanctions had an effect on causality of per between poverty line, on corruption control and vice versa.
- sanctions had a significant positive effect on poverty line, but had no significant effect on GINI index. In other words, sanctions have affected the causality of income distribution on poverty line.
- sanctions had no effect on causality of poverty line, on Atkinson Index and vice versa.
- sanctions had no effect on causality of GINI index, on administrative corruption and vice versa.
- sanctions had no effect on causality of GINI index, on corruption control and vice versa.
- sanctions had a significant positive effect on administrative corruption, but had no significant effect on Atkinson index. In other words, sanctions have affected the causality of income distribution on administrative corruption.
- sanctions had a significant positive effect on Atkinson index, but had no significant effect on corruption control. In other

words, sanctions have affected the causality of corruption control on income distribution.

According to the obtained results of the present study, GINI index is not the cause of per capita income under normal condition, but is its cause under sanctions condition. In contrast, Atkinson index is the cause of per capita income neither under normal condition, nor under sanctions condition. Also, GINI index is the cause of poverty under normal condition, but is not its cause under sanctions condition. In contrast, Atkinson index is the cause of per capita income neither under normal condition, nor under sanctions condition. Also, the causality of per capita income on GINI was non-significant under any conditions. In other words, per capita income is not a good index for investigating income distribution. Also, poverty line is not the cause of GINI index under normal condition, but is its cause under sanctions conditions. According to the results, administrative corruption can be the cause of GINI index neither under normal condition, nor under sanctions condition. In contrast, corruption control is the cause of GINI index under both conditions. Also, no significant relationship was found between poverty and

Other result show that GINI index is not the cause of administrative corruption but Atkinson index is the cause of administrative corruption. In other words, income distribution is the cause of administrative corruption in terms of Atkinson index. Investigating the poverty indices showed that per capita income and poverty line are not the cause of corruption under normal condition, but they are the cause of corruption under sanctions condition. Also, income distribution indices of GINI and Atkinson are the cause of corruption control under both conditions. Among poverty indices, per capita income and poverty line are not the cause of corruption control under normal conditions, but poverty line can be the cause of corruption control under sanctions condition.

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8- Conclusion

The purpose of the present study was to investigate the effect of sanctions on causal relationship between corruption, income inequality and poverty in Iran during1984 to 2020. For this purpose, the indices of per capita income p, poverty line, Atkinson, GINI, administrative corruption and corruption control were investigated. In general, the following results were obtained from the present study:

1. Income distribution is not an effective variable for poverty in Iran.
2. Corruption is an effective variable for causality of poverty in Iran and its significance level is higher under sanctions condition.
3. Corruption and poverty cannot properly explain the income distribution in Iran. However, the corruption control can be the cause of income distribution and poverty line is a proper representative for the cause of income distribution under sanctions conditions.
4. Income distribution is a strong variable for causality of corruption in Iran.
5. Poverty can properly explain the causality of corruption in Iran under sanctions condition, but is not the cause of corruption under normal condition.

According to the obtained results, it seems that sanctions condition is an effective variable for the relationship between variables of income distribution, corruption and poverty. However, the effective factors of income distribution need further investigations in future.

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