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A CANONICAL CORRELATION APPROACH IN DETERMINING GROWTH & DEVELOPMENT AND SOCIAL INCLUSION LINKAGES [1,2]

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ABSTRACT
Keywords

Canonical Correlation Analysis, Canonical Redundancy Analysis, Communality Coefficient, Inclusive Growth, Social Inclusion

In 2017 Inclusive Growth and Development Report published by World Economic Forum, Inclusive Growth and Development Key Performance Indicators have been based upon three dimensions as "Growth and Development (G&D)", "Inclusion (INC)" and "Intergenerational Equity and Sustainability". In this study, interrelations between G&D and INC dimensions have been tried to be revealed for totally 91 countries which take place in 2017 Report by carrying out Canonical Correlation Analysis. Standardized canonical coefficients have shown that 'GDP per Capita' variable has provided the largest contribution to G&D dimension and 'Median Household Income' variable has created the largest effect on INC set when the first canonical correlation is taken into consideration. Based on the communality coefficients, it can be said that 'Employment' variable may not represent a strong relationship with INC set. In addition, 'Net Income Gini' and 'Wealth Gini' variables have been detected not to be associated with G&D set.

BÜYÜME & KALKINMA VE SOSYAL İÇERME İLİŞKİLERİNİ BELİRLEMEDE KANONİK KORELASYON YAKLAŞIMI

ÖZ
Anahtar Kelimeler

Kanonik Korelasyon Analizi, Kanonik Açıklanabilirlik Belireme Endeksi, Ortak Varyans Katsayısı, Kapsayıcı Büyüme, Sosyal İçerme

Dünya Ekonomik Forumu tarafından yayınlanan, 2017 Kapsayıcı Büyüme ve Kalkınma Raporu'nda Kapsayıcı Büyüme ve Kalkınma Anahtar Performans Göstergeleri "Büyüme ve Kalkınma (G&D)", "İçerme (INC)" ve "Kuşaklararası Eşitlik ve Sürdürülebilirlik" olmak üzere üç boyuta dayandırılmıştır. Bu çalışmada, Kanonik Korelasyon Analizi kullanılarak 2017 yılı raporunda yer alan toplam 91 ülke için G&D ve INC boyutları arasındaki ilişkiler ortaya konulmaya çalışılmıştır. Standartlaştırılmış kanonik katsayılar, birinci kanonik korelasyon dikkate alındığında 'Kişi başına düşen GSYİH' değişkeninin G&D boyutuna en büyük katkıyı sağladığını ve 'Medyan Hanehalkı Geliri' değişkeninin ise INC setindeki en büyük etkiyi yarattığını göstermiştir. Ortak varyans katsayılarına dayanarak, "İstihdam" değişkeninin INC seti ile güçlü bir ilişkiyi temsil etmeyebileceği söylenebilir. Ayrıca, "Net Gelir Gini" ve "Servet Gini" değişkenlerinin G&D seti ile ilişkili olmadığı tespit edilmiştir.

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1. INTRODUCTION

Nowadays the leading issues faced by many societies can be exemplified as income-wealth or gender inequality; environmental degradation through pollution in terms of air, water or soil triggering health problems, destruction of species and ecosystems, waste generation, resource depletion, justice & peace and so on. Many of these issues are highly possible to be associated with poorly distribution of resources and thus eventuated in a lower level of total factor productivity in developing countries and surely leading to a lower-level of gross domestic product (GDP). Misallocation of resources can exist due to unbalanced economic growth which may also result in welfare losses and the fact that drastic growth opportunities are in interaction with human development reciprocally has entailed a careful attention on the term of economic growth. Subsequent to mid-1980s, empirical growth studies has intensified with the initial papers by Romer (1986) and Lucas (1988) and theories appeared in these papers have made a contribution to endogenous growth models which clarify economic growth with an examination on the relationship between Research & Development (R&D) and technological development .

Inclusive Growth is a multidimensional long-term strategy of economic growth which is of crucial importance for many economies by trying to provide new opportunities for whole segments of society and taking both income-related and also non-income dimensions that are important for well-being of society into account and thus does not content with not only traditional economic output measure. It has been one of the concepts that are the most frequently mentioned about by most specialists and came into the view as a challenge required to be achieved for improving living standards. Its focus point has been mostly to provide equitable opportunities for economic agents. Its importance can also be attributed to Sustainable Development Goals (SDGs) which incorporate 'Goal 8: Decent Work and Economic Growth' designed for creating qualified job opportunities and promoting inclusive and sustainable economic growth.

National Key Performance Indicators (KPIs) -which underlie the global "Inclusive Development Index (IDI)"- specify one of the essential data sets measuring national economic performance in a more comprehensive frame than GDP per capita does solely and thus enable the countries to monitor their performances on inclusive growth and

development especially in the case when sustaining the improvement of living standards to a great extent is considered as the principal development goal rather than enhancing the amount of goods and services produced by itself (World Economic Forum, 2017: ix,19).

Table 1: Inclusive Growth and Development Key Performance Indicators

NATIONAL KEY PERFORMANCE INDICATORS					
Growth and Development		**Inclusion**		**Intergenerational Equity and Sustainability**	
*GDP (per capita)	*Labor Productivity	*Median Household Income	*Income Gini	*Adjusted Net Savings	*Dependency Ratio
*Employment	*Healthy Life Expectancy	*Poverty Rate	*Wealth Gini	*Public Debt (as a share of GDP)	*Carbon Intensity of GDP

Source: World Economic Forum (2017: ix).

Table 1 has captured three pillars of national KPIs as "Growth & Development", "Inclusion" and "Intergenerational Equity and Sustainability" each also including four core metrics of the relevant pillar. Descriptions and data sources of these sub-metrics have been given place in the 2017 Inclusive Growth and Development Report. There are many studies focusing on the links between these three pillars and their relevant measures.

Inducing employment growth by creating new job opportunities and technologies, productive entrepreneurs also play a chief role in terms of being able to revive the economy (Kritikos, 2014: 1-3). Also, a rise in factor productivity through technological advances would result in higher output levels in the economy and developed countries have experienced greater levels of factor productivities (Korkmaz & Korkmaz, 2017: 71).

Over the last several years, empirical research studies on the relationship between health and economic growth have drawn an intense attention. Many cross-country growth regressions have incorporated life expectancy variable as a proxy for health and in a general manner, life expectancy has been found to influence economic growth rate significantly and positively by many researchers (Bloom *et al.*, 2004: 1).

Barro (1996) has covered a panel study of roughly 100 countries from 1960 to 1990. Empirical findings have revealed that greater levels of schooling and life expectancy stimulate growth; lower fertility rates and improvements in terms of trade stimulate economic growth for a lower starting level of real GDP per capita supporting the neoclassical model's general inclusive concept of conditional convergence. In addition, growth has been found to be related to the initial level of real GDP per capita in a negative direction. Aghion, Howitt and Murtin (2010) have studied the connection between health and economic growth by attaching the Lucas (1988) and Nelson-Phelps (1966) approaches to human capital based on cross-country regression analyses covering the period 1960-2000 and found that a higher initial level and better life expectancy reveals an increment on per capita GDP growth in a significant manner. Mondal et al. (2015) have examined the relationship between sociodemographic and health factors for least developed countries using stepwise multiple regression method. Crude death rate, infant mortality rate, physicians' density, and gross national income per capita variables have been specified as the most notable predictors of life expectancy which is regarded as an essential indicator for national development. Ngangue and Manfred (2015) have tried to reveal the effect of life expectancy on economic growth for 141 developing countries categorized as low, intermediate and high income levels by utilizing from a dynamic panel approach covering the period 2000-2013. As a result, it has been revealed that improvement in life expectancy has a positive significant effect on the growth of Gross National Income (GNI) per capita for the developing countries with low-income and high-income except middle-income countries.

Well-rounded reports by the Commission on Macroeconomics and Health in 2001 named 'Macroeconomics and Health: Investing in Health for Economic Development' and European Commission in 2005 named 'The Contribution of Health to the Economy of the European Union' have been put forward discussing an increase in health expenditures as a tool that will contribute to the GDP growth taking both developed and developing countries into account. In case advances in health create a long-term sustainable GDP growth, crucial health policy implications will be assigned a high priority triggering a perpetual endogenous advancement in terms of health and GDP (Swift, 2011: 3).

Apart from life expectancy, labour productivity is deemed a core indicator of economic growth. Dao (2014) has made a research regarding how main determinants of economic growth have an influence on a sample of 38 developing countries over the period 1995-2010 and came to the conclusion about the dependency of GDP per capita growth rate in a linear combination on technological progress, gross capital formation, the initial level of output per capita, labour productivity growth and as well as human capital formation**.** Also, Korkmaz and Korkmaz (2017) have aimed to reveal the relationship between labor productivity –or partial factor productivity- and economic growth for seven selected OECD countries (Belgium, Germany, Spain, France, Italy, Finland and UK) covering the period 2008-2014 through panel causality analysis and found uni-directional causality relationship from economic growth to labor productivity apart from detecting a long-run equilibrium relationship.

In 2017 Inclusive Growth and Development Report which has been published by World Economic Forum, Inclusive Growth and Development Key Performance Indicators have been composed from three dimensions as "Growth & Development", "Inclusion" and "Intergenerational Equity and Sustainability". In this study, it has been aimed to reveal and compare the interrelations between "Growth & Development" (G&D) and "Inclusion" (INC) dimensions for totally 91 countries that take place in 2017 Inclusive Growth and Development Report and do not have any missing data by employing Canonical Correlation Analysis (CCA) framework which aims to measure the association between composites of two multivariate sets of variables in a way that will maximize the correlation between given sets of variables.

The rest of the paper has been organised as follows: Section 2 presents a brief notion of CCA, Section 3 sets out data set and the findings obtained from the analysis. Finally, Section 4 gives a brief summary of general conclusions.

2. CANONICAL CORRELATION APPROACH

Canonical Correlation Analysis (CCA) is a multivariate statistical approach which was developed by Hoteling (1936) and makes it possible to reveal the linear relationship between two sets of variables through the linear composites of Y and X variables.

In the canonical correlation analysis, the required assumptions can be expressed as: the data should display a multivariate normal distribution, there should be no multicollinearity problem and the sample width should be as large as possible (5 times

the number of variables) in terms of reliability. Also, while it is recommended to extract outliers before the analysis because of the fact that outliers will affect the correlation between the variables negatively (Cankaya, 2005; Cankaya et al., 2009), the data set is required to be standardized in order to eliminate errors arising from the unitary differences of the variables.

Let X be first set of variables and Y be the second set of variables. Thus, linear combinations of the X variables expressed by the new variable U_1 and Y variables expresses by the new variable V_1 are given respectively in equations (1) and (2):

$$U_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots\ldots + a_{1p}X_p \quad (1)$$

$$V_1 = b_{11}Y_1 + b_{12}Y_2 + \ldots\ldots\ldots\ldots\ldots + b_{1q}Y_q \quad (2)$$

These new U_1 and V_1 variables composed of linear combinations of original variables are known as canonical variates. The application process goes on until the correlation between m[th] canonical variates, namely C_m, is maximum (Sağlam, 2013: 69). Besides, Stewart and Love (1968) have proposed a redundancy index which indicates the portion of the variability in one set of variables that can be explained by the opposite set.

3. DATA SET and APPLICATION RESULTS

Data set used in the study have been extracted out of the 'Inclusive Growth and Development Report 2017' that has been published by World Economic Forum. In this study, it has been aimed to investigate the links between the first two dimensions of KPIs which are "Growth & Development (G&D)" and "Inclusion (INC)" for 91 countries and the choice of countries has been justified by data availability. Both dimensions consist of four core components as expressed in Table 2:

Table 2: Data Set Used in the Study

Growth & Development (G&D) Set of Variables	**Inclusion (INC) Set of Variables**
GDP Per Capita (X1)	Net Income Gini (Y1)
Labor Productivity (X2)	Poverty Rate (Y2)
Healthy Life Expectancy (X3)	Wealth Gini (Y3)
Employment (X4)	Median Income (Y4)

Canonical Correlation Analysis have been carried out for totally 91 countries as 27 advanced and 64 developing and classification of these countries have been given in Table 3:

Table 3: Country Coverage In the Research

Classification of Countries
Advanced Economies (27) *Norway, Switzerland, Luxemburg, Iceland, Denmark, Sweden, Netherlands, Australia, Austria, Finland, Ireland, Canada, Germany, Czech Republic, Belgium, Slovak Republic, France, Slovenia, United Kingdom, Estonia, United States, Japan, Israel, Spain, Italy, Portugal, Greece*
Developing Economies (64) *Lithuania, Azerbaijan, Hungary, Poland, Panama, Romania, Uruguay, Latvia, Malaysia, Costa Rica, Chile, Thailand, Russian Federation, Peru, China, Kazakhstan, Bulgaria, Paraguay, Turkey, Croatia, Macedonia FYR, Vietnam, Venezuela, Nepal, Mexico, Brazil, Georgia, Nicaragua, Colombia, Moldova, Bangladesh, Bolivia, Albania, Sri Lanka, Philippines, El Salvador, Cambodia, Tunisia, Morocco, Ukraine, Lao PDR, Armenia, Tanzania, Pakistan, Tajikistan, Ghana, Cameroon, Kyrgyz Republic, Senegal, Mali, Namibia, Uganda, Kenya, Burundi, Sierra Leone, Rwanda, Lesotho, South Africa, Nigeria, Madagascar, Mauritania, Zambia, Malawi, Mozambique*

The correlation coefficients between G&D and INC sets of variables have been presented in Table 4. Based on the results, it can be said that there is a very strong relationship between GDP Per Capita (X1) & Median Income (Y4), Labor Productivity (X2) & Median Income (Y4) and Healthy Life Expectancy (X3) & Poverty Rate (Y2) respectively. Apart from the other two relationships, Healthy Life Expectancy (X3) and Poverty Rate (Y2) are interrelated in a negative direction.

Table 4: Pearson Correlation Coefficients between G&D and INC Sets

	Y1	Y2	Y3	Y4
X1	- .5509	- .3970	- .1179	.9592
X2	- .5280	- .5388	- .1956	.9198
X3	- .4733	- .8299	- .3561	.7180
X4	.1588	.4613	.3398	- .2084

Table 5: Canonical Correlations

Pairs of Canonical Variates	**1** (U_1V_1)	**2** (U_2V_2)	**3** (U_3V_3)	**4** (U_4V_4)
Canonical Correlation	.9702	.8527	.1543	.0808

Table 5 shows the canonical correlations obtained from the CCA employed to determine the relationship between G & D and INC sets. Four canonical correlations and four canonical varieties have been obtained depending on the fact that there are four variables in each of the G&D and INC sets. According to the Table 5, the first (0.9702) and second (0.8527) canonical correlation coefficients have revealed a high relationship between G&D and INC variable sets. As it is seen, canonical correlation coefficients between the canonical variables have been arranged in descending order of magnitudes.

Significance tests for the canonical correlations obtained have appeared in Table 6. Significance tests are of paramount importance as it is required to interpret only statistically significant canonical correlations. According to Table 6, the multivariate test statistics of Pillai's Trace, Wilks' Lambda, Hotelling Trace and Roy's Largest Root point out that amongst four canonical coefficients, only the first (0.9702) and second (0.8527) computed from the first two pairs of canonical variates are realized to be statistically significant depending on the probability values in 'significance' column found to be smaller than 0.05 for the first two canonical variates.

Table 6: Statistical Significance of Canonical Correlations: MANOVA Test Criteria and F Approximations

Tests of Significance for First Pair of Canonical Variate U_1V_1					
Test Name	**Value**	**Approx. F**	**Numerator Degrees of Freedom**	**Denominator Degrees of Freedom**	**Significance of F Pr > F**
Wilks' Lambda	.01554	46.20489	16	254.2068	.00000
Pillai-Bartlett Trace	1.69865	15.86936	16	344	.00000
Hotelling-Lawley Trace	18.72917	95.40173	16	326	.00000
Roy's Largest Root	.94130	344.7534	4	86	.00000
NOTE: F Statistic for Roy's Greatest Root is an upper bound.					
Tests of Significance for Second Pair of Canonical Variate U_2V_2					
Test Name	**Value**	**Approx. F**	**Numerator Degrees of Freedom**	**Denominator Degrees of Freedom**	**Significance of F Pr > F**
Wilks' Lambda	.26475	16.51328	9	204.5845	.00000
Pillai-Bartlett	.75735	9.13478	9	352	.00000
Hotelling-Lawley Trace	2.69413	24.99557	9	334	.00000
Tests of Significance for Third Pair of Canonical Variate U_3V_3					
Test Name	**Value**	**Approx. F**	**Numerator Degrees of Freedom**	**Denominator Degrees of Freedom**	**Significance of F Pr > F**
Wilks' Lambda	.96982	.65630	4	170	.62321
Pillai-Bartlett Trace	.03034	.68785	4	360	.60075
Hotelling-Lawley Trace	.03096	.66184	4	342	.61890
Tests of Significance for Fourth Pair of Canonical Variate U_4V_4					
Test Name	**Value**	**Approx. F**	**Numerator Degrees of Freedom**	**Denominator Degrees of Freedom**	**Significance of F Pr > F**
Wilks' Lambda	.99347	.56507	1	86	.45428
Pillai-Bartlett Trace	.00653	.60153	1	368	.43849
Hotelling-Lawley Trace	.00657	.57493	1	350	.44882

Consequently, the strong relationship between G&D and INC sets has been confirmed to be significant for 95% confidence level. The Wilks' Lambda value refers to the unexplained portion of the variance between the canonical variables covered in the study. The proportion of the common variance of canonical variables is defined as the

value obtained by subtracting the Wilks 'Lambda value from 1 (Meyers *et al.*, 2013: 616). As can be seen from Table 6, the Wilks 'Lambda value of the first canonical correlation is 0.015 and this value represents the unexplained variance. The value of 0.985 obtained by subtracting this value from 1 indicates the shared common variance between variable sets across all pairs of canonical variates discussed in the study. In other words, it is possible to say that the shared common variance between G&D and INC variable sets is 98.5% which states a large effect for the full model.

Table 7: Standardized Canonical Coefficients for G&D and INC Variable Sets

	G&D Variable Set					**INC Variable Set**			
	X1	**X2**	**X3**	**X4**		**Y1**	**Y2**	**Y3**	**Y4**
U_1	- .805	- .006	- .257	.021	V_1	- .039	.097	.001	- .972
U_2	-1.251	.364	1.039	- .249	V_2	.106	-1.033	- .313	- .583
U_3	-1.748	1.776	.414	1.238	V_3	- .205	- .557	1.054	- .223
U_4	-2.586	3.437	- .899	.179	V_4	1.345	- .007	- .243	.743

Table 7 shows the standardized coefficients for G&D and INC sets. The standardized canonical variable coefficients show the amount of change in terms of the standard deviation in the canonical variable when there is a one standard deviation increase in the original variable. In other words, these coefficients are the coefficients that represent the effect amounts (contributions) of the original variables of the given set in the formation of the canonical variable in a set (Keskin *et al.*, 2005: 157).When first U_1 and V_1 pair of canonical variables is taken into consideration, the largest contribution to the formation of the canonical variable U_1 has been provided by 'GDP Per Capita (X1)' variable and the highest contribution for the INC set has been obtained by 'Median Income (Y4)' with the value of 0.972 in magnitude. For the second canonical variables, while 'GDP Per Capita (X1)' variable provides the highest contribution to G&D set again; the largest contribution to INC set in magnitude has come from 'Poverty Rate (Y2)' variable.

Table 8: Canonical Loadings for "Growth and Development" Variables Set-1 (X) and "Inclusion" Variables Set-2 (Y)

	G&D Variable Set					INC Variable Set			
	X1	**X2**	**X3**	**X4**		**Y1**	**Y2**	**Y3**	**Y4**
U_1	- .979	- .954	- .784	.249	V_1	.589	.563	.201	- .996
U_2	- .201	.029	.586	- .521	V_2	- .041	- .794	- .444	- .078
U_3	- .029	- .021	.152	.747	V_3	.169	- .226	.856	- .028
U_4	.034	.297	- .142	- .330	V_4	.789	.044	.171	- .027

Canonical loadings between canonical variables and their original set variables have taken place in Table 8. The results for first canonical variables have supported Table 7 findings in that GDP Per Capita (-.979) and Median Income (-.996) have made the largest contributions to G&D and INC sets respectively.

Table 9: Canonical Cross Loadings between G&D and INC Variable Sets

	G&D Variable Set					INC Variable Set			
	X1	**X2**	**X3**	**X4**		**Y1**	**Y2**	**Y3**	**Y4**
V_1	- .949	- .926	- .760	.241	U_1	.572	.546	.195	- .967
V_2	- .171	.025	.499	- .444	U_2	- .035	- .677	- .378	- .066
V_3	- .004	- .003	.023	.115	U_3	.026	- .035	.132	- .004
V_4	.003	.024	- .011	- .027	U_4	.064	.004	.014	- .002

The purpose of examining canonical cross-loadings is to reveal the correlation between each variable in the first set and the canonical variate of the other set and canonical cross loadings between two variable sets have been presented in Table 9. According to the first canonical correlation taken into consideration, canonical variate of INC set is extremely correlated with 'GDP Per Capita (X1)' and 'Labor Productivity (X2)' in absolute effects and these have been followed by 'Healthy Life Expectancy (X3)' variable (-0.760). On the other hand, the largest contribution to the canonical variable U_1 has come from 'Median Income (Y4)' variable (- .967).

Table 10: Squared Canonical Structure Coefficients and Communality Coefficients for Two Canonical Functions

	Function 1		Function 2		
Variable	r_s	r_s^2 (%)	r_s	r_s^2 (%)	h^2 (%)
X1	**-.949**	90.06	-.171	2.92	**92.98**
X2	**-.926**	85.75	.025	.06	**85.81**
X3	**-.760**	57.76	**.499**	24.90	**82.66**
X4	.241	5.81	-.444	19.71	25.52
Canonical R²		94.13		72.71	
Y1	**.572**	32.72	-.035	.12	32.84
Y2	**.546**	29.81	**-.677**	45.83	**75.64**
Y3	.195	3.80	-.378	14.29	18.09
Y4	**-.967**	93.51	-.066	.44	**93.95**

r_s column in Table 10 represents canonical structure coefficients calculated in Table 9. r_s^2s indicate how much of the variance a variable shares with a canonical variate in a linear manner and depending on the orthogonal canonical functions, h^2 which is known as communality coefficient is computed as the summation of squared canonical structure coefficients (r_s^2) through all significant canonical functions (Thompson, 1984: 48-49; Salkind, 2007: 1037). As expressed in Sherry and Henson (2005), communality coefficients are represented as the indicator of how useful the variables are in the model. Tablo 10 results have shown that while 90,06% of the variation in 'GDP Per Capita (X1)' has been explained by the canonical variable V_1; U_1 canonical variable has accounted for 32.72% of the variability in 'Net Income Gini (Y1)'. In addition, communality coefficients over 45% have been expressed in bold font at h^2 column in order to highlight the variables having the highest practical or beneficial use to the solution. As a result, 'GDP Per Capita (X1)', 'Labor Productivity (X2)' and 'Healthy Life Expectancy (X3)' variables have provided the main contributions to INC variable set and 'Employment (X4)' variable has been found not to be related to INC set. On the other

hand, 'Net Income Gini (Y1)' and 'Wealth Gini (Y3)' variables are not closely associated with G&D variable set.

Table 11: Results for Canonical Redundancy Analysis

Standardized Variance of the Growth and Development Variables (X set) Explained by					
Their Own Canonical Variate (Shared Variance)			**The Opposite Canonical Variate (Redundancy)**		
Canonical Function	**Percentage**	**Cumulative Percentage**	**Canonical R^2**	**Percentage**	**Cumulative Percentage**
1	63.6	63.6	.9413	59.9	59.9
2	16.4	80	.7271	11.9	71.8
3	14.5	94.5	.0238	.3	72.1
4	5.5	100	.0065	.0	72.1
Standardized Variance of the Inclusion Variables (Y set) Explained by					
Their Own Canonical Variate (Shared Variance)			**The Opposite Canonical Variate (Redundancy)**		
Canonical Function	**Percentage**	**Cumulative Percentage**	**Canonical R^2**	**Percentage**	**Cumulative Percentage**
1	42.4	42.4	.9413	39.9	39.9
2	20.9	63.3	.7271	15.2	55.1
3	20.3	83.6	.0238	.5	55.6
4	16.4	100	.0065	.1	55.7

Findings regarding the redundancy analysis have been given in Table 11. Results have shown that INC set of variables has a lower redundancy index (39.9) when compared to the one of G&D set (59.9) in the case of first canonical variables being considered. 59.9% of total variation in G&D set has been accounted for by V_1 canonical variable. For second canonical function, the redundancy index has been calculated as 11.9% for G&D set and 15.2% for INC set. G&D and INC sets of variables have a high shared variance in the case of first canonical function (63.6% for G&D set and 42.4% for INC set). Therefore, 63.6% of total variation as associated with G&D set has been accounted for by U_1 canonical variable and 42.4% by V_1 canonical variable. 100% of the total variation in G&D set of variables has been explained by all of the canonical variables in its own set. Besides, the proportion of the total variation in G&D set of variables accounted for by all of the canonical variables described by V is 72.1%. 39.9%

of total variation in INC set has been explained by the first canonical variable that belongs to G&D set. Total variation in INC set explained by all canonical variables in G&D set is 55.7% and the largest contribution to this proportion has been obtained from the first pair of canonical variables (39.9%).

4. CONCLUSION

In this study, it has been aimed to reveal the relationship between "Growth & Development (G&D)" and "Social Inclusion (INC)" dimensions of Inclusive Growth and Development KPIs which take place in 2017 Inclusive Growth and Development Report and to identify the variables being effective in explaining the existing relations for totally 91 countries by carrying out Canonical Correlation Approach. According to the research findings, standardized canonical coefficients have shown that 'GDP Per Capita' variable has provided the largest contribution to G&D dimension and 'Median Household Income' variable has created the largest effect on INC set when the first (and the highest) canonical correlation is taken into consideration. Canonical loadings have also confirmed these most effective variables as determined by standardized canonical coefficients. Therefore, 'GDP Per Capita' and 'Median Household Income' variables must have been considered primarily for building up policy implications in improving 'Growth & Development' and 'Social Inclusion' topics. According to the first canonical correlation taken into consideration; starting from the largest contribution respectively, 'GDP Per Capita (X1)' and 'Labor Productivity (X2)' have been found to be highly associated with INC set and the largest contribution to the canonical variable U_1 has come from 'Median Income (Y4)' variable. Based on the communality coefficients, 'GDP Per capita (X1)', 'Labor Productivity (X2)' and 'Healthy Life Expectancy (X3)' variables have provided the main contributions to INC variable set.

However, it can be said that 'Employment' variable may not represent a strong relationship with INC set. In addition, 'Net Income Gini' and 'Wealth Gini' variables have been detected not to be associated with G&D set; but 'Median Household Income' and 'Poverty Rate' have been the most useful variables in the model affecting G&D set. On the other hand, according to the results of Canonical Redundancy Analysis, the proportion of the total variation in G&D set explained by all of the opposite canonical variables has

been computed as 72.1% while the proportion of total variation in INC set explained by all canonical variables in G&D set has been found as 55.7%.

REFERENCES

Aghion, P., Howitt, P., & Murtin, F. (2010), *The Relationship between Health and Growth: When Lucas Meets Nelson-Phelps* (No. w15813). National Bureau of Economic Research.

Barro, R. J. (1996), Determinants of Economic Growth: A Cross-Country Empirical Study (No. w5698). National Bureau of Economic Research.

Bloom, D. E., Canning, D., and Sevilla, J. (2004), "The Effect of Health on Economic Growth: A Production Function Approach", World Development, 32(1), 1-13.

Cankaya, S. (2005), Kanonik Korelasyon Analizi ve Hayvancılıkta Kullanımı, Yayımlanmamış Doktora Tezi, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Adana.

Cankaya, S., Altop, A., Olfaz, M., and Erener, G. (2009), "Karayaka Toklularında Kesim Öncesi ve Kesim Sonrası Ölçülen Bazı Özellikler Arasındaki İlişkinin Tahmini İçin Kanonik Korelasyon Analizi. Anadolu Tarım Bilimleri Dergisi, *24*(1), 61-66.

Dao, M. Q. (2014), "Drivers of Economic Growth in Developing Countries", Studies in Economics and Econometrics, 38(1), 75-85.

Hotelling, H. (1936), "Relations between Two Sets of Variates", Biometrika, *28*(3/4), 321-377.

Keskin, S., Kor, A., and Başpinar, E. (2005), "Akkeçi Oğlaklarında Kesim Öncesi ve Kesim Sonrası Ölçülen Bazı Özellikler Arasındaki İlişki Yapısının Kanonik Korelasyon Analizi ile İrdelenmesi", Tarım Bilimleri Dergisi, 11(2): 154-159.

Korkmaz, S., and Korkmaz, O. (2017), "The Relationship between Labor Productivity and Economic Growth in OECD Countries", International Journal of Economics and Finance, 9(5), 71.

Kritikos, A. (2014), "Entrepreneurs and Their Impact on Jobs and Economic Growth", IZA World of Labor, 1-8.

Lucas Jr, R. E. (1988), "On the Mechanics of Economic Development", Journal of Monetary Economics, *22*(1), 3-42.

Meyers, L. S., Gamst, G., and Guarino, A. J. (2013), "Applied Multivariate Research: Design and interpretation", Sage publications.

Mondal, M. N. I., Ullah, M. M. M. N., Islam, M. R., Rahman, M. S., Khan, M. N., Ahmed, K. M., & Islam, M. S. (2015), "Sociodemographic and Health Determinants of Inequalities in Life Expectancy in Least Developed Countries", International Journal, *3*(2), 96-105.

Nelson, R. and E. Phelps (1966), "Investment in Humans, Technological Diffusion, and Economic Growth", American Economic Review, vol. 61, 69-75.

Ngangue, N., and Manfred, K. (2015), "The Impact of Life Expectancy on Economic Growth in Developing Countries", Asian Economic and Financial Review, *5*(4), 653.

Romer, P. M. (1986), "Increasing Returns and Long-Run Growth", Journal of Political Economy, *94*(5), 1002-1037.

Sağlam, M. (2013), "Entisol ve İnceptisol Topraklarda Bazı Fiziksel ve Kimyasal Özellikler Arasındaki İlişkinin Kanonik Korelasyon Analizi ile Belirlenmesi", SDÜ Ziraat Fakültesi Dergisi, 4(2), 66-79.

Salkind, N. J. (2007), Encyclopedia of Measurement and Statistics, Volume 1, SAGE Publications.

Sherry, A., and Henson, R. K. (2005), "Conducting and Interpreting Canonical Correlation Analysis in Personality Research: A User-Friendly Primer", Journal of Personality Assessment, *84*(1), 37-48.

Stewart, D., and Love, W. (1968), "A General Canonical Correlation Index", Psychological Bulletin, 70(3, Pt.1), 160-163.

Swift, R. (2011), "The Relationship between Health and GDP in OECD Countries in the Very Long Run", Health Economics, *20*(3), 306-322.

Thompson, B. (1984), Canonical Correlation Analysis: Uses and Interpretation, Thousand Oaks, CA: Sage.

World Economic Forum (2017), The Inclusive Growth and Development Report 2017 - Insight Report, Geneva: World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_Forum_IncGrwth_2017.pdf.