Project Report - Assignment 2

Effect of Various Factors on the World Happiness Index of Countries

ECON F342 - Applied Econometrics

A report by **Group 1**

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1. INTRODUCTION

While forming and implementing economic policies, the happiness of citizens is often overlooked. But on the contrary, it is essential and has a lasting impact on the economy in the long run.

1.1 How does individual happiness affect the economy?

Labor market outcomes: Happy workers tend to be cooperative and productive while having lower absenteeism and turnover rates, which reduce the costs of hiring and training new employees. Happy workers may also contribute to a positive organizational culture that fosters innovation and growth.

Consumption and saving decisions: Happy consumers spend on better goods and services that enhance their well-being and quality of life. Their savings ratio is comparatively higher because of their higher expectations for their economic prospects. Happy consumers are more willing to pay higher taxes for public goods and services.

Investors and entrepreneurship activities: Happy investors tend to be more optimistic and risk-taking. They diversify their portfolios in all sectors, believing in overall economic growth. They would also invest in new and emerging markets because of their positive approach. Happy entrepreneurs tend to be more adaptable and innovative, creating more jobs and, thus, value for the economy.

Political and institutional factors: Happy citizens are more engaged and informed about democratic processes. They support policies promoting economic development, social justice, and human rights. Happy citizens also foster a sense of civic responsibility that enhances the efficiency and effectiveness of public institutions.

Discussing how an individual's happiness affects overall socio-economic growth is easy. But we must remember that measuring happiness is very difficult because of the number of variables that could play a role. Happiness cannot be generalized because it is unique for every citizen. A nationwide phenomenon might affect two individuals differently.

Happiness is not a fixed or elusive goal but a dynamic and attainable one. By understanding the sources and consequences of happiness, we can make better choices and create happier societies.

Thus, measuring happiness is vital to cement the right economic and public policies. This is why we need a standard measure for it.

1.2 The World Happiness Index

The World Happiness Index ranks the happiness levels of around 150 countries based on various factors influencing the quality of life. The Sustainable Development Solutions Network, a United Nations global initiative, produces the index.

The report uses data from the Gallup World Poll, which asks individuals to rate their life, where 10 represents the best possible life, and 0 illustrates the worst possible life.

Design: This research includes formulating a system explaining the relationship between the happiness index and variables like family, GDP, life expectancy, freedom, corruption, etc., which will be discussed in detail.

Confirm: The analysis seeks to see which factors affect happiness across countries the most.

The organization of this paper is such that Section II is on related work, Section III discusses the methodology, and Section IV presents the results and in-depth discussion. Section V gives the estimation and interpretation, while Section VI concludes the paper.

2. LITERATURE REVIEW

Yukiko Uchida(2016) explored the concept of measurement of happiness. He reviewed the validity and reliability of various scales that measure happiness, such as the Satisfaction with Life Scale (SWLS), which showed high test-retest reliability in his study. He also discussed culture's role in understanding individuals' long-term happiness and life satisfaction. For example, people from individualistic cultures value personal achievement over collective achievement. This is quite the opposite for cultures that believe in collectivism.

This paper limits itself to considering only culture as a variable for happiness. The parameters taken to measure satisfaction and cultural differences here are not standard or very subjective. They failed to highlight the entire picture of various cultures as well.

Olena Stryzhak(2020) examined the relationship between education, income, economic freedom, and happiness. The author approached the results by calculating correlation values using Pearson, Spearman rank, and Kendall’s Tau. His analysis showed a strong correlation between the Happiness Index, Education Index, and Index of economic freedom.

Education enables individuals to grab better opportunities for self-expression, creative fulfillment, and moral satisfaction. While this paper used a standard measure of happiness (WHI), very few variables were proxied with the help of indices providing a narrowed conclusion.

Firmansyah and team examined the relationship between individual happiness and economic prosperity in the Wonosobo regency of Indonesia. While considering multiple variables, he found that health, value change, satisfaction, public services, and culture were the primary source of happiness. The study found insignificant income and expenses, family relationships, and environmental changes.

They thus concluded that economic factors alone do not affect happiness. At the same time, economic growth will boost the quality of life. Public programs and services will boost individual happiness. While the paper considered many variables, it needs to give a broader picture because of its small sample size of 400. The sample size could have been more diverse because everyone was from the same regency.

Hanna and team examined the relationship between happiness and specific social, economic, and political factors. Upon studying previous analysis, it was concluded that economic factors help increase happiness but only in the short term. They analyzed the data by directly asking Jazan's habitants through a survey about the source of their subjective well-being and what they say about what makes them happy.

They concluded development initiatives in the Jazan region must prioritize inclusive growth strategies that prioritize social advancement; numerous measures have been developed to measure the social dimension of development, either in conjunction with or independently of economic indicators. These indicators measure how much countries contribute to their populations' social, economic, and environmental advancement.

Drakopoulos, Stavros A examined the relationship between income and happiness, empirical findings have puzzled many economists, and some have called it the "paradox of happiness." Many countries have found that significant real-per-capita income improvements do not correspond to proportional increases in individual happiness. Many economists have been perplexed by these findings, which some have dubbed the "paradox of happiness."

This paradox has been explained in a variety of ways. Using the concept of hierarchical choice, this work seeks to address the paradox of happiness. The hierarchical approach indicates that basic human needs must be met before considering non-basic wants. According to the article, the hierarchical nature of requirements implies that satisfying basic needs boosts individual happiness far more than satisfying secondary wants.

Parul Oberoi, Shalu Chopra examined the relationship between happiness and several dependent variables, including social support, generosity, physical well-being, etc. They created a multi-regression analysis model to understand the relation between the same. However, the regression comes with shortcomings, as stated below:

Because the study's sample size is too small, the results cannot be generalized and applied to the entire country. Because the study mentioned above was conducted in only one area--Delhi NCR and East Delhi--the results cannot be compared to other places. It is only comparable to studies

undertaken in the same field. The analysis results are unique to the observations in the sample. It makes no predictions regarding data outside the sample size or the model.

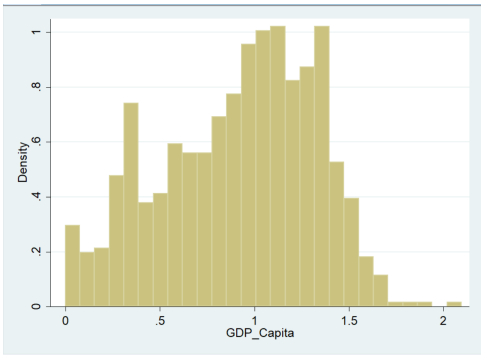
We have increased the sample size used in the regression analysis. We have covered several countries spanning different continents. The studies disregarded some criteria influencing a country's happiness score, such as GDP per capita, healthy life expectancy, and views of corruption. We have, however, tried to consider most of these factors.

3. DATA AND METHODOLOGY

3.1 DESCRIPTION OF THE DATASET

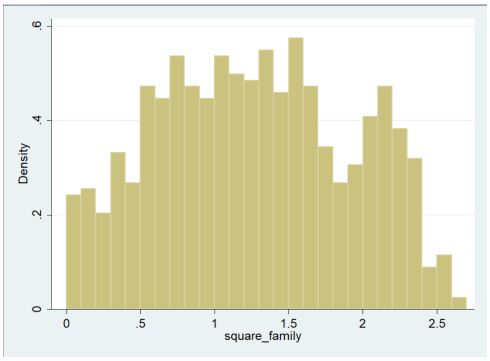
The data for this study has been sourced from Kaggle. The World Happiness Report is a survey done to gather information regarding global happiness. We are analyzing the data from 2015, 2016, 2017, 2018, and 2019 in 156 countries. This report gained global recognition as the government, organizations, etc., use happiness indicators to decide policy-making decisions. The scores are based on answers to a poll's main life evaluation question.
We used the following parameters for our analysis:

VARIABLE - Score
Description - The total score of happiness is calculated with the help of various factors.
Reason - Our dependent variable illustrates how happy a person reported themselves to be and thus is an appropriate measure of happiness.



VARIABLE - GDP_Capita
Description - It is the GDP per capita of that particular country.
Reason - It measures how much GDP contributes to an individual's happiness.

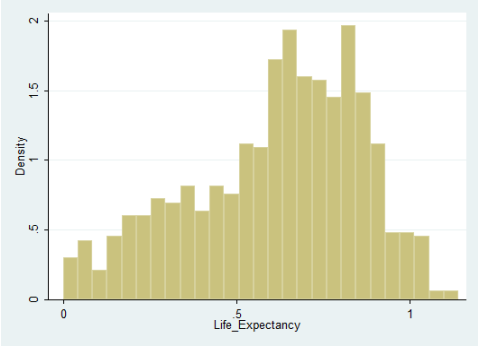
VARIABLE - square_family
Description - It is one of the independent variables.
Reason - It measures the extent to which Family contributes to an individual's Happiness. To maintain a normal distribution of the variable data points, we transformed the variable by taking the square of it.



VARIABLE - Life_Expectancy

Description - It refers to the years a person is expected to live.

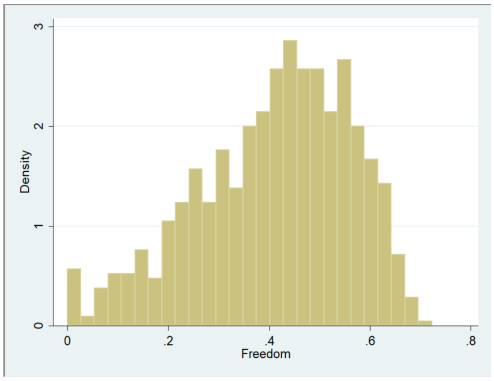
Reason - It measures the extent to which Life Expectancy contributes to an individual's Happiness.



VARIABLE -Freedom

Description - It refers to how an individual feels free in a particular country.

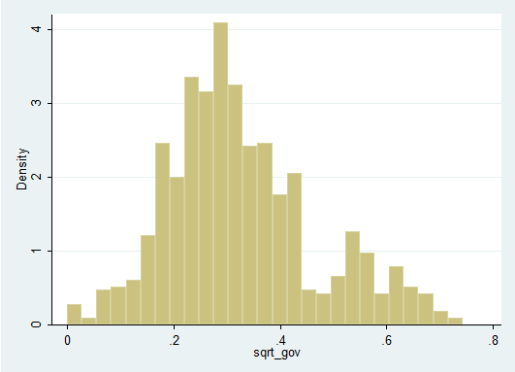
Reason - It measures how much Freedom contributes to an individual's happiness.



VARIABLE - sqrt_gov

Description - It refers to the amount of Corruption existing in the country.

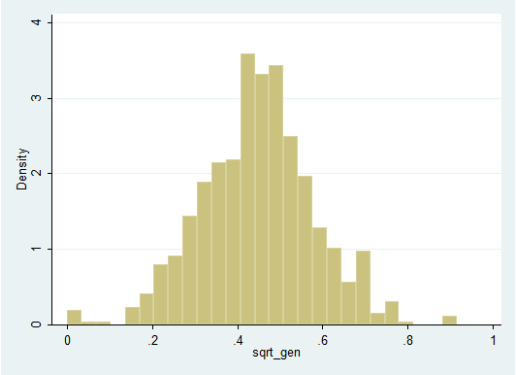
Reason - It measures how much Gov_Corruption contributes to an individual's happiness. To maintain a normal distribution of the variable data points, we transformed the variable by taking the square root of it.



VARIABLE - sqrt_gen

Description - It refers to the quality of an individual being generous.

Reason - It is the measure of the extent to which sqrt_gen contributes to an individual's happiness. To maintain a normal distribution of the variable data points, we transformed the variable by taking the square root of it.



3.2 MODEL SPECIFICATIONS

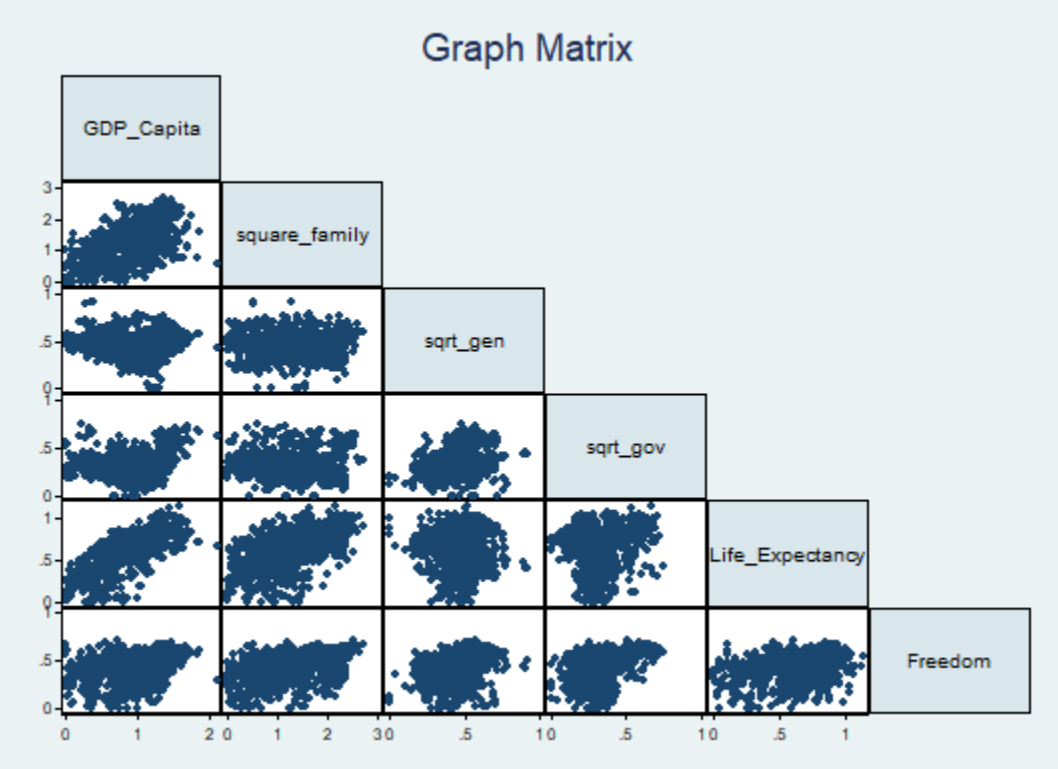
Because we had Panel data, we could control for both group- and country-fixed effects using various econometric techniques. While the Results section describes how the analysis was carried on, the methodology we have followed is as follows:

1. Transformation of independent variables
2. Summary statistics for all variables and the Graph Matrix were generated*
3. We ran a simple OLS regression for Score vs. all the other variables, effectively ignoring any country-fixed effects or time-fixed effects.*
4. Then, we executed a Fixed Effect Model using the Least Square Dummy Variable (LSDV) method. Due to a large dummy variable set, we absorbed the country to showcase only the critical information.*
5. Consequently, a Fixed Effect Model using the Within-Group Method was used and stored. (As confirmed theoretically, the results were almost identical to the LSDV method.)*
6. Next, we proceeded with the Random Effect Model, and we stored the results of the same.
7. Once all the Models had been regressed, we subsequently used several tests to choose the most appropriate form:
    a. Firstly, the Hausman Test was used to determine the difference between the Random and Fixed Effect Model. The test showed that the fixed unobserved effect is not independent of Xi. Therefore we go for the Fixed Effect Model.
    b. Subsequently, we check for the presence of Time Fixed Effects also.*(changes)
8. Finally, we test the assumptions of multicollinearity, autocorrelation, heteroscedasticity, and stationarity utilizing remedial steps wherever required.*(change)

3.3 ECONOMETRIC MODEL

$$Score_{it} = \alpha i + \beta_1 GDP\_Capita_{it} + \beta_2 square\_family_{it} + \beta_3 sqrt\_gen_{it} + \beta_4 sqrt\_gov_{it} + \beta_5 Freedom_{it} + \beta_6 Life\_Expectancy_{it} + \varepsilon_{it}$$

3.4 GRAPH MATRIX OF EXPLANATORY VARIABLES



As we can observe by the Graph Matrix, there seems to be less correlation between the independent variables. Some notable strong correlations could be inferred:

- A positive relation between square_family and GDP_Capita. This is intuitive as the GDP per capita increases, every family member, on average, would have a higher disposable income, and thus each member would derive higher happiness from family.

- Positive correlation between GDP_Capita and Life_Expectancy. This again can be explained by the fact that as the per capita income increases, everyone has the better infrastructure in terms of healthcare, nutrition, etc, and thus get increased happiness in terms of health(life expectancy)

4. RESULTS AND DISCUSSIONS

4.1 SUMMARY STATISTICS

To get the summary statistics, the **tabstat** command was used.

```
tabstat Score GDP_Capita square_family sqrt_gen sqrt_gov Freedom Life_Expectancy,
stat(n mean max min q sd)
```

Below is the table of summary statistics generated by it. It includes the **Mean, Median (p50), Standard Deviation, Number of Observation**s, and **Maximum and Minimum values** of the variable.

stats	Score	GDP_Ca~a	square~y	sqrt_gen	sqrt_gov	Freedom	Life_E~y
N	782	782	782	782	782	782	782
mean	5.379018	.9160475	1.271394	.4480286	.3259849	.4110908	.6124156
max	7.769	2.096	2.702736	.9154645	.7429065	.724	1.141
min	2.693	0	0	0	0	0	0
p25	4.509	.605	.7553	.3605551	.232379	.30953	.44006
p50	5.322	.9822047	1.265029	.4494243	.3017167	.431	.6473095
p75	6.192	1.237	1.763584	.5282613	.3953654	.531	.808
sd	1.127456	.4073401	.6519859	.1336752	.1397092	.1528804	.2483086

- The total Number of Observations(**N**)is 782 spread across five time periods(2015-19).
- The Median is given by **p50** values which stand for the 50th percentile. Similarly, **p25** and **p75** stand for 25th and 75th percentile values respectively.
- Standard deviation is given by **sd** values.
- The Mean values of the variables used are given by **mean**.
- The Maximum and Minimum values corresponding to each variable are given by **max** and **min** respectively.

4.2 ESTIMATION AND INTERPRETATION

```
. xtreg Score GDP_Capita square_family sqrt_gen sqrt_gov Freedom Life_Expectancy ,
>  fe robust cluster(country1)

Fixed-effects (within) regression               Number of obs      =       782
Group variable: country1                        Number of groups   =       170

R-sq:  within  = 0.0334                         Obs per group: min =         1
       between = 0.7323                                        avg =       4.6
       overall = 0.7078                                        max =         5

                                                F(6,169)           =      1.34
corr(u_i, Xb)  = 0.7635                         Prob > F           =    0.2412

                                (Std. Err. adjusted for 170 clusters in country1)
```

Score	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
GDP_Capita	.3621725	.2770612	1.31	0.193	-.1847741	.9091191
square_family	.001144	.0469341	0.02	0.981	-.0915086	.0937967
sqrt_gen	-.3107099	.2821774	-1.10	0.272	-.8677564	.2463366
sqrt_gov	.3810856	.2996671	1.27	0.205	-.2104875	.9726586
Freedom	.4756882	.4145434	1.15	0.253	-.3426622	1.294039
Life_Expectancy	.309373	.2226635	1.39	0.167	-.1301871	.7489332
_cons	4.675759	.4491886	10.41	0.000	3.789016	5.562502
sigma_u	.88007517					
sigma_e	.23412147					
rho	.93390826	(fraction of variance due to u_i)				

R^2: R-squared is 0.0334, which means only 3.34% of the dependent variable is explained. The F-statistic for the joint significance test is very low, meaning the variables are jointly insignificant.

Intercept: Intercept is normally the value of the score when all the dummy variables are zero, and all the independent variables are zero. But in this case, as we have clustered the data, it is the value when all the independent variables are zero for each cluster, and a person does not value any of the chosen variables w.r.t to their happiness.

GDP_Capita: This coefficient is 0.3621725, which suggests that a one-unit increase in weightage to GDP per capita is associated with a 0.3621725 unit increase in the Score, holding all other variables constant. This is as expected as if a person places more importance on something achievable; he can be happy. However, this coefficient is not statistically significant at the 5% level, as its p-value is 0.193.

Square_family: This coefficient is 0.001144, which suggests that a one-unit increase in the square of the family variable increases the score by 0.001144 units; as this is a square transformed variable, it means as the person values family more, his happiness would increase at an increasing rate, holding all other variables constant. We cannot say anything as expected or counterintuitive as each individual's perception about there is different and based on situations. However, this coefficient is not statistically significant at the 5% level, as its p-value is 0.981.

Sqrt_gen: This coefficient is -0.3107099, which suggests that a one-unit increase of the generosity variable is associated with a -0.3107099 unit decrease in the Score, holding all other variables constant and no further inference as it is square root transformed.
This is counterintuitive because if all the individuals give more importance to their own generosity in their happiness, he/she can be in a position to donate and hence should be able to donate and increase their happiness, but the model tells us that net happiness would decrease. The coefficient is not significant at the 5% level, as its p-value is 0.272 nevertheless is counterintuitive.

sqrt_gov: This coefficient is 0.3810856, which suggests that a one-unit increase in the square root of the government variable is associated with a 0.3810856 unit increase in the Robust Score, holding all other variables constant. However, this coefficient is not statistically significant at the 5% level, as its p-value is 0.205.

Freedom: This coefficient is 0.4756882, which suggests that a one-unit increase in the Freedom variable is associated with a 0.4756882 unit increase in the Score. This is as counterintuitive as if a person thinks freedom to make life choices contributes more to happiness implies that he/she lacks the freedom. If that forms the central part of happiness, the person is supposed to become more unhappy. This coefficient is not significant even at a 5% level of significance.

Life_Expectancy: This coefficient is 0.309373, which suggests that a one-unit increase in how much a person values Life Expectancy in happiness is associated with a 0.309373 unit increase in the Score, holding all other variables constant. This is again as expected as if a person values life expectancy indicates his willingness to live/contentment with life and hence would be happier.
However, this coefficient is not statistically significant at the 5% level, as its p-value is 0.167.

4.3 ASSUMPTIONS AND REMEDIAL MEASURES

4.3.1 Durbin Wu Hausman Test

In Panel data analysis, the Hausman test is used to determine whether fixed effect or random effect will be used in our analysis. This is done by checking whether the difference in coefficients is systematic or not.

Null Hypothesis: $\mathbf{H_0}$: α_i is independent of X_j

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
GDP_Capita	.3621725	1.270982	-.9088099	.1379098
square_fam~y	.001144	.0105256	-.0093815	.0062499
sqrt_gen	-.3107099	.2872425	-.5979525	.124165
sqrt_gov	.3810856	.5683143	-.1872287	.1212581
Freedom	.4756882	1.149976	-.6742874	.0923903
Life_Expec~y	.309373	.9633352	-.6539622	.0917469

```
                b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =     1602.16
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

As the prob>chi2 value is less than 0.05, we reject the null hypothesis and conclude that difference in coefficients is systematic and hence α_i is dependent of X_j. So there is significant difference between the coefficients of fixed and random effect models and thus we cannot use random effect model. Because of this, we choose the fixed effects model for our analysis.

4.3.2 F-Test for Time-Fixed Effects

To check for time-fixed effects in our model, a joint F-Test was done to check whether all years are jointly equal to 0 or not. The null hypothesis states that it does not have time fixed effect.

Null Hypothesis: $\mathbf{H_0}$: 2016.year = 2017.year = 2018.year = 2019.year = 0.

```
. testparm i.Year

 ( 1)  2016.Year = 0
 ( 2)  2017.Year = 0
 ( 3)  2018.Year = 0
 ( 4)  2019.Year = 0

       F(  4,    169) =    1.61
            Prob > F =    0.1749
```

As the prob > F value is greater than 0.05, we fail to reject the null hypothesis and conclude that our model does not have time fixed effect and all the time dummies are jointly insignificant.

4.3.3 Test for homoscedasticity

For our model to be homoscedastic, all independent variables should have the same variance, which should also be finite. It could be tested using the command **xttest3** on stata**.**

Null Hypothesis: $\mathbf{H_0}$**:** Data is homoscedastic.

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (170)  =   4.0e+32
Prob>chi2 =      0.0000
```

As the prob>chi2 value is < 0.05, we can reject the null hypothesis of our data being homoscedastic and conclude that our model is suffering from Heteroscedasticity.

Remedial Measures

As our model suffers from heteroskedasticity; robust standard errors were used as shown below:

```
. xtreg Score GDP Capita square family sqrt gen sqrt gov Freedom Life Expectancy , fe robust
```

4.3.4 Test for Autocorrelation

Serial correlation in a model can lead to a smaller value of standard errors than what they should be, resulting in a higher value of R squared.

To check for this, the **xtserial** command was used. It is a Lagram - Multiplier test for serial correlation.

Null Hypothesis: $\mathbf{H_0}$**:** No First order Autocorrelation

```
. xtserial Score GDP_Capita square_family sqrt_gen sqrt_gov Freedom Life_Expectancy

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     152) =    182.469
           Prob > F =      0.0000
```

As the Prob> F value is less than 0.05, we reject the null hypothesis and conclude that our model suffers from First order autocorrelation.

Remedial Measures

A way to rectify it is by making clusters where errors can be arbitrarily located. We have used the **cluster** command to control for autocorrelation as shown below:

```
. xtreg Score GDP_Capita square_family sqrt_gen sqrt_gov Freedom Life_Expectancy ,
>  fe robust cluster(country1)
```

4.3.5 Test for Multicollinearity

It happens due to the correlation between independent variables. Partial correlation is allowed, but perfect collinearity is not allowed. For this, we have done the **VIF** test.

```
. vif
```

Variable	VIF	1/VIF
GDP_Capita	2.91	0.343559
Life_Expec~y	2.77	0.361368
square_fam~y	1.82	0.549802
Freedom	1.64	0.611533
sqrt_gov	1.37	0.728706
sqrt_gen	1.21	0.829323
Mean VIF	1.95	

In Our dataset, all the VIF values of the variables are less than 10. As the mean VIF value is 1.95, which is lesser than 10, It means it is safe to assume that our model does not suffer from multicollinearity.

4.3.6 Unit Root Test

To check for Stationarity conditions, we check whether the panels have a unit root or not through the Fischer score based on the Augmented Dickey-Fuller test. Since our data is unbalanced, we are unable to run the unit root test for 14 panels due to the unbalanced data, but the rest of the panels show the given results:

Null Hypothesis: $\mathbf{H_0}$**:** All Panels contain unit roots.

```
Fisher-type unit-root test for Score
Based on augmented Dickey-Fuller tests
---------------------------------------
Ho: All panels contain unit roots          Number of panels       =     170
Ha: At least one panel is stationary       Avg. number of periods =    4.60

AR parameter: Panel-specific               Asymptotics: T -> Infinity
Panel means:  Included
Time trend:   Not included
Drift term:   Not included                 ADF regressions: 0 lags
------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------
 Inverse chi-squared(312)  P      1096.9398       0.0000
 Inverse normal            Z        -3.8551       0.0001
 Inverse logit t(719)      L*      -13.7913       0.0000
 Modified inv. chi-squared Pm       31.4227       0.0000
------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------
```

As we can see, the p-value < 0.05, so we reject the Null hypothesis. Herewith, we state that the panels are stationary and do not contain any unit roots.

5. CONCLUSION

In this research, an economic study was conducted on the effect of various factors on the world happiness index in about 156 countries. The panel-type data is taken from Kaggle and is highly rated for quality. Despite this, the assumption of homoskedasticity is not satisfied by the data set and suffers from first-order autocorrelation. For rectifying heteroskedasticity, robust standard errors were used. VIF test showed that our model is free from multicollinearity. Our panels came out to be stationary with no unit roots (using Unit Root Test).

Many variables, like life expectancy, per capita GDP, corruption, etc. that influence the happiness index has been taken from the data and used in the econometric model. The fixed effects model is used in line with the results from the Durbin- Wu- Hausman Test.

Very less correlation was observed between the independent variables except between square_family, GDP_Capita, and Life_Expectancy for which correlation makes proper sense as the GDP per capita increase, every family member on average would have a higher disposable income, and thus each member would derive higher happiness from family. Similarly, as the per capita income increases, more access to better infrastructure in terms of healthcare, nutrition, etc., thus increasing happiness in terms of health.

Although not very intuitive, the results of all of the explanatory variables came out to be jointly insignificant at a 5% significance level.

The regression shows a positive correlation between the happiness score and GDP_capita, square_family, sqrt_gov, freedom, and life expectancy, whereas the happiness score shows a negative correlation with sqrt_gen. However, none of them came out to be significant. Thus, none of our factors affect the happiness score significantly.

6. REFERENCES

1. Papers used for literature review:
    a. Uchida, Y., & Oishi, S. (2016). The Happiness of Individuals and the Collective. *Japanese Psychological Research*, *58*(1), 125–141
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