Inequality Adjusted Human Development Index:
A Method for the Economics of Frustration
And the Computation of its Model

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"The Ultimate Resource in economic development is people. It is people, not capital or raw materials that develop an economy."

~ Peter F. Drucker

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About the Authors

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Acknowledgements

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Abstract: *This paper focusses on the econometric application to identify various factors which affects Inequality-Adjusted Human development Index (IHDI) from various sources by the utilization of a global data set. In the subsequent parts, the idea of Economic Frustration is also defined on the hypothesis of the fact that the significant variables (both statistically and economically significant) that affect the IHDI are the antithesis to it when it comes to defining Economic Frustration. The aforementioned hypothesis where Economic Frustration is considered the inverse of IHDI's variables emanates from a fact that Anxiety has been proven to be a key component for its role in affecting IHDI.*

Part I: Econometric Analysis of Inequality Adjusted Human Development Index

I. Introduction

In 1990, the Human Development Index (HDI) was created in order to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone[1]. Therefore, the Human Development Index was created on the basis of Life Expectancy Index, Educational Index and GNI Index. However, the mechanism of calculating these indexes have been very superficial and limited. Furthermore, Human Development Index also fails to account for inequality adjustments and related parities which obscure our general understanding of human development index.

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[1] Ul-Haq, M. (1990). Human Development Reports. http://hdr.undp.org/en/content/human-development-index-hdi

According to McGillivray (1991), the HDI fails to also account for intercountry development level comparisons[2]. Pertaining to the aforementioned reasons, an **inequality human development index (IHDI)** was created in order to account for inequalities from the various sectors which could hamper overall economic development. Under perfect conditions IHDI equates to HDI but with growing inequalities IHDI falls below HDI–this happens due to the application of methodology of "discounting rule" [3].

Attenuating on this information, in the first part, this paper would try to understand variables from various sectors and indexes to understand the significances of these variables on the IHDI. A statistical analysis will be conducted to understand two things: firstly, the type of relationship held between dependent variables and independent variables. Secondly, if a cyclical relationship exists in this analysis.

Furthermore, in the second part, a mathematical approach to create a model termed as "economic frustration model" would be made. The idea of an "economic frustration model" is based on an antithesis of IHDI or such corresponding variables. In other words, if an index could be argued to create an emphasis on the Human Development Index, conterminously, an index which models economic frustration would be made. At this point, prior to statistical tests there are two methods which would be actively pursued to create the model:

1. On the basis of econometric analysis, variables which turn up to be both economically and statistically significant (irrespective of negative or positive relationship) will be utilized in the model.

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[2] McGillivray, M. (2002, July 10). The human development index: Yet another redundant composite development indicator? https://www.sciencedirect.com/science/article/abs/pii/0305750X9190088Y

[3] Human Development Reports (UNDP). Retrieved June 11, 2020, from http://hdr.undp.org/en/content/inequality-adjusted-human-development-index-ihdi

2. The determination of whether this index is macro or micro in nature will also depend on the independent variables. If any of the variables hold a national index the model will be macro and vice versa.

II. <u>Literature Review</u>

This paper would inculcate variables across various fields of Economics and various other factors in order to understand how IHDI has a much bigger impact on various sectors both advertently and inadvertently.

A. <u>Psychological and Mental Health Related Factors</u>

Mental health disorders have been attributed to hold negative implications for the poor and hamper net economic development by increasing homelessness, higher rates of incarceration, poor educational outcomes, reduced income and higher unemployment rates (Funk et al, 2012)[4]. This study aims to take variables such as **% of population confirmed to have reported having depression symptoms and disorders**. In fact, depression based disorders have been reported to have shown a positive correlation with countries with high HDI (Cifuentes et al.,2008)[5]. This paper will retest this phenomenon to check if a similar pattern exists on a global scale.

Furthermore, this study would also include other mental health problems such as share of population with anxiety factors, **ADHD (male to female ratios) and suicides rates** as well to understand the relationship they hold to IHDI to discern a more

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[4] Funk, M., Drew, N., & Knapp, M. (2012). Mental health, poverty and development.
https://www.emerald.com/insight/content/doi/10.1108/17465721211289356/full/html?queryID=

[5] Cifuentes, M., Sembajwe, G., Tak, S., Gore, R., Kriebel, D., & Punnett, L. (2008, June 02). The association of major depressive episodes with income inequality and the human development index.
https://www.sciencedirect.com/science/article/abs/pii/S0277953608002098?casa_token=DwcpvUS8cFUAAAAA%3ALkiNAZI2aaYM9gvKs4EjnTVzYqx3uqs4xIEHeJJU8N5qT_09N961BGln7LslbfkPJ9Jl22Aw1eE

comprehensive relationships. The hypothesis at this point would be that all the aforementioned mental health problems will hold a similar relationship without much scattering or deviance.

Other than mental health problems, this study would also take into account some of the other psychological factors which could, by intuition, be said to have a positive effect in regards to IHDI. Firstly, **subjective well-being factor or "happiness index"** has been considered in this study on the basis of testing an implied hypothesis mentioned by Hall and Helliwell (2014) where a positive correlation may exist[6]. This test would be an opportunity to check if this econometric model can confirm this relationship as a precedence into this inquiry of thought. Moreover, a standardized mental logical component–**Intelligence Quotient (IQ)** has been considered in this study. IQ has faced many such backlashes in the past by different educational and psychological papers due to its inefficacy for capturing accurate individual's creative capabilities (Kaufman, 2015)[7]–a factor which is one of the front runners when it comes to deducing human capital factor in Solow-Swan model of economic growth (1956)[8]. But in spite of this criticism, IQ has shown to have a one point increase in association with a 4% increase in wealth growth for the average country (Hafer, 2017)[9]. Given such evidences, this paper would proceed with IQ as a test factor to determine as to how does this variable behave when it comes to computing global data for Human Development Index.

B. <u>Education</u>

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[6] Hall, J., & Helliwell, J. F. (2014, April 08). Human Development Reports. Retrieved June 15, 2020, from http://hdr.undp.org/en/content/getting-serious-about-happiness

[7] Kaufman, J. C. (2015, August 07). Why Creativity Isn't in IQ Tests, Why it Matters, and Why it Won't Change Anytime Soon Probably. https://www.mdpi.com/2079-3200/3/3/59/htm

[8] Solow, Robert, Swan, Trevor (1956). A Contribution to the Theory of Economic Growth. https://www.econ.nyu.edu/user/debraj/Courses/Readings/Solow.pdf

[9] Hafer, R. (2017, February 13). New estimates on the relationship between IQ, economic growth and welfare. Retrieved June 15, 2020, https://www.sciencedirect.com/science/article/abs/pii/S016028961630318X

In 2015, all the United Nations Members unanimously agreed on a 2030 Sustainable Development Goals (SDG's) on 17 crucial sectors, among which universal primary education was one of the biggest challenges which needed to be overcome. Conterminously, this study will pursue data which relates directly for 5 primary education variables as well.

The first variable in regards to Education chosen is **the percentage of enrollable population enrolled in primary education** in a given year. This independent variable becomes an obvious addendum in our study due to two main reasons. Firstly, enrollment of schools has been found out to have a direct relationship with building a "knowledge capital" for any particular country–as described by Solow-Swan model's human capital and intellectual property components[10]. Furthermore, such findings have also been backed up in regional based studies where particularly primary education has shown positive relationships in countries of Tanzania, Pakistan, and Turkey even though income distribution differed[11][12][13]. The main objective is to see if the seemingly positive relationship may show economic and statistical significance on a global data.

The second variable which this study has included is **primary school drop-out** rate as a percentage of the total children who are eligible to be enrolled (by age). The primary hypothesis is that if enrollment could create a certain impact on IHDI in the study then dropout rates should have an equivalently inverse significance with the reasoning that the former acts as a catalyst for economic growth while the latter is a constraint. In contrary to

[10] Parker, C. B. (2016, April 07). Quality of schools is critical for economic growth in developing countries, Stanford expert says https://news.stanford.edu/2016/02/08/education-knowledge-capital-020816/

[11] Wobst, P., & Seebens, H. (1970, January 01). The Impact Of Increased School Enrollment On Economic Growth In Tanzania,. https://ideas.repec.org/p/ags/ubzefd/18737.html

[12] Afzal et al (2010). Relationship Between School Education and Economic Growth in Pakistan. https://pdfs.semanticscholar.org/9651/bb36daa61455506b54cba41c673bdaf9ea24.pdf

[13] Gümüš, Sedat & Kayhan, Selim (January,2012). The Relationship between Economic Growth and School Enrollment Rates: Time Series Evidence from Turkey. https://www.researchgate.net/publication/312710935_The_Relationship_between_Economic_Growth_and_School_Enrollment_Rates_Time_Series_Evidence_from_Turkey

the studies mentioned before where positive relationship between economic growth and enrollment was observed, it is quite possible as well that the dropout rates may still lead to economic growth until tested. The explanation of this paradoxical prediction is on the basis of a study seen during the Asian Financial crisis when older children in a family were facing non-enrollments than the younger children. This occurred because the long-term consequences were identified by these families where the older child is closer to a complete primary education than the younger child (Barret & Carter,2018)[14]. Furthermore, the younger child was diverted towards domestic help as well–a pattern which is much more visible in lesser developed countries as well. Because of this diversion more labor gets available for higher production (Heltberg et al, 2012)[15].

However, continuous enrollment and dropout rates in a country could potentially lead to a factor of bias in data and therefore to attenuate this bias, **persistence to last grade of primary school** variable will also be included in this study to understand as to how many students actually make it till the end. The model of economic frustration which will be later discussed in part of this paper could possibly entail this factor depending on its significance–theoretically, higher persistence could actually be a significant contributor of a frustration emanating from the need of completing education and could have possible long term deleterious impacts when it comes to participating in labor force. Apart from this the fourth and the second standardized variable in education bloc is **Literacy Rate (% of population)**. The advantage of using literacy rate is that it includes data for the entire population who have had the minimal primary education completion experience regardless of age. However, it may not be discernable as to what relationship between IHDI and Literacy Rate may be achieved. For example: IHDI may turn out to have no significant effect

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[14] Barrett, Christopher B., Michael R. Carter, Jean-Paul Chavas (2018). *The Economics of Poverty Traps.* London; Chicago;: The University of Chicago Press.
https://ebookcentral.proquest.com/lib/uc/reader.action?docID=5495409&ppg=32

[15] Heltberg, R., Hossain, N., & Reva, A. (2012). Living through Crises: How the Food, Fuel, and Financial Shocks Affect the Poor. https://books.google.com/books?id=UFj-ZQZAoq0C

on literacy rates or especially the vice versa if the educational standards are outstripped by the demands of skills prevalent in labors in a country. Furthermore, lower literacy rate could still be argued to have a significant effect on IHDI since in a study by Biao et al. (2014) it was noticed that certain impoverished countries hold populations who lack formal education but are skilled when it comes to job requirement fulfillment[16].

The final variable concerning education is the percentage of **trained teachers in primary education (% of total teachers in a country)**. It has been researched that trained teachers (both primary and non-primary) who are above a set standard of mean effectiveness can marginally generate long term students gains of over $40,000 in a class size of 20 and this values increases with increasing class sizes (Hanushek, 2011)[17]. This paper will test if such an activity is seen on a global dataset as well, then there would be a human capital and a GNI enrichment with shortened inequalities–key components which would result in higher IHDI values.

C. <u>Financial Factors</u>

Financial Factors become the forefront of human development index, both macro and micro indicators when it comes to testing econometric relationship with Human Development Index.

As per Elysia and Syahzuni (2018) a test between Human Development Index and **GDP per capita** for 10 ASEAN countries turned out to hold a positive relationship[18]. Furthermore, a conclusion drawn in this study states that the HDI can benefit growth rates and therefore this study will take three different routes: firstly, instead of HDI, IHDI is chosen to see if this holds true. Secondly, it would also be tested if the similar relationship holds for IHDI as well to

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[16] Biao et al. (2014). The contribution of the Human Development Index Literacy Theory to the Debate on Literacy and Development. https://files.eric.ed.gov/fulltext/EJ1158706.pdf

[17] Hanushek, Eric (2011). The Economic Value of Higher Teacher Quality. *Economics of Education Review.* https://hanushek.stanford.edu/sites/default/files/publications/Hanushek%202011%20EER%2030%283%29.pdf

[18] Elistia, E., & Syahzuni, B. (2018). THE CORRELATION OF THE HUMAN DEVELOPMENT INDEX (HDI) TOWARDS ECONOMIC GROWTH (GDP PER CAPITA) IN 10 ASEAN MEMBER COUNTRIES. https://journal.unpak.ac.id/index.php/jhss/article/view/949

ascertain if there is some credibility to the new development index that has been adopted. Lastly, does the same relationship hold for a global data as well?

The next variable under financial factors that this study would take into consideration is the core "real adjusted family income" in form of **Adjusted Net National Income per capita** which is computed after deducting domestic consumption, usage of natural resources and depreciation. In simpler terms, this variable would act as acquired savings which would help us understand the impact of savings on IHDI.

Furthermore, this study would take **GINI Index** into consideration which one may predict to have a multicollinearity problems during regression analysis, however this paper hypothesizes that this multicollinearity factor may not be that high since methodology for GINI is mostly different in comparison to other variables taken into this study that have been adjusted.

In terms of trade, this paper would pursue **net trade, logistics performance index and gross capital formation** in this study since trade on an overall basis has been disputed in relation with human development index given that impact of trade is very scattered for different countries. However, Davies et al. (2006) contests that the impact of trade has been a positive correlation with HDI in their studies by utilizing a GMM method[19].

Furthermore, expenditure variables in sectors of **military expenditure (% of GDP), transports(exports and imports), international tourism(% of imports) and R&D expenditures (% of GDP)** would be taken into consideration to help us see how global expenditures may be affecting IHDI.

Chiefly this study would focus on the financial factors of Economic Growth **as growth % of GDP for every country and Coverage of social insurance programs** to derive separate quadratic equations to evaluate the importance of the turning point at which the relationship between IHDI and the aforementioned variables holds. However, this step would be taken only if the variables prove either show economic or statistical significance or both.

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[19] Davies, Antony & Quinlivian, Gary (2006). A Panel Data Analysis of the Impact of Trade on Human Development. https://www.researchgate.net/publication/222705399_A_Panel_Data_Analysis_of_the_Impact_of_Trade_on_Human_Development

D. <u>Demographical Factors</u>

The foremost important variable in this study would be **life expectancy** since it is one of the core components which IHDI takes into account. Particularly, in this study, life expectancy would be taken a year before the year of IHDI data i.e. if the IHDI data is of 2016 then life expectancy data of 2015 would be taken into account to understand the question of today's life expectancy versus future IHDI.

The second most important demographical factor is **population density** which is essential in this study–in fact, if the preliminary statistical study proves its statistical significance, it would be a very important component in inculcating it into the mathematical modelling for economic frustration. Furthermore, higher population density in a regional based study in Sub-Saharan Africa has been insinuated as being a detrimental variable in relationship with economic development in terms of poverty alleviation policies (Sinding, 2009) [20].

Next Demographic factors that this study would include are **infant mortality rates and death rates** to compute which factor of the two holds more importance when it comes to making IHDI factor favorable.

Finally, the role of refugees and immigrants in relationship would be tested in this study through the data for **refugees residing in a host country as an immigrant or an asylee**. This will be important to understand how labor force emanating from abroad impacts economic development in a country on a global scale which could help to shape future immigration policies.

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[20] Sinding, S. (2009, October 27). Population, poverty and economic development. Retrieved June 17, 2020, from
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2781831/

E. Environmental Factors

As per the aforementioned decided SDG's for 2030, combating climate change and switching to renewable resources is one of the important goals. With major international policies and political moves in regards to climate and pollution deals and taxations being introduced, it could be said that environment related economics is an ever-evolving area of study in context of today. Therefore, this study would also try to understand as to how environmental factors have been impacting overall IHDI index since pollution levels affect its core components of age longevity and standard of living (GNI per capita).

Firstly, **carbon emissions** is one of the data variables which will be analyzed through regression since it has been found that high HDI countries have faced the problem of higher carbon emissions (Hickel, 2019)[21]. In this study we would try to understand if a similar direct relationship holds on a global data as well where IHDI has a higher variance along with CO_2 emissions.

Secondly, continuing on the effects of how pollution could impact age longevity, data to **mean exposure to air pollution** would be taken into account to understand the impact it does on IHDI too. A study by Santra (2014), shows that Air Pollution does not have much statistical bearing on countries with lower HDI[22] but the present study would try to take an experimental approach to test the relationship between exposure and IHDI on a global scale.

F. Geospatial Data

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[21] Hickel, J. (2019, November 13). The sustainable development index: Measuring the ecological efficiency of human development in the anthropocene. https://www.sciencedirect.com/science/article/pii/S0921800919303386?casa_token=kT9t9bv-MJAAAAAA%3A0EGVJGkDK-zCGDzsnoz9L156Y6acpsNvb0rticCnpiK9JE91dAjtbaoA8KE58bmqpEaxOD4wgdI

[22] Santra, S. (2014, February 08). Is Human Development Index (HDI) a Reflector of Quality of Air? A Comparative Study on Developed and Developing Countries. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2391758

The usage of geospatial data in our studies is focused on global **average temperatures** and **average rainfall**. The goal here is to test if the kind of relationship that is held by the aforementioned variables is positive or negative. There are currently two hypothesis for both the geospatial variables:

1) If the variable(s) hold significance ergo it could mean that temperatures and/or rainfall assist agricultural growth and thereby lead to better life expectancies and financial factors.

2) If the variables(s) hold no significance ergo the logical conclusion would be that geospatial data is mostly ignored in calculation of IHDI and therefore could have resulted in these results.

Either way the goal of inculcating geospatial data is based on understanding as to how indirectly climate change policies could be affecting IHDI as an experiment. For example, a case where a higher temperature with higher IHDI at a particular point of time (positive relationship) with negative aforementioned carbon emissions could indicate that environmental policy at that time was effective in achieving desired SDG goals.

H. <u>Poverty</u>

Poverty stands as one of the chief economic variables in our studies because of its nature which acts as a constraint. This study would in particular work with **poverty head count ratio at national poverty lines (% of population)** because of the following reasons:

1) Its simplicity as an indicator which is solely based on income can easily help us understand the particular dynamic of IHDI (Income determination) which gets affected in

this econometric analysis. This idea is utilized in this study based on an approach taken by Anand & Sen (1997)[23].

2) This particular is based on particular poverty determination at national lines therefore no such adjustments need to be done–something that would have been essential if the data was based on 2015 international poverty line on the income of $1.90/day[24].

In addition to the importance of poverty alleviation is one of the front goals of 2030 SDG's and therefore, poverty would certainly play an important role in this study to build an economic frustration model, should its proved that it holds statistical and/or economic significance.

I. <u>Cyberspace</u>

One of the core criticisms of IHDI is that the aforementioned dependent variable of this study does not take into account technological advancement, particularly telecommunication or its importance in a direct manner which thereby leads to a more skewed understanding of human development. As per initial research, econometric understanding of **access to basic cellular services (population density)** and **active internet users by % of total population** (as a demographical understanding) has not been done on a great extent and therefore this study would try to understand the relationship that it holds with IHDI.

J. <u>Government</u>

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[23] Anand & Sen (1997). Concepts of Human Development and Poverty: A Multidimensional Perspective. Berkeley Archives.
http://clasarchive.berkeley.edu/Academics/courses/center/fall2007/sehnbruch/UNDP%20Anand%20and%20Sen%20Concepts%20of%20HD%201997.pdf

[24] N.A, (2015). Poverty Overview, World Bank group. https://www.worldbank.org/en/topic/poverty/overview

Government related variables will be tested to determine the following:

1) We would try to understand the effect of government institutions efficacy and its impact on IHDI for the same running year. To understand this, the variable considered would be **CPIA Quality of Public Administration**.

2) Parallelly, negative externalities which IHDI may or may not cause would be studied as well. Particularly, on the basis of a study by Sarabia et al. (2019) where a study on HDI and Corruption Perception Index on European datasets proved that there were evidences of various clusters with varying data[25]. On the basis of this understanding, **Corruption Perception Index** on global data would be considered to check a global relationship between the two aforementioned variables.

3) One of the novel approaches that this study would pursue in regards to government-related variables would be to add dummy variables in form of **right-wing or other led leaning** governments of all the countries to pursue a hypothetical approach on the effects that would be visible on IHDI, where 1 means a presence of a right wing government (or policies which reflect right wing politics) and 0 means a government bereft of the aforementioned policies and ideology. However, this paper doesn't take any political stance on the results and therefore would not take any opportunities to elucidate on it if the results show no relevant significances.

 A much more conclusive approach on how overall internal governance globally has been affecting IHDI could be quantified by inculcating the variable for **democracy index**.

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[25] Sarabia, M. et al(2019). The Human Development Index (HDI) and the Corruption Perception Index (CPI) 2013-2017:
    Analysis of social conflict and populism in Europe.
    https://www.tandfonline.com/doi/full/10.1080/1331677X.2019.1697721

K. <u>Labor Economics</u>

Labor Economics is one of the most chief components to consider when it comes to discerning the impact of human capital on overall economic growth as per Solow-Swan model (1956).

This study would inculcate:

1) Participation of **labor force as a percentage of population** who are above ages of 15. This would allow for a positive labor force externality.

2) Contrarily, a negative externality for labor force would also be taken into account to understand any impacts or offsets. In fact, by Sobel's test correlation factor between Human Development Index (HDI) and unemployment rates have been found to have strong relationship (Aida et al.,2020)[26]. The present study would test whether a similar relationship holds on global scale with IHDI as well or not **when unemployment rates as a percentage of total labor force** is taken into account.

3) The final variable for labor economics as a more micro-economic factor could better understood with the **average number of hours per employed person**. This would give us insight as to how hours worked relates to IHDI and could potentially be a logical addendum for understanding IHDI in a more comprehensive format as stated by Gylafason (2016)[27].

L. <u>Resource Economics</u>

[26] Aida, N., & Khumairoh, (2020). Causal Relationship Between Economic Growth, Unemployment, Poverty and The Impact to Human Development Index (HDI). https://www.psychosocial.com/article/PR200758/10865/

[27] Gylfason, T. (2016). Human development, inequality and long working hours. https://voxeu.org/article/human-development-inequality-and-long-working-hours

One of the main goals of including resource economics related variables is to understand how different levels of adequacies and inadequacies have an overall impact on IHDI.

The first variable, **access to electricity** as a percentage of the total population is necessary to determine how the relationship between IHDI holds. Hypothetically, higher electricity in certain parts of the world has proven to have higher HDI values, for example Sub-Saharan Africa has shown a similar positive relationship (Sarkodie et al., 2020)[28].

The second variable, theoretically, a constraint variable on IHDI would be **food insecurity** as a percentage of population since by intuition it takes a toll on human capital and can indirectly affect age GNI and as well as widen the inequality scales too.

The final variable, this study would include is **people using safely managed water services (% of population)** to understand the importance of safe drinking water on IHDI. In fact previous studies have proved strong relationships between HDI and safe drinking water (Sušnik et al., 2017)[29]. This study would try to ascertain if the similar conclusion holds for IHDI as well when a more resource based variable on institutional management is concerned as mentioned before.

M. <u>Health Economics</u>

The distribution of alcohol consumption has been previously found out to be scattered in nature–higher alcohol consumption among higher HDI countries in comparison to medium HDI countries (Silva et al., 2014)[30]. This study will test the general global

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[28] Sarkodie, S., & Adams, S. (2020, February 25). Electricity access, human development index, governance and income inequality in Sub-Saharan Africa. https://www.sciencedirect.com/science/article/pii/S2352484719310443

[29] Sušnik et al., (2017). Correlation and Causation between UN Human Development Index and national and personal wealth and resource exploitation. https://www.researchgate.net/publication/320225471_Correlation_and_causation_between_the_UN_Human_Development_Index_and_national_and_personal_wealth_and_resource_exploitation

[30] Silva et al. (2014). Relationship Between Human Development and Drug Use. *Salud Mental.* http://www.inprf-cd.gob.mx/pdf/sm3701/sm370135.pdf

relationship that would exist when IHDI and **Alcohol Consumption (liters)** is compared as well.

However, the most important variable under health economics that this study would include is **Hospital Beds (per 1000 people**) in order to establish a quantified relationship with the aforementioned variable with IHDI. Positive relationship on a global scale would indicate a favorable relationship while a negative relationship could indicate a policy fallacy that has been affecting GNI through higher tax rates and/or higher depreciation of capital accumulation which ultimately affects IHDI.

N. <u>Gender, Diversity and Crime Rates (Miscellaneous)</u>

In the final sub-section of independent variables, this paper would attempt to take a route which has been mostly untested. Drawing inspiration on a paper by Fernández (2012) where coincidence between women's political and economic rights with overall economic development has been studied[31]. On the basis of this understanding, **CPIA Gender Equality Rating** has been considered to be studied. Furthermore, according to Anand and Sen (1994), for a long time now Human Development Index has ignored the gender based indicators particularly termed as GESI or Gender Equality Sensitive Indicators as well[32]. This research, therefore, would take the initiative to set a precedence on the relationship between CPIA Gender Equality Index and IHDI in a more quantified fashion.

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[31] Fernández (2012). Women's Rights and Development. *Journal of Economic Growth.* https://drive.google.com/viewerng/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxyYXF1ZWxmZXJuYW5kZXpzaXRlfGd4OjY1ODJlNjQzNjMzNmJjMjg

[32] Sen, Amartya & Anand, Sudhir (1994). Gender Inequality in Human Development: Theories and Measurement. https://ora.ox.ac.uk/objects/uuid:2c87be7b-3113-4d75-a392-5b78390df9a1/download_file?file_format=pdf&safe_filename=sudhir_anand_amartya_sen.pdf&type_of_work=Report

Moreover, on the basis of an observation on Africa's high ethnic fragmentation which has caused low schooling, political instability, high government deficits and other challenges to economic development (Easterly and Levine, 1997)[33]–this paper would pursue **Religious Diversity Index** which is measured by Pew Research Center to understand as to how the pattern of changing diversity index relates to IHDI.

The final independent variable for this study is crime rates, precisely **Intentional Homicides (per 100,000 people)**. This variable has been picked on the basis of a precedence set by Geneva Declaration Report (2010) where higher armed conflicts have shown to take highly negative effect on crucial macro-economic indicators like income gaps and poverty which have had a deleterious impact on specific MDGs (Millennium Development Goals)[34]. The present study would attempt to find a quantitative basis as to how intentional homicide rates and IHDI relate since its aforementioned negative effects could impact all three pillars on which IHDI is buttressed upon.

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[33] Easterly, W., & Levine, R. (1997, November 01). Africa's Growth Tragedy: Policies and Ethnic Divisions. *Quarterly Journal of Economics.*https://academic.oup.com/qje/article-abstract/112/4/1203/1911730?redirectedFrom=fulltext

[34] N.A (2010). More Violence, Less Development. *Geneva Declaration of Armed Violence and Development.* http://www.genevadeclaration.org/fileadmin/docs/MDG_Process/MoreViolenceLessDevelopment.pdf

III. Data and Empirical Approach

Table A below describes all the 50 independent variables that this study would pursue.

TABLE A: Information for all variables

Variable Name	Sub-Variable	Source	Definition
	Intelligence Quotient (IQ)	World Population Review	*"IQ as it is frequently called – is a measure of human intelligence. People that want to have their IQ measured take standardized tests and receive a score which ranks their level of intelligence."*
	Share of Population with Depression	Our World in Data	*"Share of population at national levels who show symptoms of depression."*

	Suicide Mortality Rate (Per 100,000 People)	The World Bank	*"Non-Age adjusted suicide rates reported for every 100,000 population at national lines."*
Psychological and Mental Health Related Factors	Share of Population with Anxiety Disorders	Our World in Data	*" Data on the % population at national lines who show symptoms of anxiety on the basis of epidemiological data."*
	Prevalence of ADHD in Males vs Females (Ratio)	Our World in Data	*" Ratio of Male to Female populations who have been diagnosed with ADHD symptoms at national levels."*

Education	Primary School Enrollment (% Gross)	The World Bank	*"% of enrolled at primary students at national levels."*
	% of Primary school aged children out of School	The World Bank	*"% of children of mean primary age who are out of school at national levels."*
	% of Primary student Persistence to the final grad	The World Bank	*" % of Primary Student cohort who show persistence to the final grade or 12th grade equivalent at national levels."*
	% of Literacy Rate	The World Bank	*"% of people ages 15 and above who are classified as Literate at national levels."*
	% of Trained Teachers in Primary Education	The World Bank	*"% of the total primary teachers who have received minimal certified training."*
Financial Factors	Adjusted Net National income per capita or Family Savings	The World Bank	*"Adjusted Net National Income per capita is calculated as GNI minus consumption of fixed capital and natural resources depletion at national levels."" Ratio of*

Financial Factors	Per Capita GDP	The World Bank	*Annual GDP to mid-year population at national lines."*
	GINI Index	The World Bank	*"The deviation of distribution of actual income against the perfect distribution at national lines (The Lorenz Curve Plot)."*
	Net Trade in Goods and Services (or BoP)	The World Bank	*"Net valuation of trade in goods and services vis-à-vis export to import difference at national lines."*
	Logistics Performance Index	The World Bank	*" The overall perception of logistics performance in transport related sector catering to all industries at national lines."*
	Gross Domestic Investment or Gross Capital Formation	The World Bank	*" The additions to fixed assets at national lines."*
	Transport Services (% of service exports)	The World Bank	*" The % of service exports which are related to transport services given in any industry at national levels."*

Financial Factors	Transport Services (% of service imports)	The World Bank	" The % of service imports which are related to transport services given in any industry at national levels."
	Military Expenditure (% of GDP)	The World Bank	"% of GDP which is devoted to military expenditure directly or indirectly at national lines."
	R&D Expenditure (% of GDP)	The World Bank	"% of GDP which is dedicated to R&D for science and technology at national levels."
	% of growth in GDP per Capita	The World Bank	"The growth % GDP per capita at national levels."
	% of imports in International Tourism	The World Bank	"% of imports that are associated with tourism (tourism)."
	% of population with insurance coverage	The World Bank	"% of people who have insurance coverage or are enrolled in social programs."

Demographical Factors	Life Expectancy (years)	The World Bank	*"The number of predicted years a person would be expected to live in prevailing patterns of mortality at national lines."*
	Population Density	The World Bank	*"People per square kilometer of land area at national lines."*
	Infant Mortality	The World Bank	*" Number of infants dying before the age of one per 1000 live births annually at national lines."*
	Death Rate	The World Bank	*" Number of deaths occurring per 1000 population estimated at midyear."*
	Refugee population	The World Bank	*"Population who are considered refugees as per 1951 convention at national poverty lines."*
Environmental Factors	CO_2 Emissions (metric tons per capita)	The World Bank	*" The metric tons per person of CO_2 emanating from burning fossil fuels and cement production."*

	Mean Exposure to Air Pollution(mg/ cm³)	The World Bank	" The mean annual exposure to PM2.5 ambience per person at national lines."
Geospatial Data	Average Rainfall (mm)	World Bank	"Average rainfall experienced in a nation in the year of 2018."
	Average Temperature (degrees Fahrenheit)	NASA	"Average temperature experienced in a nation in the year of 2018."
Poverty	Poverty Headcount Index at national poverty lines ($1.90/day)	The World Bank	"Percentage of population living below the international standard of $1.90/day earnings at national lines."
Cyberspace	Access to cellular phone services (Population Density)	The World Bank	"Number of people per 100 people who have access to basic cellular services at national lines."
	Individuals Using the internet (% of population)	The World Bank	" Percentage of population who have access to internet on the basis of last 3 months of micro-activity at national lines."

Government	CPIA Quality of Public Administration	The World Bank	*"This index measures the compatibility of the existing governmental institutions to the public needs at national lines."*
	Corruption Perception Index	Transparency International	*" This index measures the overall prevailing corrupt practices on a scale of 0 (no corruption) and 100(extreme corruption) at national lines."*
Government	Democracy Index	The Economist Intelligence Unit (EIU)	*" This index measures the practice of basic majoritarian democracy that is followed on an overall basis on the existing governmental institutions on a scale of 0 (Authoritarian) to 10 (Full Democracy) at national lines."*
	Right Wing Led Leaning (Dummy Variable)	[Data Created]	*"Governments which follow an overall right wing led policy making in every sector."[35]*

Variable Name	Sub-Variable	Source	Definition
Labor Economics	Labor Force Participation Rate (% of population 15+)	The World Bank	*" The percentage of population above the ages of 15 who are active in labor force participation in all sectors at national lines."*
	Unemployment(% of total active labor force)	The World Bank	*"The percentage of the total active labor force who suffer from unemployment irrespective of reasons but are active in seeking a job at national lines."*
	Annual Hours Worked per employed person	Our World in Data	*" Number of hours dedicated to work per employed person at national lines."*

Resource Economics	Access to Electricity (% of population)	The World Bank	*"Percentage of population who have access to electricity at national lines."*
	Food Insecurity Data (% of population)	The World Bank	*" Percentage of population who face food insecurity due to lack of monetary resources leading to reduction of calorie intake at national lines."*
Resource Economics	People using safely managed water services (% of population	The World Bank	*" Percentage of people who use safely managed water services bereft of fecal or chemical contamination, deleterious to human health at national lines."*
Health Economics	Alcohol Consumption per capita liters, 15+ ages)	The World Bank	*"Per capita of recorded and the estimation of unrecorded alcohol consumption of people over the ages of 15 at national lines."*
	Hospital beds (per 1000 people)	The World Bank	*" Number of hospital beds, both for chronic and acute care, per 1000 people at national lines."*

Gender, Diversity and Crime Rates (Miscellaneous)	CPIA Gender Equality Index	The World Bank	*"Index provided on the basis of the government institutions enforcing laws to promote gender equality (1=low, 6=high) at national lines."*
	Religious Diversity Index	Pew Research Center	*" The Index provided on the basis of religious freedom and diversity (1=low, 10=high) at national lines."*
	Crime Rate (Intentional Homicide)	The World Bank	*"Number of homicides per 100,000 people at national lines."*

What is the Regression Method used?

The regression method is used is **linear regression** because of its adjusted R-squared value being at 0.92 approximately. Below is the data of the adjusted r-square for major models tested for this study.

Models	Linear	Double -Log	Semi-Log
Adjusted-R^2	0.9243	0.9238	0.9203

(Write all the possible regressions conducted and their respective Adjusted R^2 values that was found.)

TABLE B: Descriptive Statistics

Variable Name	Sub-Variable	Number of	Mean (μ)	Minimum	Maximum	Standard Deviation (σ)

		Observations				
Psychological and Mental Health Related Factors	Intelligence Quotient (IQ)	213	42065.69	10.82	1439323.78	151593.738
	Share of Population with Depression	213	3.43	2.196	6.234	0.646
	Suicide Mortality Rate (Per 100,000 People)	213	9.32	0.5	31.9	6.019
	Share of Population with Anxiety Disorders	213	3.95	2.067	8.540	1.146
Psychological and Mental Health Related Factors	Prevalence of ADHD in Males vs Females (Ratio)	213	382962.75	364.943	17051542.731	1374254.480

Education	Primary School Enrollment (% Gross)	213	103.01	69.383	144.533	11.182
	% of Primary school aged children out of School	213	5.92	0	42.618	8.743
	% of Primary student Persistence to the final grade	213	89.21	35.499	99.977	12.347
	% of Literacy Rate	213	85.86	34.523	99.993	17.611
Education	% of Trained Teachers in Primary Education	213	89.10	14.708	100	15.509

Financial Factors						
Financial Factors	Adjusted Net National income per capita or Family Savings	213	10974.86	207.299	64629.770	14571.662
	Per Capita GDP	213	16065.02	292.998	167101.759	22831.482
	GINI Index	213	36.81	25.4	59.1	7.941
	Net Trade in Goods and Services (or BoP)	213	2300385358.39	-502981000000	256401984889.053	49381843881.816
	Logistics Performance Index	213	2.87	1.95	4.2	0.568

Financial Factors						
Financial Factors	Gross Domestic Investment or Gross Capital Formation	213	12656393987728.56	49459703.751	538490265440.020	543550199521.004
	Transport Services (% of service exports)	213	19.54	0.044	74.873	14.999
	Transport Services (% of service imports)	213	32.65	1.267	85	16.799
		213				
	Military Expenditure (% of GDP)	213	1.74	0	8.171	1.203
	R&D Expenditure (% of GDP)	213	1.16	0.015	4.393	1.012
Financial Factors						

	% of growth in GDP per Capita	213	1.32	-23.141	23.986	4.564
	% of imports in International Tourism	213	7.24	0.485	24.059	4.894
	% of population with insurance coverage	213	24.15	0.371	59.520	18.951
Demographical Factors	Life Expectancy (years)	213	72.84	53.705	84.934	7.480
	Population Density	213	362.93	0.136	20777.500	1638.529
	Infant Mortality	213	21.04	1.4	78.5	18.994
	Death Rate	213	7.59	1.202	15.4	2.609

Demographical Factors	Refugee population	213	117964.11	1	2869421	370583.689
Environmental Factors	CO_2 Emissions (metric tons per capita)	213	4.96	0.045	43.857	6.462
	Mean Exposure to Air Pollution(mg/cm^3)	213	26.43	5.861	99.734	18.242
Geospatial Data	Average Rainfall (mm)	213	1171.21	51	3240	791.85
	Average Temperature	213	66.73	22.4	83.3	14.077

Poverty	Poverty Headcount Index at national poverty lines ($1.90/day)	213	24.88	2.5	82.3	15.771
Cyberspace	Access to cellular phone services (Population Density)	213	106.91	12.865	314.922	40.119
	Individuals Using the internet (% of population)	213	55.47	1.309	100	27.998
Government	CPIA Quality of Public Administration	213	2.901	1.5	4.5	0.665
	Corruption Perception Index	213	43.12	10	88	19.14
		213	5.44	1.08	9.87	2.24

Government	Democracy Index	213	0.41	0	1	0.494
	Right Wing Led Leaning (Dummy Variable)					
Labor Economics	Labor Force Participation Rate (% of population 15+)	213	59.55	26.487	88.050	10.059
	Unemployment (% of total active labor force)	213	6.99	0.110	26.920	5.171
	Annual Hours Worked per employed person	213	1868.92	1358.587	2455.551	269.485

Resource Economics	Access to Electricity (% of population)	213	86.68	11.024	100	23.796
	Food Insecurity Data (% of population)	213	9.82	0.205	62.378	14.385
Resource Economics	People using safely managed water services (% of population	213	79.27	7.066	100	26.423

Health Economics	Alcohol Consumption per capita liters, 15+ ages)	213	6.22	0	15.2	4.074
	Hospital beds (per 1000 people)	213	3.37	0.300	16.460	2.515
Gender, Diversity and Crime Rates (Miscellaneous)	CPIA Gender Equality Index	213	3.26	1.5	4.5	0.665
	Religious Diversity Index	213	2.80	0	9	2.161
	Crime Rate (Intentional Homicide)	213	7.41	0	66.9	11.738

TABLE C: Dependent Variable Descriptive Statistics

Dependent Variable	Mean	Minimum	Maximum	Standard Deviation

Inequality Adjusted Human Development Index (IHDI)	0.581	0.25	0.876	0.189	

What does the obtained data look like?

The data used for this **model is cross-sectional** in nature and uses data for the aforementioned variables. These are the reasons for using cross-sectional data for this particular research:

1) Understanding IHDI from such a dynamic angle would require the input of multiple variables, including variables which have not been considered before. Furthermore, since the second part of this research participates in undertaking a behavioral economic approach for economic frustration, so variable characteristics are pertinent for creating a mathematical model.

2) This type of data set holds the potential to prove and disprove previously held theories and even open new frontiers for significance of variables.

What are the potential challenges?

However, with the usage of cross-sectional data regression based problems can arise as well. Here are the expected challenges:

1) **Heteroskedasticity:** This regression problem occurs when the variability of variances of the independent variables in relation to the dependent variables starts increasing as it progresses which leads to incoherent p-values and/or t-statistic inconsistencies.

This problem will be an inevitable problem in this study and could be detected by graphing certain random variables. If noticed closely in the given data set obtained for this research, there are many places where the consistency of data is broken due to extremely high numbers or 0 when there is no data reported from the given countries. This will lead to scattering of data. For missing data the method implemented is **Deterministic Regression Imputation**. This would eliminate the "scatter" of the variables.

2) **Multicollinearity:** Just like Heteroskedasticity, Multicollinearity also poses as an inevitable problem to this study as well. This problem occurs when two independent variables are correlated to each other causing invalid t-ratios and p-values.

One good example of variable set that indubitably poses the problem of multicollinearity for our study are the variable sets: *Per Capita GDP* and *Military expenditure (% of GDP)*. Due to the latter variable being derived from the former data, there is a chance of multicollinearity present in this study.

How should we detect and correct for it?

There are two steps this research intends to solve multicollinearity that would be undertaken to correct for multicollinearity:

(a) There would be a VIF (Variation Inflation Factor) Test conducted to note for variables which have the problem of multi-collinearity.

If the VIF test turns out to be more than 5 for any variable, then there is a strong possibility that there exists a problem of multi-collinearity and subsequently the data variable would be dropped and could be potentially be replaced.

3) **Omitted Variable Bias(OVB):** This problem occurs when an independent term which affects the dependent variable exists but has not been taken into account. For this research, both the observations and sample sizes are high which makes OVB an unlikely problem but cannot be ruled out.

How should we detect and correct for it?
There are three main ways to guess if Omitted Variable Bias has occurred in a regression:

(a) The parameter estimates of the independent variable are way off.

(b) The t-ratios and p-values are also not consistent which means either the inverse relationship between p-value and t-ratios is absent and/or the figures are way off.

(c) The error term or the noise is way too large. This is a much more better way of predicting OVB and requires the error term to be shortened.

This research plans to detect for OVB by Ramsey Reset Test to check if the p-value of the overall regression is high or low. A higher p-value is a positive indicator that OVB is meager in nature. In fact, this study undertakes a pool of 50 independent variables to avoid this problem.

(4) **Endogeneity:** This problem arises when some omitted variable bias has led to a term being contained in the error term. This particular term's collinearity with the independent variables causes this problem of Endogeneity. Endogeneity therefore is a cause of OVB and even unobserved heterogeneity.

This problem is highly likely to arise since a multicollinearity has a high chance to show up in this regression and if OVB shows up as well, then Endogeneity will happen too.

How should we detect and correct for it?

The way to solve this is using functional forms and other different models until a perfect model with the highest adjusted R-square has been found and implemented.

IV. Pre-Regression Rectification

A. Solving Multicollinearity

The problem of Multicollinearity was solved by using Variance Inflation Factor (VIF) tool which indicated that any independent variable which has higher value than 5 holds a multicollinearity problem. Below is the preliminary analysis of the VIF implementation findings of variables that were found to have VIF $\geq$ 5.0 and were dropped from the study.

Figure 1: <u>Preliminary VIF Analysis</u>

```
> library(car)
> vif(OLS)
    CPIA.Quality.of.Public.Administration..1..Low..6.High.                          Average.Temperature
                                              2.483824                                         4.069798
                                   Intelligence.Quotient                                       Corruption
                                              4.206057                                         7.409339
                                        Happiness.Index                   Access.to.electricity....of.population.
                                              4.860007                                         7.426092
                    Total.alcohol.consumption.per.capita                    Annual.hours.worked.per.person
                                              3.472193                                         1.743710
                  Average.precipitation.in.depth..mm.per.year.           CO2.emissions..metric.tons.per.capita.
                                              2.635037                                         2.397233
              Children.out.of.school....of.primary.school.age.    Coverage.of.social.insurance.programs....of.population.
                                              2.148937                                         2.975649
                  Intentional.homicides..per.100.000.people.              Death.rate..crude..per.1.000.people.
                                              1.665452                                         3.361852
                              GDP.per.capita.growth..annual...                            Family.Savings
                                              1.975933                                        19.233164
    Prevalence.of.severe.food.insecurity.in.the.population....       GINI.index..World.Bank.estimate.
                                              4.291384                                         2.539634
                        Gross.capital.formation..current.US..               Hospital.beds..per.1.000.people.
                                              2.429051                                         3.868631
              Individuals.using.the.Internet....of.population.         Mortality.rate..infant..per.1.000.live.births.
                                              6.721659                                        11.710071
        International.tourism..expenditures....of.total.imports.        Labor.force.participation.rate..total
                                              1.785014                                         2.369603
                    Life.expectancy.at.birth..total..years.               Logistics.Performance.Index
                                             14.316613                                         6.454155
                                    Mean.exposure.to.air                    Military.expenditure....of.GDP.
                                              2.217468                                         2.327105
          Net.trade.in.goods.and.services..BoP..current.US..    People.using.safely.managed.drinking.water.services
                                              1.608760                                         6.313209
                            GDP.per.capita..current.US..       Persistence.to.last.grade.of.primary..total....of.cohort.
                                             13.562644                                         5.452054
                                    Population.density          Poverty.headcount.ratio.at.national.poverty.lines
                                              2.115071                                         2.280806
```

Figure 1: <u>Preliminary VIF Analysis (Continued)</u>

```
                                                  ...........
    Research.and.Development.Expenditure....of.GDP.        School.Enrollment.Primary....Gross.
                                           1.372892                                    1.297856
     Mobile.cellular.subscriptions..per.100.people.                               Suicide.Rate
                                           2.579650                                    3.330742
Trained.teachers.in.primary.education....of.total.teachers.  Transport.services....of.service.exports..BoP.
                                           1.802146                                    1.696338
        Transport.services....of.service.imports..BoP.      Unemployment..total....of.total.labor.force.
                                           1.654018                                    1.886300
                                   Right.Wing..1.or.0.                                 Depression
                                           1.316579                                    2.203956
                                            Anxiety          Religious.Diversity.Index...RDI.
                                           2.681855                                    1.326302
                                               ADHD
                                           1.480293
```

In total, 10 variables tested to have VIF ≥ 5.0, with a high of 19.233 and low of 5.452 which fit the necessity of being dropped from the study.

A second verification test was made after dropping them from the study to make sure any strong possibility of multicollinearity has been dropped from the study.

Figure 2: <u>Verification VIF Analysis</u>

```
> vif(OLS2)
 CPIA.Quality.of.Public.Administration..1..Low..6.High.                      Average.Temperature
                                             1.805533                                    3.808457
                                 Intelligence.Quotient                             Happiness.Index
                                             3.389461                                    3.540119
                      Total.alcohol.consumption.per.capita          Annual.hours.worked.per.person
                                             3.153811                                    1.583546
                 Average.precipitation.in.depth..mm.per.year.      CO2.emissions..metric.tons.per.capita.
                                             2.377847                                    2.139368
             Children.out.of.school....of.primary.school.age.  Coverage.of.social.insurance.programs....of.population.
                                             1.847508                                    2.813690
                 Intentional.homicides..per.100.000.people.        Death.rate..crude..per.1.000.people.
                                             1.462079                                    2.649859
                        GDP.per.capita.growth..annual...   Prevalence.of.severe.food.insecurity.in.the.population....
                                             1.694140                                    2.681515
                        GINI.index..World.Bank.estimate.        Gross.capital.formation..current.US..
                                             2.210401                                    1.793079
                        Hospital.beds..per.1.000.people.   International.tourism..expenditures....of.total.imports.
                                             3.105750                                    1.629678
                     Labor.force.participation.rate..total                      Mean.exposure.to.air
                                             2.243354                                    2.132597
                          Military.expenditure....of.GDP.     Net.trade.in.goods.and.services..BoP..current.US..
                                             2.132100                                    1.488878
                                   Population.density       Poverty.headcount.ratio.at.national.poverty.lines
                                             1.877258                                    2.152817
      Research.and.Development.Expenditure....of.GDP.             School.Enrollment.Primary....Gross.
                                             1.286373                                    1.184986
         Mobile.cellular.subscriptions..per.100.people.                               Suicide.Rate
                                             2.208417                                    3.069329
Trained.teachers.in.primary.education....of.total.teachers.  Transport.services....of.service.exports..BoP.
                                             1.632569                                    1.638419
           Transport.services....of.service.imports..BoP.   Unemployment..total....of.total.labor.force.
                                             1.501849                                    1.712802
                                   Right.Wing..1.or.0.                                 Depression
                                             1.250585                                    1.965981
                                            Anxiety          Religious.Diversity.Index...RDI.
                                             2.066861                                    1.257006
                                               ADHD
                                             1.424709
```

The verification test confirms that any possibility of multicollinearity through VIF application has been proven to be eliminated.

B. <u>Omitted Variable Bias Investigation</u>

This study utilizes the Ramsey Reset Test to check if there is a necessity to work on Omitted Variable Bias (OVB) which emerges from a high error value.

Figure 3: <u>Ramsey Reset Test</u>

```
                                          1.121 00
> resettest(OLS2,power = 2:3,type = "regressor",data = OLS2)

        RESET test

data:  OLS2
RESET = 2.4024, df1 = 74, df2 = 101, p-value = 2.281e-05
```

The p-value has a value of 2.281e-05 or 0.003% approximately. This indicates a statistical significance or an evidence against the null hypothesis that other independent variables would be required to inculcate into this study.

V. <u>Regression Analysis</u>

After the rectification, regression for this study was executed to check economic and statistical significances. Below is the full report of the study.

Figure 4: <u>Regression Output</u>

''

```
Residuals:
      Min        1Q    Median        3Q       Max
-0.162920 -0.038242  0.001698  0.036372  0.146783

Coefficients:
                                                          Estimate Std. Error t value Pr(>|t|)
(Intercept)                                              -5.815e-03  1.426e-01  -0.041 0.967513
CPIA.Quality.of.Public.Administration..1..Low..6.High.    1.083e-02  9.251e-03   1.171 0.243099
Average.Temperature                                      -5.858e-04  6.212e-04  -0.943 0.346960
Intelligence.Quotient                                     4.206e-03  7.719e-04   5.449  1.7e-07 ***
Happiness.Index                                           2.931e-02  7.881e-03   3.719 0.000269 ***
Total.alcohol.consumption.per.capita                      6.582e-03  1.980e-03   3.325 0.001078 **
Annual.hours.worked.per.person                            1.049e-05  2.005e-05   0.523 0.601502
Average.precipitation.in.depth..mm.per.year.              1.134e-05  8.593e-06   1.319 0.188861
CO2.emissions..metric.tons.per.capita.                    6.572e-04  9.063e-04   0.725 0.469278
Children.out.of.school....of.primary.school.age.         -6.895e-04  6.560e-04  -1.051 0.294677
Coverage.of.social.insurance.programs....of.population.   8.302e-04  4.020e-04   2.065 0.040368 *
Intentional.homicides..per.100.000.people.                9.843e-05  4.334e-04   0.227 0.820588
Death.rate..crude..per.1.000.people.                     -4.941e-03  2.792e-03  -1.770 0.078479 .
GDP.per.capita.growth..annual...                          1.698e-03  1.159e-03   1.465 0.144655
Prevalence.of.severe.food.insecurity.in.the.population.... -1.414e-03  4.713e-04  -2.999 0.003100 **
GINI.index..World.Bank.estimate.                         -2.400e-03  8.874e-04  -2.704 0.007528 **
Gross.capital.formation..current.US..                     5.237e-14  2.215e-13   0.236 0.813412
Hospital.beds..per.1.000.people.                          9.203e-03  3.503e-03   2.627 0.009371 **
International.tourism..expenditures....of.total.imports.   7.081e-04  1.088e-03   0.651 0.516178
Labor.force.participation.rate..total                    -3.130e-04  6.063e-04  -0.516 0.606348
Mean.exposure.to.air                                     -4.021e-04  3.687e-04  -1.091 0.276892
Military.expenditure....of.GDP.                           1.082e-02  4.780e-03   2.263 0.024889 *
Net.trade.in.goods.and.services..BoP..current.US..       -8.584e-14  3.089e-13  -0.278 0.781424
Population.density                                       -1.414e-06  3.796e-06  -0.372 0.710007
Poverty.headcount.ratio.at.national.poverty.lines        -3.305e-04  4.547e-04  -0.727 0.468295
Research.and.Development.Expenditure....of.GDP.           7.112e-04  4.903e-03   0.145 0.884828
School.Enrollment.Primary....Gross.                       2.015e-04  4.287e-04   0.470 0.638922
Mobile.cellular.subscriptions..per.100.people.            5.785e-04  1.657e-04   3.492 0.000607 ***
Suicide.Rate                                             -1.683e-03  1.327e-03  -1.268 0.206593
Trained.teachers.in.primary.education....of.total.teachers. -9.439e-05  4.029e-04  -0.234 0.815031
Transport.services....of.service.exports..BoP.            1.430e-04  3.850e-04   0.371 0.710818
Transport.services....of.service.imports..BoP.           -5.159e-04  3.190e-04  -1.617 0.107652
Unemployment..total....of.total.labor.force.              2.030e-03  1.143e-03   1.777 0.077355 .
Right.Wing..1.or.0.                                      -6.100e-03  1.012e-02  -0.603 0.547291
Depression                                               -2.020e-03  9.858e-03  -0.205 0.837872
Anxiety                                                   1.648e-02  5.515e-03   2.989 0.003206 **
Religious.Diversity.Index...RDI.                          1.968e-03  2.272e-03   0.866 0.387491
ADHD                                                     -3.904e-09  4.118e-09  -0.948 0.344458
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.06501 on 175 degrees of freedom
Multiple R-squared:  0.8905,    Adjusted R-squared:  0.8673
F-statistic: 38.46 on 37 and 175 DF,  p-value: < 2.2e-16
```

From the above, Statistical Significance Output, these are the following points of interest:

1) 'Intelligence Quotient' is highly significant at α=0.001 (or 99.9% confidence interval).

2) 'Happiness Index' is highly significant at α=0.001 (or 99.9% confidence interval).

3) 'Mobile cellular subscriptions (per 100 people)' is highly significant at α=0.001 (or 99.9% confidence interval).

4) 'Total alcohol consumption per capita' is significant at α=0.01 (or 99% confidence interval).

5) 'Prevalence of severe food insecurity in the population (%)' is significant at α=0.01 (or 99% confidence interval).

6) 'GINI index (World Bank estimate)' is significant at α=0.01 (or 99% confidence interval).

7) 'Hospital beds (per 1,000 people)' is significant at α=0.01 (or 99% confidence interval).

8) 'Anxiety' is significant at α=0.01 (or 99% confidence interval).

9) 'Coverage of social insurance programs (% of population)' is significant at α=0.05 (or 95% confidence interval).

10) 'Military expenditure (% of GDP)' is significant at α=0.05 (or 95% confidence interval).

11) 'Death Rate, crude (per 1,000 people)' is significant at α=0.1 (or 90% confidence interval).

12) 'Unemployment, total (% of total labor force)' is significant at α=0.1 (or 90% confidence interval).

VI. Quantile Regression Analysis

Importance of Quartile Regression Analysis:

Quantile regression is a type of regression used to look at variables outside of the mean of the data. Ordinary regression analysis uses the method of least squares to measure out the conditional mean while quantile regression estimates the conditional medium of the response variables. As a result, this gives different perspectives of the data that is useful when trying to understand non-normally distributed data.

The initial attempts to eliminate statistical problems were conducted in order to remove problems of heteroskedasticity and undue statistical significances. However, in this multiple linear regression, the condition of a homoscedastic pattern among the independent and dependent variables still do not seem to be fulfilled completely due to two main hypothesized reasons:

1) The presence of too many variables and data which could be useful in having a more accurate and diverse prediction could also have its negative effect of scattering of data.

2) Mean imputation technique used to prevent this scatter of data could still have its drawbacks of lack of exponential smoothing.

Furthermore, a quantile analysis of the regressions between different percentiles would provide us with a distribution of the skewness of different independent variables in a set parameter.

Figure 5: Regression Output at 20th Percentile

```
Call: rq(formula = Y ~ X, tau = 0.2, data = IHDIimputed_1_)

tau: [1] 0.2

Coefficients:
                                                        coefficients lower bd upper bd
(Intercept)                                             -0.02889     -0.32235  0.22101
XCPIA.Quality.of.Public.Administration..1..Low..6.High.  0.00397     -0.01249  0.02487
XAverage.Temperature                                    -0.00157     -0.00245 -0.00079
XIntelligence.Quotient                                   0.00461      0.00321  0.00570
XHappiness.Index                                         0.03281      0.01676  0.06006
XTotal.alcohol.consumption.per.capita                    0.00775      0.00333  0.00919
XAnnual.hours.worked.per.person                          0.00001     -0.00002  0.00005
XAverage.precipitation.in.depth..mm.per.year.            0.00001      0.00000  0.00004
XCO2.emissions..metric.tons.per.capita.                  0.00098     -0.00059  0.00170
XChildren.out.of.school....of.primary.school.age.       -0.00044     -0.00233  0.00112
XCoverage.of.social.insurance.programs....of.population. 0.00111     -0.00013  0.00117
XIntentional.homicides..per.100.000.people.             -0.00042     -0.00116  0.00067
XInternational.tourism..expenditures....of.total.imports. 0.00034    -0.00249  0.00223
XDeath.rate..crude..per.1.000.people.                   -0.00167     -0.00834  0.00435
XGDP.per.capita.growth..annual...                        0.00298     -0.00097  0.00505
XPrevalence.of.severe.food.insecurity.in.the.population.... -0.00008 -0.00092  0.00043
XGINI.index..world.Bank.estimate.                       -0.00310     -0.00402 -0.00074
XHospital.beds..per.1.000.people.                        0.00203     -0.00341  0.00827
XLabor.force.participation.rate..total                   0.00019     -0.00185  0.00118
XMean.exposure.to.air                                   -0.00003     -0.00139  0.00012
XMilitary.expenditure....of.GDP.                         0.01482      0.00492  0.02063
XPopulation.density                                      0.00000     -0.00013  0.00001
XPoverty.headcount.ratio.at.national.poverty.lines      -0.00067     -0.00154  0.00003
XResearch.and.Development.Expenditure....of.GDP.        -0.00030     -0.01411  0.01236
XSchool.Enrollment.Primary....Gross.                     0.00045      0.00007  0.00115
XMobile.cellular.subscriptions..per.100.people.          0.00038      0.00009  0.00073
XSuicide.Rate                                           -0.00173     -0.00385  0.00167
XTrained.teachers.in.primary.education....of.total.teachers. -0.00061 -0.00099 0.00074
XTransport.services....of.service.exports..BoP.          0.00019     -0.00052  0.00104
XTransport.services....of.service.imports..BoP.         -0.00027     -0.00094  0.00043
XUnemployment..total....of.total.labor.force.            0.00214      0.00156  0.00463
XRight.Wing..1.or.0.                                     0.00713     -0.01376  0.02247
XDepression                                             -0.01902     -0.03708  0.00318
XAnxiety                                                 0.02523      0.01145  0.03016
XReligious.Diversity.Index...RDI.                        0.00467      0.00098  0.00757
XADHD                                                    0.00000      0.00000  0.00000
```

Figure 6: Regression Output at 80th Percentile

```
Call: rq(formula = Y ~ X, tau = 0.8, data = IHDIimputed_1_)

tau: [1] 0.8

Coefficients:
                                                          coefficients  lower bd  upper bd
(Intercept)                                                  0.14854    -0.14480   0.28860
XCPIA.Quality.of.Public.Administration..1..Low..6.High.      0.01510    -0.01887   0.03834
XAverage.Temperature                                        -0.00014    -0.00106   0.00169
XIntelligence.Quotient                                       0.00359     0.00301   0.00447
XHappiness.Index                                             0.02514     0.01495   0.03503
XTotal.alcohol.consumption.per.capita                        0.00139    -0.00115   0.00826
XAnnual.hours.worked.per.person                             -0.00002    -0.00004   0.00003
XAverage.precipitation.in.depth..mm.per.year.                0.00000    -0.00002   0.00002
XCO2.emissions..metric.tons.per.capita.                      0.00059    -0.00109   0.00411
XChildren.out.of.school....of.primary.school.age.           -0.00074    -0.00218   0.00039
XCoverage.of.social.insurance.programs....of.population.     0.00064    -0.00020   0.00132
XIntentional.homicides..per.100.000.people.                  0.00012    -0.00123   0.00141
XInternational.tourism..expenditures....of.total.imports.    0.00095    -0.00082   0.00270
XDeath.rate..crude..per.1.000.people.                       -0.00844    -0.01259  -0.00020
XGDP.per.capita.growth..annual...                            0.00214    -0.00076   0.00627
XPrevalence.of.severe.food.insecurity.in.the.population....  -0.00160    -0.00199  -0.00032
XGINI.index..World.Bank.estimate.                           -0.00232    -0.00444  -0.00086
XHospital.beds..per.1.000.people.                            0.01685     0.00742   0.02197
XLabor.force.participation.rate..total                       0.00049    -0.00009   0.00110
XMean.exposure.to.air                                       -0.00092    -0.00154   0.00065
XMilitary.expenditure....of.GDP.                             0.01574    -0.00082   0.02650
XPopulation.density                                         -0.00001    -0.00001   0.00032
XPoverty.headcount.ratio.at.national.poverty.lines          -0.00059    -0.00179   0.00099
XResearch.and.Development.Expenditure....of.GDP.             0.01112     0.00601   0.02031
XSchool.Enrollment.Primary....Gross.                         0.00018    -0.00030   0.00099
XMobile.cellular.subscriptions..per.100.people.              0.00066     0.00042   0.00085
XSuicide.Rate                                               -0.00038    -0.00261   0.00246
XTrained.teachers.in.primary.education....of.total.teachers. -0.00030    -0.00062   0.00062
XTransport.services....of.service.exports..BoP.              0.00006    -0.00064   0.00058
XTransport.services....of.service.imports..BoP.             -0.00054    -0.00122   0.00042
XUnemployment..total....of.total.labor.force.                0.00359     0.00128   0.00546
XRight.Wing..1.or.0.                                        -0.00782    -0.02388   0.01166
XDepression                                                  0.00339    -0.01251   0.01092
XAnxiety                                                     0.00897    -0.00078   0.02358
XReligious.Diversity.Index...RDI.                           -0.00126    -0.00585   0.00093
XADHD                                                        0.00000     0.00000   0.00000
```

Figure 7: Anova Test to compare coefficients
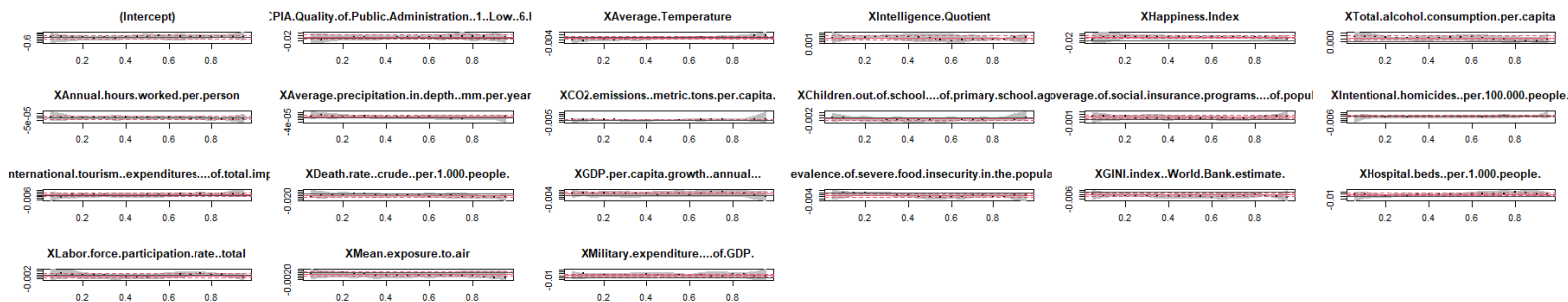

```
    Df Resid Df F value    Pr(>F)
1   35        391  2.8901 2.985e-07 ***
```

Anova test suggest that there is a significant differences between the coefficients of the independent variables when compared at 20th percentile and 80th percentile. (Jump to pp. 52 for explanation).

This can be identified by looking at the p-value that suggests evidence to reject the null hypothesis. The null hypothesis in an Anova test was that the coefficients are not different in the two different regressions that are being conducted.

The next regression analysis compares variables among the 20th and 80th percentile.

Figure 8: Variables Comparison: 20th Percentile vs 80th Percentile

```
Call: rq(formula = Y ~ X, tau = c(0.2, 0.8), data = IHDIimputed_1_)

tau: [1] 0.2

Coefficients:
                                                       coefficients  lower bd  upper bd
(Intercept)                                               -0.02889   -0.32235   0.22101
XCPIA.Quality.of.Public.Administration..1..Low..6.High.    0.00397   -0.01249   0.02487
XAverage.Temperature                                      -0.00157   -0.00245  -0.00079
XIntelligence.Quotient                                     0.00461    0.00321   0.00570
XHappiness.Index                                           0.03281    0.01676   0.06006
XTotal.alcohol.consumption.per.capita                      0.00775    0.00333   0.00919
XAnnual.hours.worked.per.person                            0.00001   -0.00002   0.00005
XAverage.precipitation.in.depth..mm.per.year.              0.00001    0.00000   0.00004
XCO2.emissions..metric.tons.per.capita.                    0.00098   -0.00059   0.00170
XChildren.out.of.school....of.primary.school.age.         -0.00044   -0.00233   0.00112
XCoverage.of.social.insurance.programs....of.population.   0.00111   -0.00013   0.00117
XIntentional.homicides..per.100.000.people.               -0.00042   -0.00116   0.00067
XInternational.tourism..expenditures....of.total.imports.  0.00034   -0.00249   0.00223
XDeath.rate..crude..per.1.000.people.                     -0.00167   -0.00834   0.00435
XGDP.per.capita.growth..annual...                          0.00298   -0.00097   0.00505
XPrevalence.of.severe.food.insecurity.in.the.population.... -0.00008  -0.00092   0.00043
XGINI.index..World.Bank.estimate.                         -0.00310   -0.00402  -0.00074
XHospital.beds..per.1.000.people.                          0.00203   -0.00341   0.00827
XLabor.force.participation.rate..total                     0.00019   -0.00185   0.00118
XMean.exposure.to.air                                     -0.00003   -0.00139   0.00012
XMilitary.expenditure....of.GDP.                           0.01482    0.00492   0.02063
XPopulation.density                                        0.00000   -0.00013   0.00001
XPoverty.headcount.ratio.at.national.poverty.lines        -0.00067   -0.00154   0.00003
XResearch.and.Development.Expenditure....of.GDP.          -0.00030   -0.01411   0.01236
XSchool.Enrollment.Primary....Gross.                       0.00045    0.00007   0.00115
XMobile.cellular.subscriptions..per.100.people.            0.00038    0.00009   0.00073
XSuicide.Rate                                             -0.00173   -0.00385   0.00167
XTrained.teachers.in.primary.education....of.total.teachers. -0.00061 -0.00099   0.00074
XTransport.services....of.service.exports..BoP.            0.00019   -0.00052   0.00104
XTransport.services....of.service.imports..BoP.           -0.00027   -0.00094   0.00043
XUnemployment..total....of.total.labor.force.              0.00214    0.00156   0.00463
XRight.Wing..1.or.0.                                       0.00713   -0.01376   0.02247
XDepression                                               -0.01902   -0.03708   0.00318
XAnxiety                                                   0.02523    0.01145   0.03016
XReligious.Diversity.Index...RDI.                          0.00467    0.00098   0.00757
XADHD                                                      0.00000    0.00000   0.00000
```

Call: rq(formula = Y ~ X, tau = c(0.2, 0.8), data = IHDIimputed_1_)

tau: [1] 0.8

Coefficients:

|	coefficients	lower bd	upper bd
(Intercept)	0.14854	-0.14480	0.28860
XCPIA.Quality.of.Public.Administration..1..Low..6.High.	0.01510	-0.01887	0.03834
XAverage.Temperature	-0.00014	-0.00106	0.00169
XIntelligence.Quotient	0.00359	0.00301	0.00447
XHappiness.Index	0.02514	0.01495	0.03503
XTotal.alcohol.consumption.per.capita	0.00139	-0.00115	0.00826
XAnnual.hours.worked.per.person	-0.00002	-0.00004	0.00003
XAverage.precipitation.in.depth..mm.per.year.	0.00000	-0.00002	0.00002
XCO2.emissions..metric.tons.per.capita.	0.00059	-0.00109	0.00411
XChildren.out.of.school....of.primary.school.age.	-0.00074	-0.00218	0.00039
XCoverage.of.social.insurance.programs....of.population.	0.00064	-0.00020	0.00132
XIntentional.homicides..per.100.000.people.	0.00012	-0.00123	0.00141
XInternational.tourism..expenditures....of.total.imports.	0.00095	-0.00082	0.00270
XDeath.rate..crude..per.1.000.people.	-0.00844	-0.01259	-0.00020
XGDP.per.capita.growth..annual...	0.00214	-0.00076	0.00627
XPrevalence.of.severe.food.insecurity.in.the.population....	-0.00160	-0.00199	-0.00032
XGINI.index..World.Bank.estimate.	-0.00232	-0.00444	-0.00086
XHospital.beds..per.1.000.people.	0.01685	0.00742	0.02197
XLabor.force.participation.rate..total	0.00049	-0.00009	0.00110
XMean.exposure.to.air	-0.00092	-0.00154	0.00065
XMilitary.expenditure....of.GDP.	0.01574	-0.00082	0.02650
XPopulation.density	-0.00001	-0.00001	0.00032
XPoverty.headcount.ratio.at.national.poverty.lines	-0.00059	-0.00179	0.00099
XResearch.and.Development.Expenditure....of.GDP.	0.01112	0.00601	0.02031
XSchool.Enrollment.Primary....Gross.	0.00018	-0.00030	0.00099
XMobile.cellular.subscriptions..per.100.people.	0.00066	0.00042	0.00085
XSuicide.Rate	-0.00038	-0.00261	0.00246
XTrained.teachers.in.primary.education....of.total.teachers.	-0.00030	-0.00062	0.00062
XTransport.services....of.service.exports..BoP.	0.00006	-0.00064	0.00058
XTransport.services....of.service.imports..BoP.	-0.00054	-0.00122	0.00042
XUnemployment..total....of.total.labor.force.	0.00359	0.00128	0.00546
XRight.Wing..1.or.0.	-0.00782	-0.02388	0.01166
XDepression	0.00339	-0.01251	0.01092
XAnxiety	0.00897	-0.00078	0.02358
XReligious.Diversity.Index...RDI.	-0.00126	-0.00585	0.00093
XADHD	0.00000	0.00000	0.00000

VII. <u>Gaussian Finite Mixture Model (EM Algorithm)</u>

As proven by the Ramsey Reset Test, that there exists a significant difference among the regressions at the 20th percentile against the 80th percentile.

One assumption of such a possible difference is that the existence of immense data asynchronicity has caused a higher p-value at 2.985E-07 at 99.9% confidence interval.

Therefore, a Gaussian Finite Mixture Model has been applied here to understand the different groups of population that are visible in our group of study.

Figure 9a: <u>Classification Based Populations</u>
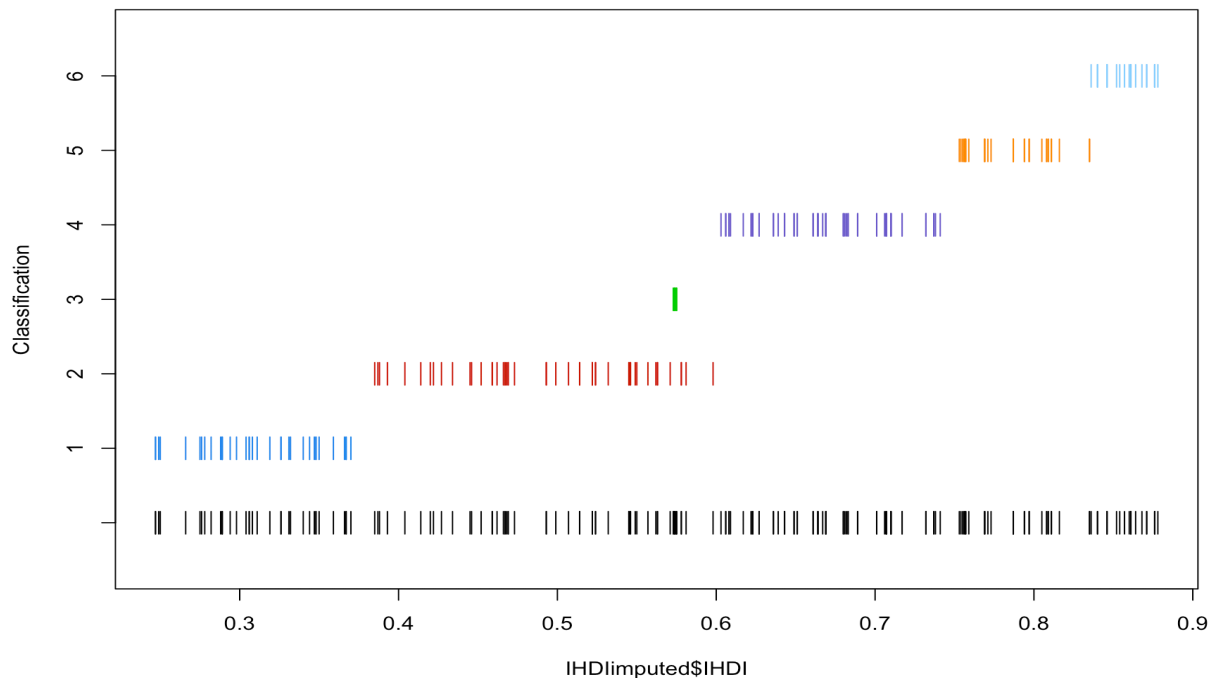
In the figure above, there are 6 dominant classifications in our data, with classification number 2 having the highest probability of frequency at $\mathbb{P} \approx 0.22$ and classification 3 with the lowest frequency at $\min(\mathbb{P}) > 0.1$

Figure 9b: <u>Uncertain Populations</u>
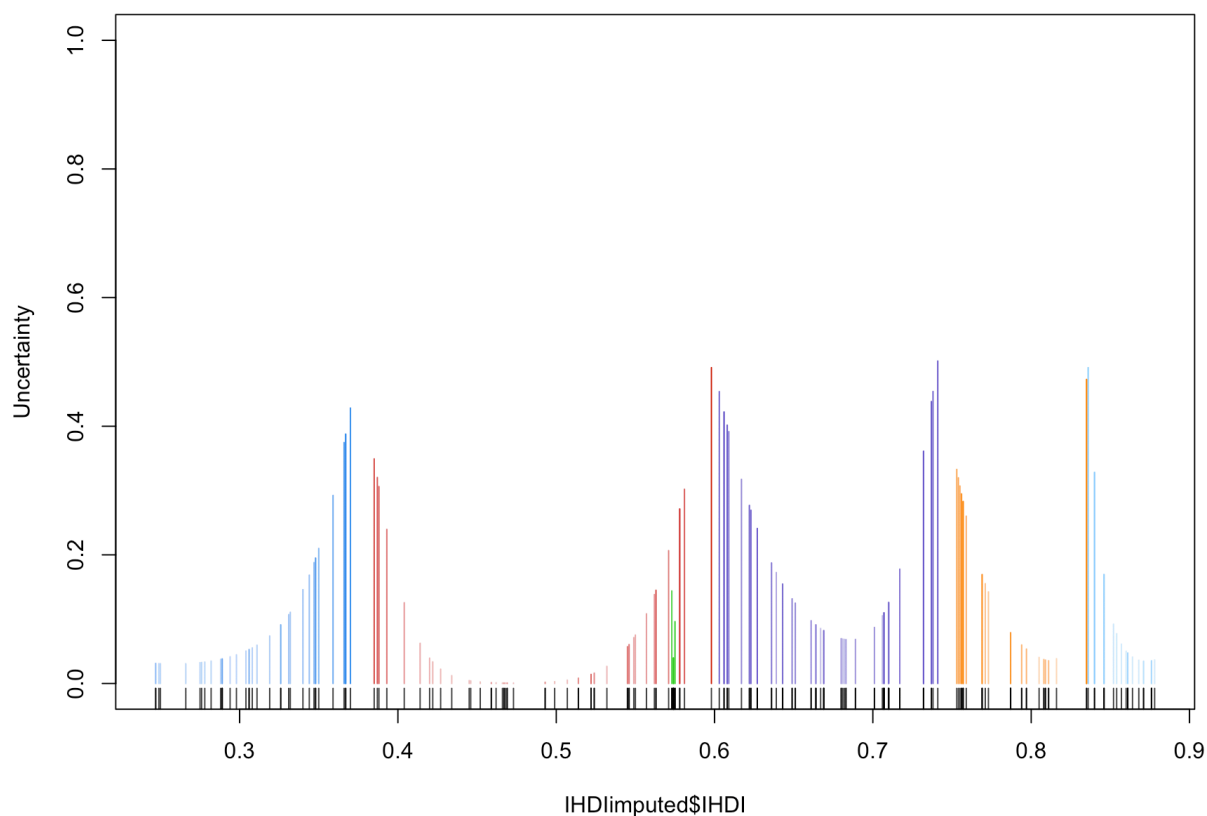
The above graph plots all the uncertain populations which have lower than observable probabilities. At the level of 0.6 to 0.75 approximately we see a higher frequency of uncertain populations and on an overall scale there are multiple populations, more than the ones, with the observable probabilities. This would help us explain why the Ramsey Reset Test had a pattern that resulted in vast inconsistencies on the two separate quantiles.

VIII. Elasticities of Continuous Variables

Elasticity is essential in this study to understand the effect that different explanatory variables have in the dependent variables.

The model that we use is a linear regression model and is in the format of:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \dots \beta_{37} X_{37} + \varepsilon$$

The elasticity formula for any independent variable could be denoted as:

$$\in = \beta_n * \frac{X_n}{y}$$

Both the X_n and y are mean values of the total variables of the data set.

Following are the elasticities and their explanations of all the variables that this study uses:

TABLE D: Elasticity of Variables

Independent Variable (I.V)	I.V Mean (X_n)	I.V. Regression Coefficient (β_n)	Elasticity	Interpretation
CPIA Gender Equality Rating (1=low to 6=high)	3.138497653	1.084e-2 Or .0184	0*	Statistically Insignificant
Average Temperature	66.77793427	-5.858e-4 Or -.0005858	0*	Statistically Insignificant
Intelligence (Statistically Significant)	85.68544601	4.206e-3 Or .004206	0.601544585 (Relatively Inelastic)	At the mean, 1% increase in Intelligence is associated with approximately 0.60% increase in IHDI, keeping all else constant
Happiness Index (Statistically Significant)	5.513276995	2.931e-2 Or .02931	0.269722467 (Relatively Inelastic)	At the mean, 1% increase in Happiness Index is associated with approximately 0.27%

			increase in IHDI, keeping all else constant
Total Alcohol Consumption per Capita *(Statistically Significant)*	6.530516432	6.582e-3 Or .006582	0.071745868 (Relatively Inelastic)	*At the mean, 1% increase in Total Alcohol Consumption per Capita Growth is associated with approximately 0.07% increase in IHDI, keeping all else constant*
Annual Hours Worked per Person	1834.448972	1.049e-5 Or .00001049	0*	*Statistically Insignificant*
Average Precipitation in Depth (mm per year)	1232.976526	1.134e-5 Or .00001134	0*	*Statistically Insignificant*
CO2 Emissions (metric tons per capita)	5.32193537	6.572e-4 Or .0006572	0*	*Statistically Insignificant*
Children out of School (% of primary school age)	6.620306573	-6.895e-4 Or -.0006895	0*	*Statistically Insignificant*
Coverage of Social Insurance Programs (% of population) *(Statistically Significant)*	22.74496672	8.302e-4 Or .0008302	0.031518064 (Relatively Inelastic)	*At the mean, 1% increase in Coverage of Social Insurance Programs is associated with approximately 0.03% increase in IHDI, keeping all else constant*
Intentional Homicides (per 100,000 people)	8.084976526	9.843e-5 Or .00009843	0*	*Statistically Insignificant*
Death Rate, Crude (per 1,000 people)	7.561239437	-4.941e-3 Or -.004941	-0.062359028	*At the mean, 1% increase in Death Rate is associated with approximately 0.06%*

Note: columns beyond the first four represent CO_2 Emissions row as written.

(Statistically Significant)			*(Relatively Inelastic)*	*decrease in IHDI, keeping all else constant*
GDP per Capita Growth (annual%)	1.087098748	1.698e-3 Or .001698	0*	*Statistically Insignificant*
Prevalence of Severe Food Insecurity in the Population (%) *(Statistically Significant)*	12.60542684	-1.414e-3 Or -.001414	-0.029750787 *(Relatively Inelastic)*	*At the mean, 1% increase in Prevalence of Severe Good Insecurity in the Population is associated with approximately 0.03% decrease in IHDI, keeping all else constant*
GINI Index (World Bank estimate) *(Statistically Significant)*	38.52629108	-2.400e-3 Or -.0024	-0.154333404 *(Relatively Inelastic)*	*At the mean, 1% increase in GINI Index is associated with approximately 0.15% decrease in IHDI, keeping all else constant*
Gross Capital Formation (Current US$)	23208872903	5.237e-14 Or .00000000000005237	0*	*Statistically Insignificant*
Hospital Beds (per 1,000 people) *(Statistically Significant)*	2.92399061	9.203e-3 Or .009203	0.044915567 *(Relatively Inelastic)*	*At the mean, 1% increase in Hospital Beds is associated with approximately 0.04% increase in IHDI, keeping all else constant*
International Tourism, Expenditures (% of total imports)	7.804980728	7.081e-4 Or .0007081	0*	*Statistically Insignificant*
Labor Force Participation Rate, Total	58.74931756	-3.130e-04 Or -.0003130	0*	*Statistically Insignificant*

Mean Exposure to Air	25.22357088	-4.021e-4 Or -.0004021	0*	*Statistically Insignificant*
Military Expenditure (% of GDP) *(Statistically Significant)*	1.852089298	1.082e-2 Or .01082	0.03344881 (Relatively Inelastic)	*At the mean, 1% increase in Military Expenditure is associated with approximately 0.03% increase in IHDI, keeping all else constant*
Net Trade in Goods and Services (BoP, current US$)	1711044930	-8.584e-14 Or -.0000000000008584	0*	*Statistically Insignificant*
Population Density	359.7217691	-1.414e-6 Or -.000001414	0*	*Statistically Insignificant*
Poverty Headcount Ratio at National Poverty Lines	22.48779343	-3.305e-4 Or -.0003305	0*	*Statistically Insignificant*
R&D Expenditure (% of GDP)	1.132084322	7.112e-4 Or .0007112	0*	*Statistically Insignificant*
School Enrollment Primary (% gross)	102.7868145	2.015e-4 Or .0002015	0*	*Statistically Insignificant*
Mobile Cellular Subscriptions (per 100 people) *(Statistically Significant)*	107.9210249	5.785e-4 Or .0005785	0.104207965 (Relatively Inelastic)	*At the mean, 1% increase in Mobile Cellular Subscriptions is associated with approximately 0.10% increase in IHDI, keeping all else constant*
Suicide Rate	9.24741784	-1.683e-3 Or -.001683	0*	*Statistically Insignificant*

Trained Teachers in Primary Education (% of total teachers)	90.53344859	-9.439e-5 Or -.00009439	0*	*Statistically Insignificant*
Transport Services (% of service exports, BoP)	19.59540146	1.430e-4 Or .0001430	0*	*Statistically Insignificant*
Transport Services (% of service imports, BoP)	32.02549944	-5.159e-4 Or -.0005159	0*	*Statistically Insignificant*
Unemployment, Total (% of total labor force) *(Statistically Significant)*	7.00312677	2.030e-3 Or .002030	0.023729004 (Relatively Inelastic)	*At the mean, 1% increase in Unemployment, Total is associated with approximately 0.02% increase in IHDI, keeping all else constant*
Right Wing (1 or 0)	0.41314554	-6.100e-3 Or -.0061	0*	*Statistically Insignificant*
Depression	3.416467102	-2.020e-3 Or -.00202	0*	*Statistically Insignificant*
Anxiety *(Statistically Significant)*	4.047109489	1.648e-2 Or .01648	0.111325243 (Relatively Inelastic)	*At the mean, 1% increase in Anxiety is associated with approximately 0.11% increase in IHDI, keeping all else constant*
Religious Diversity Index (RDI)	2.93943662	1.968e-3 Or .001968	0*	*Statistically Insignificant*
ADHD	365546.659	-3.904e-9 Or -.000000003904	0*	*Statistically Insignificant*

* Elasticities for insignificant variables is 0

IX. <u>Marginal Effects for Continuous Variables</u>

Marginal Effects is needed to understand the changes that an independent variable has on a dependent variable in its original units. It is necessary to measure such changes especially when dummy variables are taken into account in a data set.

The following are the marginal effects of the variables that we can note.

TABLE E. Marginal Effects and Interpretations of The Variables

Independent Variable (I.V)	I.V. Regression Coefficient (β_n)	Interpretation
CPIA Gender Equality Rating (1=low to 6=high)	1.084e-2 Or .0184	*Increasing CPIA Gender Equality Rating by 1 unit is associated with approximately .02% increase in IHDI, all else constant.*
Average Temperature	-5.858e-4 Or -.0005858	*Increasing Average Temperature by 1 unit is associated with approximately .0005% decrease in IHDI, all else constant.*
Intelligence	4.206e-3 Or .004206	*Increasing Intelligence by 1 unit is associated with approximately .004% increase in IHDI, all else constant.*
Happiness Index	2.931e-2 Or .02931	*Increasing Happiness Index by 1 unit is associated with approximately .03% increase in IHDI, all else constant.*

Total Alcohol Consumption per Capita	6.582e-3 Or .006582	Increasing Total Alcohol Consumption per Capita by 1 unit is associated with approximately .007% increase in IHDI, all else constant.
Annual Hours Worked per Person	1.049e-5 Or .00001049	Increasing Annual Hours Worked per Person by 1 unit is associated with approximately .00001% increase in IHDI, all else constant.
Average Precipitation in Depth (mm per year)	1.134e-5 Or .00001134	Increasing Average Precipitation in Depth by 1 unit is associated with approximately .00001% increase in IHDI, all else constant.
CO2 Emissions (metric tons per capita)	6.572e-4 Or .0006572	Increasing CO2 Emissions by 1 unit is associated with approximately .0007% increase in IHDI, all else constant.
Children out of School (% of primary school age)	-6.895e-4 Or -.0006895	Increasing Children out of School by 1 unit is associated with approximately .0007% decrease in IHDI, all else constant.
Coverage of Social Insurance Programs (% of population)	8.302e-4 Or .0008302	Increasing Coverage of Social Insurance Programs by 1 unit is associated with approximately .0008% increase in IHDI, all else constant.
Intentional Homicides (per 100,000 people)	9.843e-5 Or .00009843	Increasing Intentional Homicides by 1 unit is associated with approximately .0001% increase in IHDI, all else constant.
Death Rate, Crude (per 1,000 people)	-4.941e-3 Or -.004941	Increasing Death Rate by 1 unit is associated with approximately .005% decrease in IHDI, all else constant.

GDP per Capita Growth (annual%)	1.698e-3 Or .001698	*Increasing GDP per Capita Growth by 1 unit is associated with approximately .002% increase in IHDI, all else constant.*
Prevalence of Severe Food Insecurity in the Population (%)	-1.414e-3 Or -.001414	*Increasing Prevalence of Severe Good Insecurity in the Population by 1 unit is associated with approximately .001% decrease in IHDI, all else constant.*
GINI Index (World Bank estimate)	-2.400e-3 Or -.0024	*Increasing GINI Index by 1 unit is associated with approximately .002% decrease in IHDI, all else constant.*
Gross Capital Formation (Current US$)	5.237e-14 Or .00000000000005237	*Increasing Gross Capita Formation by 1 unit is associated with approximately .00000000000005% increase in IHDI, all else constant.*
Hospital Beds (per 1,000 people)	9.203e-3 Or .009203	*Increasing Hospital Beds by 1 unit is associated with approximately .01% increase in IHDI, all else constant.*
International Tourism, Expenditures (% of total imports)	7.081e-4 Or .0007081	*Increasing International Tourism by 1 unit is associated with approximately .0007% increase in IHDI, all else constant.*
Labor Force Participation Rate, Total	-3.130e-04 Or -.0003130	*Increasing Labor Force Participation Rate by 1 unit is associated with approximately .0003% decrease in IHDI, all else constant.*
Mean Exposure to Air	-4.021e-4 Or -.0004021	*Increasing Mean Exposure to Air by 1 unit is associated with approximately .01% decrease in IHDI, all else constant.*

Military Expenditure (% of GDP)	1.082e-2 Or .01082	Increasing Military Expenditure by 1 unit is associated with approximately .01% increase in IHDI, all else constant.
Net Trade in Goods and Services (BoP, current US$)	-8.584e-14 Or -.00000000000008584	Increasing Net Trade in Goods and Services by 1 unit is associated with approximately .00000000000009% decrease in IHDI, all else constant.
Population Density	-1.414e-6 Or -.000001414	Increasing Population Density by 1 unit is associated with approximately .000001% decrease in IHDI, all else constant.
Poverty Headcount Ratio at National Poverty Lines	-3.305e-4 Or -.0003305	Increasing Poverty Headcount Ratio at National Poverty Lines by 1 unit is associated with approximately .0003% decrease in IHDI, all else constant.
R&D Expenditure (% of GDP)	7.112e-4 Or .0007112	Increasing R&D Expenditure by 1 unit is associated with approximately .0007% increase in IHDI, all else constant.
School Enrollment Primary (% gross)	2.015e-4 Or .0002015	Increasing School Enrollment Primary by 1 unit is associated with approximately .0002% increase in IHDI, all else constant.
Mobile Cellular Subscriptions (per 100 people)	5.785e-4 Or .0005785	Increasing Mobile Cellular Subscriptions by 1 unit is associated with approximately .001% increase in IHDI, all else constant.
Suicide Rate	-1.683e-3 Or -.001683	Increasing Suicide Rate by 1 unit is associated with approximately .002% decrease in IHDI, all else constant.

Trained Teachers in Primary Education (% of total teachers)	-9.439e-5 Or -.00009439	*Increasing Trained Teachers in Primary Education by 1 unit is associated with approximately .0001% decrease in IHDI, all else constant.*
Transport Services (% of service exports, BoP)	1.430e-4 Or .0001430	*Increasing Transport Services by 1 unit is associated with approximately .0001% increase in IHDI, all else constant.*
Transport Services (% of service imports, BoP)	-5.159e-4 Or -.0005159	*Increasing Transport Services by 1 unit is associated with approximately .0005% decrease in IHDI, all else constant.*
Unemployment, Total (% of total labor force)	2.030e-3 Or .002030	*Increasing Unemployment by 1 unit is associated with approximately .002% increase in IHDI, all else constant.*
Right Wing (1 or 0)	-6.100e-3 Or -.0061	*Increasing Right Wing by 1 unit is associated with approximately .006% decrease in IHDI, all else constant.*
Depression	-2.020e-3 Or -.00202	*Increasing Depression by 1 unit is associated with approximately .002% decrease in IHDI, all else constant.*
Anxiety	1.648e-2 Or .01648	*Increasing Anxiety by 1 unit is associated with approximately .02% increase in IHDI, all else constant.*
Religious Diversity Index (RDI)	1.968e-3 Or .001968	*Increasing RDI by 1 unit is associated with approximately .002% increase in IHDI, all else constant.*
ADHD	-3.904e-9 Or -.000000003904	*Increasing ADHD by 1 unit is associated with approximately .000000004% decrease in IHDI, all else constant.*

X. Understanding Significant Variables

The statistically significant independent variables identified earlier, if compared to the interpretations of marginal effects and elasticities- show a synchronicity which is in accordance with the statistical expectations of this study. Out of the 37 independent variables in the regression analysis, few components have shown to be important both statistically and intuitively. It must be noted that a majority of variables which are statistically significant have turned out to be economically significant as well.

TABLE F: Rank by Economic Significance of Variables

Variable Name	|Coefficient|	Economic Significance	Statistical Significance
Happiness Index	0.02931	Significant	Yes-99.9% Confidence Interval

CPIA Gender Equality Rating (1=low to 6=high)	0.0184	Significant	No
Anxiety	0.01648	Significant	Yes-99% Confidence Interval
Military Expenditure (% of GDP)	0.01082	Significant	Yes-95% Confidence Interval
Hospital Beds (per 1,000 people)	0.009203	Significant	Yes-99% Confidence Interval
Total Alcohol Consumption Per Capita	0.006582	Significant	Yes-99% Confidence Interval
Right Wing (1 or 0)	0.0061	Significant	No
Death Rate, Crude (per 1,000 people)	0.004941	Significant	Yes-90% Confidence Interval
Intelligence Quotient	0.004206	Significant	Yes-99.9% Confidence Interval
GINI Index (World Bank estimate)	0.0024	Moderate	Yes-99% Confidence Interval
Unemployment, Total (% of total labor force)	0.00203	Moderate	Yes-90% Confidence Interval
Depression	0.00202	Moderate	No
Religious Diversity Index (RDI)	0.001968	Moderate	No
GDP per Capita Growth (annual %)	0.001698	Moderate	No
Suicide Rate	0.001683	Moderate	No
Prevalence of Severe Food Insecurity (%)	0.001415	Moderate	Yes-99% of Confidence Interval
Coverage of Social Insurance Programs (% of population)	0.0008302	Moderate	Yes-95% Confidence Interval

R&D Expenditure (% of GDP)	0.0007112	Moderate	No
International Tourism, Expenditures (% of total imports)	0.0007081	Moderate	No
Children Out of School (% of primary school age)	0.0006895	Moderate	No
CO2 Emissions (metric tons per capita)	0.0006572	Moderate	No
Average Temperature	0.0005858	Moderate	No
Mobile Cellular Subscriptions (per 100 people)	0.0005785	Moderate	Yes-99.9% Confidence Interval
Transport Services (% of service imports, BoP)	0.0005159	Moderate	No
Mean Exposure to Air	0.0004021	Moderate	No
Poverty Head Count Ratio at National Poverty Line	0.0003305	Moderate	No
Labor Force Participation Rate, Total	0.000313	Moderate	No
School Enrollment Primary (% of Gross)	0.0002015	Low	No
Transport Services (% of service exports, BoP)	0.000143	Low	No
Intentional Homicides (per 100,000 people)	0.00009843	Low	No
Trained Teacher in Primary Education (% of total teachers)	0.00009439	Low	No
Average Precipitation in Depth (mm per year)	0.00001134	Insignificant	No
Annual Hours Worked Per Person	0.00001049	Insignificant	No
Population Density	0.000001414	Insignificant	No
ADHD	3.904E-09	Insignificant	No
Net Trade in Goods and Services (BoP, current US$)	8.584E-14	Insignificant	No

Gross Capital Formation (Current US$)	5.237E-14	Insignificant	No

This is the following index on which the Economic Significance for every variable is marked on Table F.

$$0 \leq |\beta_w| \leq 0.00003 \leq |\beta_x| \leq 0.0003 \leq |\beta_y| \leq 0.003 \leq |\beta_z|$$

Where,

$|\beta_w| \rightarrow Economically\ Insignificant$

$|\beta_x| \rightarrow Economic\ Significance\ is\ Low$

$|\beta_y| \rightarrow Economic\ Significant\ is\ Moderate$

$|\beta_z| \rightarrow Economically\ Significant$

A. Independent Variable #1: Happiness Index

Happiness Index constitutes as one of the principal parts of IHDI's factors.

Prediction to why the variable is both economically significant and statistically significant is challenging to formulate. Assumptions can be made that psychological factors have a considerable impact seeing that the model formed a few statistically significant variables dealing with the mindset. Happiness Index, Anxiety, and IQ are all variables that are classified as psychological variables that are both statistically significant and economically significant. Concluding that mindset of a population has a possibility of having a large impact on IHDI of a country.

It could be argued in F.A Hayek's line of thought where the utility and satisfaction is the end goal than the means of getting the aforementioned goals. By that thought we can

rationalize this Happiness to be the incentive with Economic Development as the means[35]. However, more research would need to be done to elaborate more about the existence of such results, but for now there is reasonable evidence to support this hypothesis.

Happiness Index independently is viewed as a good indicator of IHDI because of the correlation of development with the attitude of the population. When a population, in general, is happy and more developed the result is more productivity as a society. This results in a more developed and functioning population which increases significance in IHDI.

B. Independent Variable #2: Anxiety

Another psychological variable that is both statistically significant and economically significant is Anxiety at 99% confidence interval.
Researching more about the impact of keeping a population mentally healthy is an important finding. Countries need to understand the psychological effects on their people. Having this understanding could be very useful when trying to become a more developed country. More research trying to understand this finding needs to be done.

There are few assumptions with which we can predict the aforementioned findings. First, a high IHDI means a more developed country. That is obvious but it also means the type of work they do is very different. Lesser developed countries will be mostly be classified in the primary and secondary sectors of the economy mostly due to abundance in labor-intensive industries. While more developed countries will still have these jobs but tend to have more of capital-intensive jobs. These sectors focus on retail, financial services, information technology, education and research and development. These jobs are much

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[35] Oswald, A. (2012, January 27). Happiness and Economic Performance. https://academic.oup.com/ej/article-abstract/107/445/1815/5063980

more difficult and require a higher education. Since there is requirement of higher education and more thought process needed to get to these sectors, we can take the liberty to insinuate that the pressure on citizens to close the gap of education with lower opportunities. Even though it is better for a country to have a higher IHDI to a certain level there is a correlation where an effect is the population also having higher anxiety.

C. Independent Variable #3: Military Expenditure

Military expenditure lies within the 95% confidence interval while holding high economic significance. Very interestingly, military expenditure shows a positive correlation with Human Development Index and would have a negative correlation with Economic Frustration, as discussed later in the paper. The understanding here could be that expenditure on military armament is seen on a global scale as a sense of security even if a country is not necessarily involved in active deployment or any other form of belligerence or an emergency. However, in spite of this, the paradox of such an econometric result still demands for more investigation to explain this phenomenon.

D. Independent Variable #4: Hospital Beds

Hospital Beds is arguably the most essential component to get a superficial overview of how the condition of a health sector in any economy, therefore, its economic and statistical significance at 99% confidence interval is no surprise. Furthermore, this variable also shows a positive correlation, pointing to the fact that better hospital bed availability is required to have a better health care that improves labor force vitality necessary for the betterment of the IHDI.

E. Independent Variable #5: Total Alcohol Consumption

Total alcohol consumption was an unexpected significant variable in our research. Our reasoning for such results was made on the following assumption:

Countries with higher IHDI will have more technological advances that will help reduce time on primary job sectors like farming, fishing, and agriculture. With proper equipment and technological advances that make the basic task like farming easier and more efficient this could lead to maximization of leisure time and more jobs in the service sector. With this time off we theorize that a part of the population will be able to participate in alcohol consumption. It could be effectively argued, conterminously, that the increase in alcohol consumption offsets the level of anxiety, as discussed before, and results in an improvement in IHDI, thereby triggering a cyclical procedure on human behavior to economic development.

F. Independent Variable #6: Death Rate

Death rate is economically significant and is at 90% on the confidence interval.

Death rate was not unexpected to be significant. Death rate brings about decrease in labor force which would impact the IHDI. A lower IHDI in turn could bring about more resource constraints that affect human lives, thereby increasing death rate due to a paucity of essential commodities like medical supplies, food, water, education and more. Therefore, there is correlation between IHDI and death rate because of the lack of economic structure to be able to reduce deaths within the nation. This has a similar touch of assumption to aforementioned variable of Hospital Beds.

G. Independent Variable #7: Intelligence Quotient

Intelligence Quotient is another psychological yet an intellectual based variable that is significant with both economical and statistical significance. As mentioned above, our research shows that psychological variables are a large determinant of IHDI and need to be deeply researched. IQ tests a person intelligence and predicts the potential of an individual. As previously mentioned the importance of researching anxiety and happiness, is also important to be able to educate a countries population. A country that is more educated and can perform jobs in higher sectors of the economy, like research and development, are

assumed to have a higher IHDI, with reference to the Solow-Swan model of Economic Development.

However, it must also be remembered that IQ has its drawbacks given its standardization and its only partial-success to capture a person's intellect rather than an education level.

Let's ask ourselves, what determines the IQ at the first place?

To answer this, we need to know exactly what an IQ score test is. IQ is a standardized test that looks at five factors: knowledge, quantitative reasoning, visual-spatial processing, working memory, and fluid reasoning. When testing IQ, the test can look deeply into an individual's specific knowledge, vocabulary, expressive language and more. It should be noted that a person usually keeps their IQ score throughout there life. Around 25% of tested individuals will obtain a ten-point IQ score difference. This means that improving IQ during the later stages of life would be challenging.

Research tests that have been done throughout the years show that IQ can either be determined by genetic or environmental factors (ambience). Of course, there is more that goes into IQ but these two factors seem to be the most impactful. Test were done on a twin to figure out whether environmental or genetics play a larger role in IQ. Twins were given an IQ test and questions about whether they were split at birth or not. Twins that were separated at birth showed less similar IQ scores showing that environment influences IQ, but twins also showed similar IQ's more than those of fraternal twins. Siblings raised together in the same environment have similar IQ's to those that adopted children meaning genetics are influences in IQ. Studies show that genetics account for around 50% and environment accounts for 25% of determining IQ. Both play a large role in determining IQ[36].

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[36] Oommen, A. (2014, August 25). Factors Influencing Intelligence Quotient. Retrieved August 22, 2020, from https://medcraveonline.com/JNSK/factors-influencing-intelligence-quotient.html

This buttresses the veracity that IQ is both environmental and genetically influenced. Which means we can assume that since more developed countries give a better environment to learn and develop which in turn can influence IHDI positively. However, this encourages the need to work more on the avenue of how genetics could possibly be a pre-cursor to Economic Development.

H. Independent Variable #8: GINI Index

GINI Index is a good indicator for income across a population. Therefore, it doesn't come to a surprise that it is moderately economically significant and is also statistically significant on the 99% confidence interval. Furthermore, a negative correlation suggests that there is a strong evidence of a necessity for income equality for a better IHDI.

I. Independent Variable #9: Unemployment, Total

Unemployment cause economic frustration and has a correlation to effect IHDI. Unemployment rates cause a reduction of economic production as labor markets get diluted and therefore the aforementioned variable is scrutinized for being very harmful to an economy. Thereby this comes as no surprise that Unemployment is 90% on the confidence interval with a moderate significance in our econometric results.

J. Independent Variable #10: Prevalence of Severe Food Insecurity

Prevalence of severe food insecurity is moderate economic significant with a 99% statistical significance. A prevalence of food insecurity, takes a severe toll on Labor Economics of any country and thereby affects IHDI.

K. Independent Variable #11: Coverage of Social Insurance Programs

Coverage of Social Insurance Programs has a moderate economic significant with a 95% statistical significance which suggests that a scenario when individuals are more bereft of Social Insurance Programs, a higher amount of problems start arising with IHDI being affected as people might be denied many insurance benefits that affect the willingness to work and affect other variables simultaneously.

XI. <u>Interaction Term Study I: Square of the independent variable "Anxiety"</u>

The study of interaction term of the squared term for Anxiety is essential to understand for two reasons: Firstly, it statistical significance at the 99% shows hope for how we may envision the relationship of constraints to human psyche and human economic development. Secondly, in the latter part of this research, we understand the reciprocal nature of our regression which is used to understand the computation of Economic Frustration, where Anxiety is the most vital component.

Figure 9. Regression with interaction term of the term Anxiety-Squared

```
Residuals:
     Min       1Q    Median       3Q       Max
-0.167713 -0.035084  0.001658  0.033061  0.158961

Coefficients:
                                                        Estimate Std. Error t value Pr(>|t|)
(Intercept)                                            -2.454e-01 1.557e-01  -1.576  0.11688
CPIA.gender.equality.rating..1.low.to.6.high.          3.177e-02 1.005e-02   3.160  0.00186 **
Average.Temperature                                    -1.756e-04 6.177e-04  -0.284  0.77659
Intelligence.Quotient                                   4.148e-03 7.468e-04   5.554 1.03e-07 ***
Happiness.Index                                         3.239e-02 7.610e-03   4.257 3.38e-05 ***
Total.alcohol.consumption.per.capita                    6.687e-03 1.913e-03   3.496  0.00060 ***
Annual.hours.worked.per.person                          1.830e-05 1.948e-05   0.940  0.34874
Average.precipitation.in.depth..mm.per.year.            1.080e-05 8.360e-06   1.292  0.19801
CO2.emissions..metric.tons.per.capita.                  4.401e-04 8.849e-04   0.497  0.61957
Children.out.of.school....of.primary.school.age.       -6.144e-04 6.379e-04  -0.963  0.33686
Coverage.of.social.insurance.programs....of.population. 1.024e-03 3.961e-04   2.585  0.01055 *
Intentional.homicides..per.100.000.people.              1.839e-04 4.181e-04   0.440  0.66069
Death.rate..crude..per.1.000.people.                   -3.620e-03 2.737e-03  -1.322  0.18780
GDP.per.capita.growth..annual...                        1.963e-03 1.087e-03   1.805  0.07282 .
Prevalence.of.severe.food.insecurity.in.the.population....-1.266e-03 4.584e-04  -2.761  0.00638 **
GINI.index..World.Bank.estimate.                       -2.351e-03 8.592e-04  -2.736  0.00687 **
Gross.capital.formation..current.US..                  -5.443e-14 2.155e-13  -0.253  0.80090
Hospital.beds..per.1.000.people.                        7.772e-03 3.420e-03   2.273  0.02426 *
International.tourism..expenditures....of.total.imports. 7.966e-04 1.042e-03   0.765  0.44550
Labor.force.participation.rate..total                  -2.771e-04 5.876e-04  -0.472  0.63781
Mean.exposure.to.air                                   -3.375e-04 3.587e-04  -0.941  0.34804
Military.expenditure....of.GDP.                         1.109e-02 4.620e-03   2.399  0.01748 *
Net.trade.in.goods.and.services..BoP..current.US..      1.669e-14 3.011e-13   0.055  0.95585
Population.density                                      4.661e-07 3.717e-06   0.125  0.90037
Poverty.headcount.ratio.at.national.poverty.lines      -2.166e-04 4.330e-04  -0.500  0.61754
Research.and.Development.Expenditure....of.GDP.          1.604e-03 4.756e-03   0.337  0.73634
School.Enrollment.Primary....Gross.                     2.427e-05 4.183e-04   0.058  0.95380
Mobile.cellular.subscriptions..per.100.people.          4.300e-04 1.690e-04   2.545  0.01179 *
Suicide.Rate                                           -1.874e-03 1.268e-03  -1.478  0.14124
Trained.teachers.in.primary.education....of.total.teachers. -7.231e-05 3.908e-04  -0.185  0.85343
Transport.services....of.service.exports..BoP.          2.132e-04 3.760e-04   0.567  0.57151
Transport.services....of.service.imports..BoP.         -5.705e-04 3.088e-04  -1.848  0.06633 .
Unemployment..total....of.total.labor.force.            1.494e-03 1.121e-03   1.333  0.18425
Right.Wing..1.or.0.                                    -4.289e-03 9.814e-03  -0.437  0.66259
Depression                                              8.084e-04 9.629e-03   0.084  0.93318
Anxiety                                                 6.940e-02 2.602e-02   2.667  0.00838 **
Religious.Diversity.Index...RDI.                        1.401e-03 2.201e-03   0.637  0.52521
ADHD                                                   -5.861e-09 4.012e-09  -1.461  0.14581
gls                                                    -5.645e-03 2.797e-03  -2.018  0.04514 *

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.06296 on 174 degrees of freedom
Multiple R-squared:  0.8978,    Adjusted R-squared:  0.8755
F-statistic: 40.25 on 38 and 174 DF,  p-value: < 2.2e-16
```

In the regression computated above, the term "gls" represents the squared Anxiety variable.

Given this regression, we can derive a quadratic equation from the results with regards to just Anxiety:
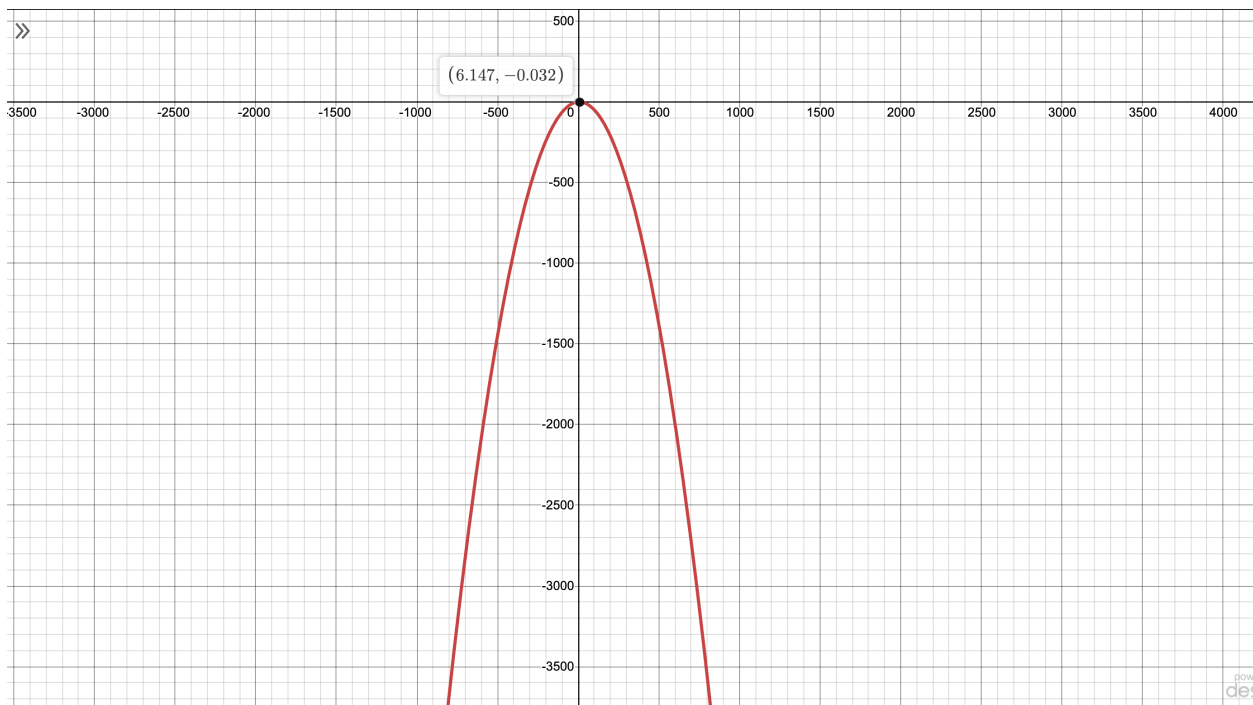
$$y = -0.005645x^2 + 0.0694x - 0.2454 \qquad \text{..............(i)}$$

Where,

$y =$ Inequality Adjusted Human Development Index

$x =$ Anxiety, as a percent of population

Figure 10. <u>Graph of IHDI to Anxiety Relationship</u>

* Source: Desmos Calculator. <u>https://www.desmos.com/calculator</u>

Taking, a derivative of equation (i) and setting it to 0 gives us, the turning point:

$$\rightarrow \frac{dy}{dx} = -2 * 0.005645x + 0.0694$$

Then,

$$\frac{dy}{dx} = 0$$

$\therefore$

$\rightarrow$ $\quad -2 * 0.005645x + 0.0694 = 0$

$\rightarrow$ $\quad x = 6.147 \text{ (approximately)}$

These findings show that, under a cetris paribus assumption, Inequality-Adjusted Human Development Index increases until Anxiety approximately reaches 6.147% of the total population before falling.

XII. <u>Interaction Term Study II: Product of Anxiety and Intelligence Quotient</u>

As mentioned in the Solow-Swan model of Economics, where human intellectual property is one of the key components when it comes to Economic Growth, Intelligence Quotient in our study is the closest factor to account for the aforementioned component. Using Anxiety as a product variable we can understand the changes that may occur as we manipulate the values, consequently affecting IHDI at the end.

Suppose a preliminary regression is defined as:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \dots \varepsilon$$

Where,

$y=$ Inequality Adjusted Human Development Index (Dependent variable)
$X_1=$ Anxiety, as a percentage of population
$X_2=$ Intelligence Quotient

From this equation, the addition of a new interaction term would make the regression equation look like:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 . X_2 \dots \varepsilon$$

The product of the two variables X_1 and X_2 when put in a regression could help us understand the amount of X_2 that is needed in a singular regression for understanding the y variable in terms of X_1.

Simply put–the prediction of X_1 will be on the basis of the following equation:

$$y = \beta_0 + \beta_1 X_1 + \beta_3 X_1 . X_2$$

Putting this in perspective, following are the results of the new regression with the interaction variable added in:

Figure 11. <u>Regression with Interaction Term of Product of Anxiety and Intelligence Quotient</u>

```
Residuals:
     Min       1Q    Median       3Q       Max
-0.168685 -0.034799  0.000106  0.037517  0.157780

Coefficients:
                                                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                                               -5.220e-01  2.330e-01  -2.241 0.026318 *
CPIA.gender.equality.rating..1.low.to.6.high.              3.059e-02  1.004e-02   3.046 0.002680 **
Average.Temperature                                       -1.961e-04  6.166e-04  -0.318 0.750856
Intelligence.Quotient                                      8.493e-03  2.128e-03   3.991 9.68e-05 ***
Happiness.Index                                            3.388e-02  7.643e-03   4.433 1.64e-05 ***
Total.alcohol.consumption.per.capita                       6.826e-03  1.912e-03   3.570 0.000462 ***
Annual.hours.worked.per.person                             1.651e-05  1.933e-05   0.854 0.394172
Average.precipitation.in.depth..mm.per.year.               1.087e-05  8.342e-06   1.303 0.194390
CO2.emissions..metric.tons.per.capita.                     6.202e-04  8.760e-04   0.708 0.479894
Children.out.of.school....of.primary.school.age.          -3.729e-04  6.548e-04  -0.570 0.569718
Coverage.of.social.insurance.programs....of.population.    8.639e-04  3.879e-04   2.227 0.027229 *
Intentional.homicides..per.100.000.people.                 3.407e-05  4.206e-04   0.081 0.935524
Death.rate..crude..per.1.000.people.                      -3.573e-03  2.732e-03  -1.308 0.192725
GDP.per.capita.growth..annual...                           2.120e-03  1.087e-03   1.951 0.052673 .
Prevalence.of.severe.food.insecurity.in.the.population.... -1.123e-03  4.654e-04  -2.413 0.016860 *
GINI.index...World.Bank.estimate.                         -2.438e-03  8.586e-04  -2.840 0.005057 **
Gross.capital.formation..current.US..                     -3.385e-14  2.147e-13  -0.158 0.874890
Hospital.beds..per.1.000.people.                           7.303e-03  3.425e-03   2.132 0.034390 *
International.tourism..expenditures....of.total.imports.    6.650e-04  1.040e-03   0.639 0.523536
Labor.force.participation.rate..total                     -2.516e-04  5.869e-04  -0.429 0.668684
Mean.exposure.to.air                                      -2.809e-04  3.580e-04  -0.785 0.433714
Military.expenditure....of.GDP.                            8.701e-03  4.640e-03   1.875 0.062447 .
Net.trade.in.goods.and.services..BoP..current.US..        -2.988e-14  3.011e-13  -0.099 0.921042
Population.density                                         1.480e-06  3.720e-06   0.398 0.691234
Poverty.headcount.ratio.at.national.poverty.lines         -2.760e-04  4.319e-04  -0.639 0.523665
Research.and.Development.Expenditure....of.GDP.            4.021e-03  4.781e-03   0.841 0.401459
School.Enrollment.Primary....Gross.                        9.236e-05  4.158e-04   0.222 0.824472
Mobile.cellular.subscriptions..per.100.people.             4.301e-04  1.686e-04   2.551 0.011609 *
Suicide.Rate                                              -1.743e-03  1.265e-03  -1.377 0.170136
Trained.teachers.in.primary.education....of.total.teachers. -1.536e-04  3.930e-04  -0.391 0.696353
Transport.services....of.service.exports..BoP.             9.875e-05  3.720e-04   0.265 0.791002
Transport.services....of.service.imports..BoP.            -6.188e-04  3.099e-04  -1.997 0.047371 *
Unemployment..total....of.total.labor.force.               1.513e-03  1.116e-03   1.357 0.176696
Right.Wing..1.or.0.                                       -1.822e-03  9.864e-03  -0.185 0.853679
Depression                                                 1.223e-03  9.622e-03   0.127 0.898989
Anxiety                                                    1.187e-01  4.626e-02   2.566 0.011138 *
Religious.Diversity.Index...RDI.                           1.567e-03  2.200e-03   0.712 0.477220
ADHD                                                      -6.873e-09  4.014e-09  -1.712 0.088632 .
fls                                                       -1.112e-03  5.075e-04  -2.191 0.029760 *


Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.06284 on 174 degrees of freedom
Multiple R-squared:  0.8983,    Adjusted R-squared:  0.876
F-statistic: 40.43 on 38 and 174 DF,  p-value: < 2.2e-16
 .
```

In the regression analysis above the term "fls" is the product of Anxiety and Intelligence Quotient.

The relationship derived from the regression results could be set as:

$$y = -0.522 + 0.1187 * X_1 - 0.0001961 * X_2 - 0.00112 * X_1 * X_2$$

<u>Interpreting Anxiety to Intelligence Quotient using the Interaction term</u>

For Anxiety, the following equation could be drawn:

$$y = -0.522 + 0.1187 * X_1 - 0.00112 * X_1 * X_2$$

<u>Interpretations:</u>

1. **Theoretical View:** At the mean, increasing Anxiety by 1 unit, when Intelligence Quotient is 0, then the IHDI decreases by 0.4033% approximately, all else constant.

2. **Practical View:** At the mean, increasing Anxiety by 1 unit, when Intelligence Quotient is at its mean of approximately 85.69 (check pp. 52, Table D: Elasticity of Variables), then the IHDI decreases by 0.4992% approximately, all else constant.

<u>Interpreting Intelligence Quotient to Anxiety using the Interaction term</u>

For Intelligence Quotient, the following equation could be drawn:

$$y = -0.522 - 0.0001961 * X_2 - 0.00112 * X_1 * X_2$$

<u>Interpretations:</u>

1. **Theoretical View:** At the mean, increasing by Intelligence Quotient by 1 unit, when Anxiety is 0, then the IHDI decreases by 0.5222% approximately, all else constant.

2. **Practical View:** At the mean, increasing Intelligence Quotient by 1 unit, when Anxiety is at is mean of approximately 4.047 (check pp. 54, Table D: Elasticity of Variables), then the IHDI decreases by approximately 0.5267%, all else constant.

It's interesting to note that in all the 4 scenarios charted, IHDI decreases in all of them. However, the greatest fall in IHDI is noticed when practically, Anxiety stays at its mean while Intelligence Quotient is held at constant of 1. In summary increasing Anxiety by 4.467, then the IHDI fall gets exacerbated by 0.86% approximately (percentage change from 0.5222% to 0.5267%).

However, this exacerbation gets outstripped by the former case when the Intelligence Quotient is adjusted to the mean at 85.69 then the IHDI falls further by 23.778% (percentage change from 0.4033% to 0.4992%)

Part II: Computation of Economic Frustration

Theorem of Economic Frustration:

"The Model of Economic Frustration could be defined as a function that predicts the vexation of the human state of comportment at a particular point of time for the almost-global population. Its exacerbation is concomitant to the explanatory variables of Crude Death Rate, Food Insecurity and GINI Index. Antithetically, explanatory variables of Intelligence Quotient, Happiness Index, Total Alcohol Consumption, Coverage of Social Insurance Programs, Hospital Beds, Military Expenditure, Mobile Cellular Subscription, Unemployment as a Percentage of the Labor Force and Anxiety have been reported as mitigators of the aforementioned theory."

Hypothesis I: All statistical significant values have a constant initial value of rise or fall, at *cetris paribus* assumption.

Independent Variable	Notation	Co-efficient
Intelligence Quotient	I_q	0.004206
Happiness Index	H_i	0.02931
Total Alcohol Consumption	T_c	0.006582

Coverage of Social Insurance Programs	I_c	0.0008302
Death Rate, Crude	D_r	-0.004941
Food Insecurity	F_i	-0.001414
GINI Index	Gi	-0.0024
Hospital Beds	H_b	0.009203
Military Expenditure	M_e	0.01802
Mobile Cellular Subscription	M_c	0.0005785
Unemployment, Total (% of Labor Force)	U_l	0.00203
Anxiety	A	0.01648

Hypothesis II : Variables are an antithesis of IHDI in terms of operation or the mirror of IHDI on the basis of operation usage.

Usage of Operation Index will be done as following in our model:

Independent Variable	Operation Usage
Intelligence Quotient	Negative
Happiness Index	Negative
Total Alcohol Consumption	Negative
Coverage of Social Insurance Programs	Negative
Death Rate, Crude	Positive
Food Insecurity	Positive
GINI Index	Positive
Hospital Beds	Negative
Military Expenditure	Negative
Mobile Cellular Subscription	Negative
Unemployment, Total (% of Labor Force)	Negative

Anxiety	Negative

Case for the notion of IHDI Antithesis: The basis of the fact that Economic Frustration is the antithesis of IHDI emanates from a simple theory that: **What can cause Economic Development among individuals can reversibly cause Economic fallout or frustration**. The reason this paper notes Economic Frustration instead of "Economic Breakdown" is due to the involvement of Anxiety into this model as an economically and statistically significant variable.

Anxiety has been proven to be a factor which results in Frustration(Steimer, 2002)[37], which we conterminously see here that a reduction of anxiety reduces the Economic Frustration, even though its existence does result in Economic Development on a global scale.

Methodology-wise, the reversible operation usage to compute the model walks on the lines of Pareto Optimality where the previously "better off" variables have been turned to "worse off" and the vice versa.

Hypothesis III : Variables have different weighting function on the basis of their statistical significance which was proved econometrically previously.

Independent Variable	**Weighting Factor**
Intelligence Quotient	$\overline{0.999}$
Happiness Index	$\overline{0.999}$
Total Alcohol Consumption	0.99
Coverage of Social Insurance Programs	0.95

---

[37] Steimer, T. (2002, September). The Biology of fear-and anxiety-related behaviors. Retrieved 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3181681/

Death Rate, Crude	0.90
Food Insecurity	0.99
GINI Index	0.99
Hospital Beds	0.99
Military Expenditure	0.95
Mobile Cellular Subscription	$\overline{0.999}$
Unemployment, Total (% of Labor Force)	0.90
Anxiety	0.99

The weightage function is important to understand the varied importance given to the above significant variables. The model takes into account the weightage of these variables directly in terms of their statistical significances.

One may argue that the economic significance have not been weighted accordingly, however, since the economic significance arrives from the co-efficient values, there is an automatic correction seen when they are used as initial value terms in a convoluted integral setting which defines the way the function moves.

Furthermore, it should also be noted that this paper considers only the dual significant variables due to their visible significance in our aforementioned Econometric results, thereby, to concede, there remains an invisible partial asymmetricity in the model which cannot be detected and could require extensive studies beyond this threshold.

I. <u>The Economic Frustration Model</u>

Assertion I : The Model of Economic Frustration is macro-behavioral in nature vis-à-vis, a potential quasi-calculus function. It doesn't qualify as a solid macro-economic indicator.

Assertion II*:* The model on the whole be in terms of absolute valuation of all the indicators, post their computation. This is necessary for presenting a hypothetical and abstract solution in a comprehensive setting.

Equation I. <u>Bhunia-Dean Model of Economic Frustration</u>

$$
\mathcal{E}_\phi = \left| \overline{-0.999}(I_q + H_i + M_c) - 0.99(T_c - F_i - G_i + H_b + A) - 0.95(I_c + M_e) + 0.9(U_l - D_r) \right|
$$

Mathematical Definitions of Independent Variables:

(Check Appendices A)

$$
a) \quad I_q = \int_0^{0.004206} \sin(\frac{\pi}{2} - \tau) \cdot I_q(\tau)\, d\tau + \int_{0.004206}^{t} \sin(\frac{\pi}{2} - \tau) \cdot I_q(\tau)\, d\tau
$$

$$
b) \quad H_i = \int_0^{0.02931} \sin(\frac{\pi}{2} - \tau) \cdot H_i(\tau)\, d\tau + \int_{0.02931}^{t} \sin(\frac{\pi}{2} - \tau) \cdot H_i(\tau)\, d\tau
$$

$$c) \quad M_c = \int_0^{0.0005785} \sin(\frac{\pi}{2} - \tau) \cdot M_c(\tau) \, d\tau + \int_{0.0005785}^{t} \sin(\frac{\pi}{2} - \tau) \cdot M_c(\tau) \, d\tau$$

$$d) \quad T_c = \int_0^{0.006582} \sin(\frac{\pi}{2} - \tau) \cdot T_c(\tau) \, d\tau + \int_{0.006582}^{t} \sin(\frac{\pi}{2} - \tau) \cdot T_c(\tau) \, d\tau$$

$$e) \quad F_i = \int_{-0.001414}^{0} \sin(\frac{\pi}{2} - \tau) \cdot F_i(\tau) \, d\tau + \int_{0}^{t} \sin(\frac{\pi}{2} - \tau) \cdot F_i(\tau) \, d\tau$$

$$f) \quad G_i = \int_{-0.0024}^{0} \sin(\frac{\pi}{2} - \tau) \cdot G_i(\tau) \, d\tau + \int_{0}^{t} \sin(\frac{\pi}{2} - \tau) \cdot G_i(\tau) \, d\tau$$

$$g) \quad H_b = \int_0^{0.009203} \sin(\frac{\pi}{2} - \tau) \cdot H_b(\tau) \, d\tau + \int_{0.009203}^{t} \sin(\frac{\pi}{2} - \tau) \cdot H_b(\tau) \, d\tau$$

$$h) \quad A = \int_0^{0.01648} \sin(\frac{\pi}{2} - \tau) \cdot A \ (\tau) d\tau + \int_{0.01648}^{t} \sin(\frac{\pi}{2} - \tau) \cdot A \ (\tau) \, d\tau$$

$$i) \quad I_c = \int_0^{0.0006572} \sin(\frac{\pi}{2} - \tau) \cdot I_c(\tau) \, d\tau + \int_{0.0006572}^{t} \sin(\frac{\pi}{2} - \tau) \cdot I_c(\tau) \, d\tau$$

$$j) \quad M_e = \int_0^{0.006582} \sin(\frac{\pi}{2} - \tau) \cdot M_e(\tau) \, d\tau + \int_{0.006582}^{t} \sin(\frac{\pi}{2} - \tau) \cdot M_e(\tau) \, d\tau$$

$$k) \quad U_l = \int_0^{0.00203} \sin(\frac{\pi}{2} - \tau) \cdot U_l(\tau) + \int_{0.00203}^{t} \sin(\frac{\pi}{2} - \tau) \cdot U_l(\tau) \, d\tau$$

$$l) \quad D_r = \int\limits_{-0.004941}^{0} \sin(\frac{\pi}{2} - \tau) \cdot D_r\,(\tau)\ d\tau + \int\limits_{0}^{t} \sin(\frac{\pi}{2} - \tau) \cdot D_r\,(\tau)\,d\tau$$

II. <u>Conclusion</u>

Currently, Economic Frustration is a very prevalent human economic syndrome which requires more research. This paper sets the precedence on how the theory of Economic Frustration could be modelled to work in a more theoretical standards. However, with the frequency of this invisible component burgeoning unbeknownst to us, it is imperative that a more practical scale be introduced which could contribute to the quantitative field of Development Economics and ultimately assist in understanding the micro-level components which needs to be resolved or practiced on a macro level.

It was interesting to note that, certain variables which were tried as test variables in the beginning of this study. For example, along with Alcohol Consumption's statistical and economic significance, we also noted its positive correlation with IHDI. If it was to be considered an antithesis to the idea of Economic Frustration, then it could be intuitively be argued that a decrease in alcohol consumption should result in fall of Economic Frustration to a certain point. However, the dependence on reversibility of IHDI for concluding certain effects might turn out to be fallacious.

It must be remembered that, in the long run, dependence on IHDI for Economic Frustration could result in a skewed understanding of how Economic Frustration works and therefore, it is expected that in the future more relationships between psychological and economic decisions could be made. One of the lucrative methodology could be the utilization of fMRI to predict how brain activity could result in exacerbation of this concept of "Economic Frustration". Furthermore, fMRI scans could help in developing predictions of general micro-behavior of people on certain observations.

In conclusion, there needs to be more broader perspective and methods that need to be applied to help us understanding this near-invisible phenomenon that plagues us consciously yet unconsciously.

III. <u>Bibliography</u>

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Note on econometric software: This paper utilizes R-Studio and its different packages for the various econometric functions applied in here. For the imputation for the missing data tactic applied, the package "*mice*" was used. For the usage of quantile regression, the package used was "*quantreg*". For the VIF analysis, the package used was "*vif*" was applied here. Finally, for the finite mixture model, the package used was "*mclust*".

Appendices A

The methodology applied in the mathematical definition of each independent variable relies on the concept of Convolution Integrals where,

$$(f * g)(t) = \int_0^t f(t - \tau) \cdot g(\tau) \, d\tau$$

For each independent variable the following methodology has been applied:

$$I_q(t) = [1 \cdot I_q] \text{ where } f = 1 \text{ and } g = I_q$$

Furthermore, we know that $\sin\left(\frac{\pi}{2}\right) = 1$ which leads g to be redefined as $g = \sin(\frac{\pi}{2})$

This gives us the following equation:

$$I_q = \int_0^{0.004206} \sin(\frac{\pi}{2} - \tau) \cdot I_q(\tau) \, d\tau + \int_{0.004206}^t \sin(\frac{\pi}{2} - \tau) \cdot I_q(\tau) \, d\tau$$

Where,

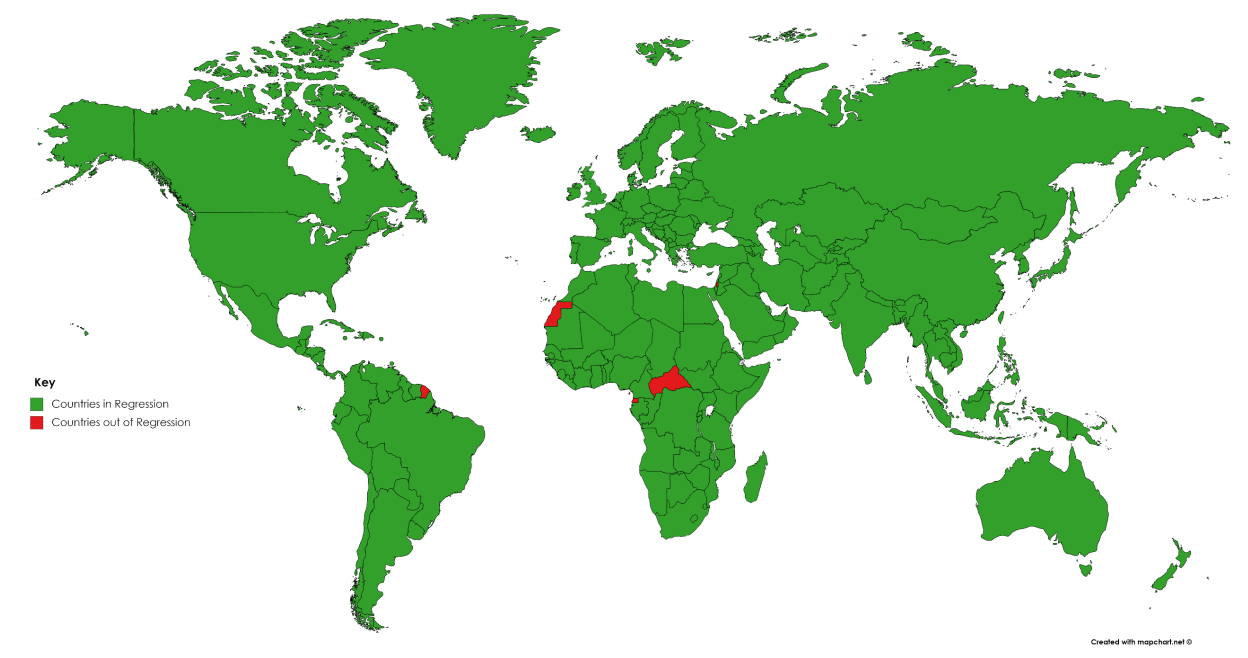The upper limit of t is an imaginary point at the particular time of regression where the intercept of Intelligence Quotient (for this case) was 4.206E-03.

Similarly other variables have been accordingly defined by this methodology where,

$$\rightarrow \quad I_q, H_i, M_c, T_c, F_i, G_i, H_b, A, I_c, M_e, U_l, D_r \neq \sin(\frac{\pi}{2})$$

Appendices B

Total number of Countries = 213

Afghanistan
Albania
Algeria
American Samoa
Andorra
Angola
Antigua and Barbuda
Argentina
Armenia
Aruba
Australia
Austria
Azerbaijan
Bahamas, The
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bermuda
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
British Virgin Islands
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Cambodia
Cameroon
Canada
Cayman Islands
Chad
Channel Islands

Chile
China
Colombia
Comoros
Congo, Dem. Rep.
Congo, Rep.
Costa Rica
Cote d'Ivoire
Croatia
Cuba
Curacao
Cyprus
Czech Republic
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Equatorial Guinea
Eritrea
Estonia
Eswatini
Ethiopia
Faroe Islands
Fiji
Finland
France
French Polynesia
Gabon
Gambia, The
Georgia
Germany
Ghana
Gibraltar
Greece
Greenland
Grenada

Guam
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hong Kong SAR, China
Hungary
Iceland
India
Indonesia
Iran, Islamic Rep.
Iraq
Ireland
Isle of Man
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
Korea, Dem. People's Rep.
Korea, Rep.
Kosovo
Kuwait
Kyrgyz Republic
Lao PDR
Latvia
Lebanon
Lesotho
Liberia
Libya
Liechtenstein
Lithuania
Luxembourg
Macao SAR, China

Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia, Fed. Sts.
Moldova
Monaco
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Netherlands
New Caledonia
New Zealand
Nicaragua
Niger
Nigeria
North Macedonia
Northern Mariana Islands
Norway
Oman
Pakistan
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland

Portugal
Puerto Rico
Qatar
Romania
Russian Federation
Rwanda
Samoa
San Marino
Sao Tome and Principe
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Sint Maarten (Dutch part)
Slovak Republic
Slovenia
Solomon Islands
Somalia
South Africa
South Sudan
Spain
Sri Lanka
St. Kitts and Nevis
St. Lucia
St. Martin (French part)
St. Vincent and the Grenadines
Suriname
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia

Turkey
Turkmenistan
Turks and Caicos Islands
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Uzbekistan
Vanuatu
Venezuela, RB
Vietnam
Virgin Islands (U.S.)
Yemen, Rep.
Zambia
Zimbabwe