Global Scientific JOURNALS

GSJ: Volume 12, Issue 4, April 2024, Online: ISSN 2320-9186
www.globalscientificjournal.com

Analysis of the Degrees of Explainability of Multiple Macroeconomic Indicators to Happiness

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April 2024

This paper explores the relations between four country-level macroeconomic indicators (namely income level, income inequality, unemployment level, and gender inequality) and happiness. Past studies have suggested that there are nuances surrounding each of the relations. In spite of these nuances, this paper seeks to find the correlations' association powers, which this paper dubs as "the degrees of explainability". This is done through the employment of multiple statistical analyses as the methodology. They are the correlation coefficient of the linear regression analysis, the pearson coefficient, and P-value. The results show that among the four correlations observed, only 3 have statistical significance, they are income level, income inequality, and gender inequality. From those, the income level has the highest degree of explainability to happiness. It is followed by the gender inequality. In last place, with the lowest degree of explainability to happiness is the income inequality.

***Keywords**: Income level, income inequality, gender inequality, unemployment, happiness*

I. BACKGROUND

The studies of happiness have been prevalent in the field of economics since the 1970s (Clark, 2018). This branch of economics was developed as economists have found out that measuring welfare and development solely by the numerical metrics are not enough (Clark, 2018). Stemming from the studies of human mind, also more popularly known as psychology, happiness has been regarded as an analytical tool to measure the economic activities of a society using points of measurement that are emotional in nature, such as well-being (Clark, 2018).

Since its emergence, the incorporation of measuring well-being into the studies of economics has been regarded as complementary to the generally more classical macroeconomic measurement that have been used since the 1930s (Ribeiro i Santos, 2019). As macroeconomics measure the behavior of an overall economy, which encompasses markets, businesses, consumers, and governments, the economics of happiness does not seek to replace measures of macroeconomic models, such as inflation, price levels, rate of economic growth, national income, gross domestic product, and unemployment level; but instead, they give meaning to these numeric measurements (Graham, 2005).

The relationship between different macroeconomic indicators to happiness have been widely explored by economists (Di Tella, MacCulloch i Oswald, 2003). One of the most popular is the relationship between income and happiness (Di Tella, MacCulloch i Oswald, 2003). The findings are that the higher the income, the happier the people (Parker, brak daty). However, this is only true to some extent (Clark, 2018). Because there is a pattern that defies this logical assumption, which says that in richer countries where the national income level is already high, the higher the income, the level of happiness does not necessarily increase (The Economist, 2006). This is called the Easterlin paradox (Graham, 2005). In the Easterlin paradox, when income and happiness are being put in two different axis of a matrix, there is an imaginary saturation line where the more income achieved does not translate to more happiness (Graham, 2005). The Easterlin paradox demonstrates the complexity of relationship between the macroeconomic indicators with happiness. It is just one of the nuances that the traditional macroeconomic indicators have when they are being put in contrast with happiness and well-being.

Another nuance that can be seen from a macroeconomic indicator in its relation to happiness is the unemployment level (Winkelmann, 2014). To understand this, one first needs to look at how unemployment affects happiness. Unemployment level defines the general health of the economy (Lumen, brak daty). This is because unemployment explains the level of labor ineffectiveness (Parker, brak daty). Unemployment means that labor is not used to its fullest potential, leaving room to produce maximum goods and services that is not fulfilled (Parker, brak daty). In its relation to happiness, unemployment is generally seen to be in inverse correlation (Parker, brak daty). The higher the level of unemployment, the lower the level of happiness (Parker, brak daty). This is because unemployment has left a person without an income (Parker, brak daty). While this is more obvious, another reason for an unemployed person to be unhappy requires a deeper thought than just an economic calculation: the loss of happiness in a state of unemployment is due to the loss of "a person's duty as a human being", as Nobel laureate George Akerlof said (Winkelmann, 2014).

While it is a general understanding that the higher the unemployment, the lower the happiness, the level of unhappiness between equally unemployed people can be different from person-to-person. One of the most obvious reasons is related to age and gender (Parker, brak daty). The level of unhappiness in two societies with an equal level of unemployment will be different based on how many of the unemployed is men in working prime age (Parker, brak daty). This is due to the social norm where men outside of prime working age are socially less acceptable to be out of work (in other words, young and old men, as well as women, are more socially acceptable to be out of work) (Parker, brak daty). Here is where the nuance comes in: although high unemployment generally means low happiness, the higher the men in working prime age is unemployed, the lower the happiness level (Parker, brak daty).

When compared between the two abovementioned macroeconomic indicators, their relations to the happiness level are varied depending on the nuances. These nuances are present differently for different indicators, and therefore, have different levels of explainability to the happiness level. When national income is being observed, the happiness level is explainable through the nuances of the saturation line in income vis-à-vis happiness matrix. Meanwhile, when unemployment level is being observed, the happiness level is explainable through the lens of gender and age, especially how many among the unemployed population is men of working prime age.

II. RESEARCH FOCUS

These nuances are the central issue that is tried to be addressed in this paper. Particularly, this paper will try to examine the varying degree of explainability in the relationships between different macroeconomic indicators and its effect on happiness across different countries around the globe. In doing so, this paper will compare these degrees from the various indicators and its effect on happiness. The result will be different explainability power from one indicator to another. This explainability power will then be rank, from the highest (the indicator that can best explain the relationship between its indicator and the happiness level) to the lowest (the indicator that can least

explain the relationship between its indicator and the happiness level. Following along the two examples of indicators that have been mentioned previously, which is national income and unemployment, this paper will try to determine the explainability power of these two indicators. The result will be an indication of which one has a higher power than the other. If the national income has a higher explainability power than the unemployment, it means that the national income can better explain its relationship to happiness than the unemployment can.

Unlike the examples above where there are only two macroeconomic indicators being measured against happiness to find its degree of explainability and then these degrees are compared to each other, this paper will analyze 4 macroeconomic indicators. They are Gross National Income per capita (GNI per capita), GINI index, Gender Development Index (GDI), and the unemployment level. Where the macroeconomic data is available, each of these indicators will be measured independently against the happiness level for countries spanning multiple years, 2012 through 2021.

The analysis will be done in several steps. First, in each year that will be observed, each indicator will be treated as its own dataset. Second, this dataset then will be measured against the happiness indicator for the same year, which will be the second dataset for that year. Third, multiple statistical analyses will be done to determine the degree of explainability of the first dataset to the second (or in other words, from one macroeconomic indicator to happiness), and the product would be in a single numeric form. Fourth, once all of the 4 macroeconomic indicators are analyzed against the happiness level, one-by-one, there will be 4 different numbers that will represent the degrees of explainability of each macroeconomic indicators to happiness. Fifth, these degrees of explainability will then be ranked from highest to lowest. Sixth and final step, all of the previous steps will be done repeatedly throughout the multiple years from 2012 to 2021.

The reason why this research is done throughout multiple years is because this is a way to the reliability of the research result. This is by making sure that the result of the data analysis is replicable (Mohajan, 2017). Since to check the replicability of the result needs to be done using new datasets, that is why the analysis will be done in multiple years because each year will have different dataset from the next, and thus, will assure new data being analyzed every single time. Once the analysis is done for all the years, and all of them indicates the same rank of macroeconomic indicators, then the replicability of the data is ensured, which means the result of the reliability of the research is secured.

III. THEORETICAL APPROACH

There has been vast number of studies that explores the aspects of economics of happiness. The most widely-explored topic is probably the relations between income and happiness. The earliest happiness studies in economics took the form of “principle of utility”, where people’s behavior should focus on maximum utility (Tsui, 2014). In this case, the main adage is the higher the income, the happier people will be (Tsui, 2014). However, when put in specific context, this adage is not always true. This is where the Easterlin paradox is introduced. Easterlin (1974) observes that the positive correlation between income and happiness is not persistent everywhere (Tsui, 2014). In places where the income is already high (or in other words, in rich places), the correlation becomes less prevalent (Tsui, 2014). This is explained through the “relative income effect” (Tsui, 2014). In places where income is already high, although the absolute income (the amount of money one earns) is high, it does not necessarily mean that the relative income (the amount of money one earns in relation to his peers) is also high (Tsui, 2014). This can be explained through logical consequence: once the level of income of the general society goes up, which effecting the income of individuals that are members of that society to go up as well, while the other conditions pertaining to that society is fixed, and therefore, the increase of that individual income become meaningless (Tsui, 2014).

The relative income effect also pertains to the greater issue of income inequality in the society, which is another macroeconomic indicator that is closely-related to happiness (Tsui, 2014). The term “relative income” itself

sets the standard for comparison between members of the society, which brings to light the topic of (in)equality when two incomes compared (Tsui, 2014). In fact, one could argue that the relations between income inequality and happiness is closer than the relations between income level and happiness because people would rather choose to have higher relative income even though the absolute income is lower (Jin i Hong, 2022). This is particularly demonstrated through the results of playing experimental Ultimatum Game, where responder would rather reject an offer that is deemed lower than his/her counterpart even though the alternative is he/she gets nothing (Knight i Gunatilaka, 2022). In the ultimatum game, responder could only respond to the offer given by the proposer, wherein if he/she accepts, he/she will get the amount offered and the proposer will get the rest (Dickinson, 2000). Oppositely, if he/she rejects, both will get nothing (Dickinson, 2000). When the responder deems the offer he/she gets is less than what the proposer gets, he/she will reject the offer knowing that he/she will get nothing (Dickinson, 2000). The operative words here are "get less than" and "get nothing", whereas "get less than" signifies relative income and "get nothing" signifies absolute income. When the responder is faced with the choices of "get less than" (negative relative income) but "get something" (positive absolute income), or "get equally nothing" ("equal" signifies positive relative income and "nothing" is a negative absolute income), he/she chooses the second one. This shows that positive relative income trumps positive absolute income in the decision-making process.

The decision-making process is the foundation of economics (Di Tella, MacCulloch i Oswald, 2003). The fundamental assumption of classic economic theory is that people are able to identify and choose what is best for them (Lane, 2017). Borrowing from psychology, the term "what is best" is synonymous to "what yields the greatest happiness" (Kumalasari, Karremans i Dijksterhuis, 2020). Since the abovementioned experimental result has demonstrated that in a decision-making process when one is presented with inequality, one will choose equality (in the case above, the positive relative income), while also assuming that the goal of a decision-making process is to yield happiness, it means that equality leads to happiness. On the same assumption, since it has also been established that in a decision-making process, one chooses relative income (positive equality) over absolute income (positive income), it means that (in)equality affects happiness more than income level.

While explaining about income and inequality, one should also remember the inherent assumption of income: it is only obtained through employment (Böckerman i Ilmakunnas, 2004). In relations to employment, income is understood as the total remuneration paid by an employer to an employee as reimbursement for work carried out during the reference period of payments (Böckerman i Ilmakunnas, 2004). More than that, the significance of these two closely intertwined economic concepts can be seen in the way that they are independently two of the most basic foundations of macroeconomics (Keynes, 1935). Income and employment alone can tell the degree of economic health of a society (Keynes, 1935). The income and employment theory suggests that income and employment are macroeconomically important in two ways: it is a purpose to be kept in mind when creating policies, and also a way to achieve economic stability (Keynes, 1935).

When it comes to its effect on happiness, employment becomes an important subject as it is generally understood that unemployment leads to unhappiness (Aliyev, 2021). This is because unemployment generates pecuniary costs for the unemployed people, resulting in the decrease of happiness as compared to employed people (Aliyev, 2021). However, the effects of employment to happiness are hinging on the contexts, and that is why, studies that observe the relations between employment generate various results. The variety of results are related to multiple things, including government intervention, the employment enjoyability, and gender background. They each will be explained in the following paragraphs.

The government intervention to unemployment affects the happiness of the society in general (Aliyev, 2021). This is evident for the case of Azerbaijan, where unemployment tends to affect negatively on happiness (Aliyev, 2021). However, since Azerbaijan is a country with an already-low income level and limited government resources, it means the country has scarce unusually scarce resources to support the unemployed population (Aliyev, 2021). This is coupled by the fact that the economic activities are riddled with informal sectors, as well as the government has no sufficient census data, the low unemployment benefit does not help the most in need (Aliyev,

2021). It resulted in the ineffective distribution of the unemployment benefit, and therefore, the most vulnerables are being overlooked (Aliyev, 2021). This is perceived as unfairness, and as have been established in the previous part of this paper that unfairness can often lead to unhappiness, it is believed that once the unemployment benefit is redistributed effectively to cover those who need the most, the general happiness can increase (Aliyev, 2021).

While the relations of unemployment and happiness are straightforward when it comes to unjust distribution of scarce government resources in low income countries, in higher income countries such as the UK, the relations between unemployment and happiness paints a more nuanced picture. In the case of Azerbaijan, unemployment leads to unhappiness, and unfair topics surrounding unemployment leads to even more unhappiness, in the case of UK and Japan, unemployment contradictorily may lead to happiness. In the UK, when both the daily activities of the employed and the unemployed are observed, the employed are reporting work as their "least enjoyable activities of their day" (Hoang i Knabe, 2020). Furthermore, it is also reported that a large share of their time is spent at work and on work-related activities (Hoang i Knabe, 2020). Meanwhile, for the unemployed, they are able to spend more time on leisure and more enjoyable activities (Hoang i Knabe, 2020). It is said that in average, when both their time of day are weighted equally, the unemployed experience more enjoyment than the employed. In this case, the employment (dis)enjoyability is seen to be the factor that determines the level of happiness (Hoang i Knabe, 2020).

Another factor that might affect the relations between unemployment and happiness is gender (Liao, 2021). As mentioned previously in the beginning of this paper, the gender dimension is important when looking at how unemployment affects happiness. In countries where the population of men in prime working age is significant, as opposed to countries where otherwise is true (population of women as well as much-older and much-younger men is significant), will have lower happiness if the unemployment level between the two is same. This can be summed up through the social production function theory, which states that people seek physical and social well-being through behaviors that enhance status, affection, and behavioral confirmation (van der Meer, 2014). It is said that due to differences in gaining social approval between men and women, unemployment is more detrimental to men (traditionally seen as a breadwinner) than to women (van der Meer, 2014). The phenomenon is true when the European Social Survey 2004 is being looked at, from where it can be inferred that the factor of employment affecting well-being is bigger for men than for women (van der Meer, 2014).

While the relations between unemployment and happiness when it comes to gender dimension has been explored, the relations between gender itself and happiness is also interesting to observe. Studies have suggested that the global average shows women reporting better well-being than men although women are worse off in almost every aspect of life (women, as compared to men, are granted fewer freedoms, get worse representation, experience more discrimination, are more frequent victims of violence, and are more likely to be diagnosed with anxiety or depressive disorders) (Montgomery, 2022). Concretely, in the case of US for example, just being female increases life satisfaction reports more than moving a decile higher in the income distribution, which is equivalent to thousands of dollars annually (Montgomery, 2022). This is true not only in US but across much of the world and for the world on average (Montgomery, 2022).

While the relations between being female and happiness have been reported similarly across various studies, critics to this conclusion have been rampant (Montgomery, 2022). This is especially because most of the studies done used self-report as the method of obtaining the data, a method whose results when taken at its face value is prone to both bias (when applied to something as personal as happiness) and differing personal standard (when applied to something as abstract as happiness) (Montgomery, 2022). That is why, when used a different analysis that also serves as a corrector to the self-report methodology called vignettes anchoring (which essentially means that, in addition to taking the survey answers at its face value, all of the survey questions are "anchored" into an objective and standardized base also known as vignette), women are experiencing less happiness than men (Montgomery, 2022).

IV. METHODOLOGY

Many of studies on well-being have been reliant on statistical analysis as its methodology. This paper will be no different. There are two types of analyses that will be employed, they are linear regression and pearson coefficient. Both have the purpose of explaining the relations between two datasets. In this case, the pairings of datasets will look so that each macroeconomic indicator is paired with happiness. Therefore, there will be 4 pairs: GNI per capita to happiness, GINI index to happiness, GDI to happiness, and unemployment level to happiness. This will be replicated throughout the years 2012 to 2021. That being said, the result will be 8 pairs of statistical analyses, 4 for regression analysis and 4 for pearson coefficient, that stretch over these years.

To understand the difference between the two statistical analyses, their definitions need to first be looked at. Linear regression analysis is a statistical method used for creating an estimation model of relationships between one independent variable and one dependent variable (Shalabh). Linear regression analysis consists of different elements, but this study will particularly focus on the correlation coefficient (R^2) (Chung). Correlation coefficient is a statistical measure that determines the proportion of variance in the dependent variable that can be explained by the independent variable (The Hong Kong Polytechnic University). In other words, it shows how well the data fit the regression model (Rao, 2020). That is why, this coefficient is also known as the goodness-of-fit measurement (Rao, 2020). Meanwhile, the pearson coefficient is a descriptive statistic, meaning that it summarizes the characteristics of a dataset (Laerd Statistics). Specifically, it describes the strength and direction of the linear relationship between two quantitative variables (Laerd Statistics). It is used to test whether there is a significant relationship between two variables (Laerd Statistics).

As both analyses have been defined, now the differences will be explained. The very clear difference between the two is in the analysis mechanism (Schober, Boer i Schwarte, 2018). Linear regression analyses datasets by developing an estimation model and check how well the pairing of data points in the dataset fit this model (Schober, Boer i Schwarte, 2018). Meanwhile, the pearson coefficient, as its name suggests, is a coefficient (Schober, Boer i Schwarte, 2018). Therefore, it inherently analyses the data by showing the calculation result of a mathematical equation that shows the strength of the pairing of data points in relations to the whole dataset (Schober, Boer i Schwarte, 2018). The second difference is in the relations between variables. In linear regression, the variables are categorized into two: independent and dependent (SAGE Publications, brak daty). Therefore, this analysis is hinging on the validity of hypothesis, which variable is influencing and which is being influenced (Glymour, Scheines, Spirtes i Meek, 1994). In other words, there is a dimension of causality (Glymour, Scheines, Spirtes i Meek, 1994). Meanwhile, the pearson coefficient does not care about this. It merely calculates a degree of correlation and how strong that degree of correlation is (SAGE Publications, brak daty). As opposed to the linear regression that relies heavily on the estimation model to be the basis to check the hypothesis, pearson coefficient analysis comes to a result by checking how consistent its degree of correlation is for the whole dataset (SAGE Publications, brak daty).

While the differences between linear regression and pearson coefficient have been explained, the similarity also will be described. Both methods can be used to explain the correlation between two variables (Schober, Boer i Schwarte, 2018). Especially bearing in mind that the correlation coefficient is an important aspect of the linear regression method, same as pearson coefficient, they are used to quantify the relationship between two variables, in terms of the strength and the direction of the relationship (Bandason, 2019). To understand this, it must first be understood that both coefficients fall within the range of -1 to 1. The range of -1 to 0 and 0 to 1 shows the strength of the relationship, the closer the coefficient is to 0, the weaker the relationship (Statistics Solutions, brak daty). Meanwhile, in regards to the direction of the relationship, positive sign shows that the relationship is direct (also known as proportional) (Schober, Boer i Schwarte, 2018). This means that an increase in the first variable means an increase in the second (Schober, Boer i Schwarte, 2018). In contrast, negative sign signifies an inverse relationship (Schober, Boer i Schwarte, 2018). This means that an increase in the first variable means a decrease in the second (Schober, Boer i Schwarte, 2018). This is especially true for the pearson coefficient (SAGE Publications, brak daty).

Meanwhile, for the correlation coefficient in linear regression analysis, the end result can slightly change because this coefficient is presented in a square-form (R^2) (The Hong Kong Polytechnic University). Since both positive and negative numbers when squared result in positive numbers, it means that the end product does not concern with the direction of the correlation (The Hong Kong Polytechnic University).

Both the linear regression and the pearson coefficient analyses in this paper are automated using formulas in Microsoft Excel. The formulas are (if column B represents the Y-value (dependent variable in linear regression), in this case, the happiness level, and column A represents the X-value (independent variable in linear regression), in this case, the macroeconomic indicator):

Analysis	Formula	Result illustration
Correlation coefficient in linear regression	=linest(B2:B150,C2:C150,TRUE,TRUE)	0.156188305 | 0.2001922 0.009001888 | 0.0850852 0.67190715 | 0.1244695 301.0439004 | 147 4.663968691 | 2.27742
Pearson coefficient	=pearson(B2:B150,C2:C150)	0.819699427

Since in this illustration the rows taken into account in the formula is ranging from row 2 to 150, it means that there are 149 data pairs in the population that is being statistically analyzed. In other words, there are 149 data pairs between the two datasets (each dataset belongs to each variable).

When applying the above formulas, the state of the data having a pair (both datasets have data point for the same item) is crucial. It means that for the calculation to happen, there should be no item in both datasets that miss a data point (Newsom, brak daty). This is because these coefficients analyze the relation between two variable, therefore in itself it means that there should be two variable exists. If one is missing, the analysis cannot be performed. Since all the datasets (the 4 macroeconomic indicators as well as the happiness indicator) are provided by different sources, it needs to be stated that in this study there is possibility that the number of items in the dataset are not always the same (there might occasionally be an item is present in one dataset that is missing in the other dataset), and consequently, the population will differ from each correlations to another, unique per indicator per year. To understand better, please see below illustration:

Country	Happiness Indicator		GNI Per Capita		GINI Coefficient	
	2012	*2019*	*2012*	*2019*	*2012*	*2019*
Country A	Available	Available	Available	Not Available	Available	Available
Country B	Available	Available	Available	Available	Available	Not Available
Country C	Available	Available	Available	Available	Available	Not Available

Therefore, the correlations that are analyzable from the above datasets are:

Correlations	*2012*	*2019*

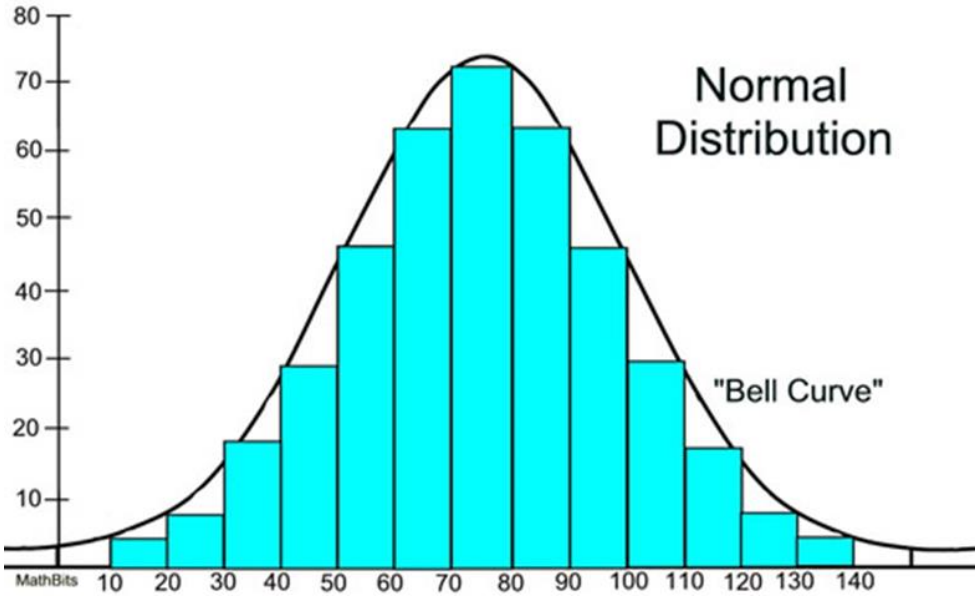
	Country A	Country B	Country C	Country A	Country B	Country C
Happiness to GNI per capita	Analyzable	Analyzable	Analyzable	Not Analyzable	Analyzable	Analyzable
Happiness to GINI Coefficient	Analyzable	Analyzable	Analyzable	Analyzable	Not Analyzable	Not Analyzable

As per above analyzability of each data pairings, the populations will be as follows:

Indicator / Year	*2012*	*2019*
Happiness to GNI per capita	3	2
Happiness to GINI Coefficient	3	1

It needs to be noted that this assumption is true only when everything else is equal (*ceteris paribus*).

Another aspect to keep in mind, before applying the formulas, the datasets are first normalized. This is because the statistical analyses are effective when there is normal distribution in the dataset (AV Content Team, 2024). Normal distribution itself is a probability distribution that is symmetric about the mean, showing that data near the mean are more frequent in occurrence than data far from the mean (Frost, brak daty). In a normal distribution, there are two important parameters: the mean and the standard deviation (Kumar, 2020). The mean in normal distribution represents the peak or highest point (Kumar, 2020). The distribution then falls symmetrically around the mean, the width of which is defined by the standard deviation (Frost, brak daty). To check whether a dataset has normal distribution, usually one will employ the dataset's histogram (Roberts, brak daty). Below is the histogram illustration when a dataset has normal distribution:



Since the illustration looks like a bell, the normal distribution is also called "bell curve" (Roberts, brak daty).

Statistical analyses work best when the dataset has normal distribution, therefore the normal distribution can also serve as a checker. Before a statistical analysis is applied to a dataset, one must first check if that dataset has normal distribution. If not, then an attempt at normalizing the distribution of the dataset is ought to be done.

The most common way to normalize a dataset is to apply natural logarithm (West, 2021). In this paper, the datasets do not always have normal distribution. That is why, all the datasets that are used in this paper are normalized first by applying the natural logarithm into every single data point. Same as the previous calculations, this is done automatically using formula in Microsoft Excel. Below is the formula:

Before Application of Natural Logarithm		Formula	After Application of Natural Logarithm	
Estonia (happiness index in 2016)	5.517	=ln(B2) *B2 is the cell location of Estonia happiness index 2016	Estonia (happiness index in 2016)	1.7078432

V. PURPOSE, HYPOTHESIS, AND EXPLANATION OF VARIABLES

Besides normal distribution, there is another checker in statistical analysis called P-value. It signifies the probability of obtaining test results at least as extreme as the result actually observed, under the assumption that the null hypothesis is correct (Altman i Krzywinski, 2017). Null hypothesis is a condition where there is no significant relationship between the variables being tested (Altman i Krzywinski, 2017). Null hypothesis is used in hypothesis testing (Altman i Krzywinski, 2017). A hypothesis can only be accepted when the null hypothesis is rejected (Altman i Krzywinski, 2017). This is where P-value comes in to the picture. The smaller the P-value, the more likely the null hypothesis is rejected (Mindrila i Balentyne, brak daty). In this case, the hypothesis can be regarded as a significant relationship between the variables (Altman i Krzywinski, 2017). The P-value itself can be calculated using a T-test. The general rule of thumb is, if the P-value resulted from a T-test is below 0.05, then the result is statistically significant (Di Leo i Sardanelli, 2020). Below is the Microsoft Excel formula (using same assumption as the example to demonstrate formula for linear regression and pearson coefficient):

Test Name	Formula	Result Illustration
T-test to determine P-value	=t.test(B2:B150,C2:C150,2,1)	1.1844E-130

While the abovementioned hypothesis is a general hypothesis of every study that seeks to test the degree of correlations between two variables, this paper will employ a more specific hypothesis. However, to do that, the purpose of this study will first be explained. To do so, the fact that this study is done to check the degree of explainability of each macroeconomic indicators towards happiness has been explained in the beginning of the paper will be recalled. As have been previously mentioned also, this paper is aimed at finding out which macroeconomic indicator has the best degree of explainability to happiness and which indicator has the least by ranking those degrees of explainability. In regards to the correlation coefficient in linear regression as well as the pearson coefficient, they represent the degree of explainability. Therefore, when trying to rank the degrees of explainability, this paper ranks the correlation coefficients in linear regression and pearson coefficient of macroeconomic indicators

and happiness to each other. To ensure reliability, this will be done across the years span of 2012-2021, each year separately.

Since the purpose of the study is to rank the correlation coefficient in linear regression as well as the pearson coefficient each year separately, the specific hypothesis is that the position in the ranking for each of the correlations will be the same in both coefficients for all the year. The illustration will be as follows:

	Year 1	Year 2	Year 3		Year n
Rank #1	Correlation W	Correlation W	Correlation W		Correlation W
Rank #2	Correlation X	Correlation X	Correlation X	→	Correlation X
Rank #3	Correlation Y	Correlation Y	Correlation Y		Correlation Y
Rank #4	Correlation Z	Correlation Z	Correlation Z		Correlation Z

Note:

Correlation W is between Macroeconomic Indicator A and Happiness
Correlation X is between Macroeconomic Indicator B and Happiness
Correlation Y is between Macroeconomic Indicator C and Happiness
Correlation Z is between Macroeconomic Indicator D and Happiness

Related to hypothesis, there is an aspect that is important to mention, they are assumptions. Assumptions are different from hypothesis in the way that assumptions are taken for granted, while hypothesis needs to be tested (Andal, brak daty). Therefore, assumptions' validity is never questioned. This is rooted from the different purpose of the two, whereas hypothesis is used to determine the successfulness of the result (output), assumptions' function is to justify the type of input or the employment of the process (Andal, brak daty). Meanwhile, both have similarity of having to do with the analysis of the data (Andal, brak daty). In this paper, the assumptions are important in the case of linear regression analysis. This is because this analysis incorporates a model that explains causality of variables, hence there needs to be a differentiation between dependent and independent variables. The assumptions are as follows: for linear regression analysis, the macroeconomic indicators are the independent variables and happiness is the dependent variable.

V. a. GNI Per Capita as variable

In regards to the use of variables, this study employs 4 macroeconomic indicators to be calculated in terms of their correlations to happiness. Each indicator is representative of corresponding macroeconomic factors that are the scope of the research. These are: income represented by the GNI per capita, income inequality represented by the GINI coefficient, unemployment represented by the unemployment level, and gender represented by the GDI. Each of these indicators will be explained in the following paragraphs.

The GNI per capita is a macroeconomic indicator available in the World Bank data bank (The World Bank data bankB, 2024). It is defined as the gross national income, converted to US dollars using the World Bank Atlas method, divided by the midyear population (The World Bank data bank, 2011). Furthermore, GNI is the sum of value added by all the resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad (The World

Bank data bank, 2011) (The World Bank data bankB, 2024). In other words, GNI includes income as earned by a country's residents, whether it originates from production within its borders, or from assets held abroad. The Atlas method itself is a method used to minimize the effect of volatile exchange rate, so that when translated into US dollars, the number becomes more stable (The World Bank data helpdesk, 2024). It does so by calculating the average exchange rate in the affected year and two years preceding it, adjusted by the rate of inflation in the country and international inflation (The World Bank data helpdesk, 2024).

There are discussions surrounding the usage of GNI per capita as a metric in economics. They are varied in nature, some are positive and some negative. Among the praises to GNI per capita is the fact that GNI is comprehensive in terms of capturing the overall economic situation in a country, compared to its widely-used predecessors which is GDP and GNP (Battu, 2016). This is because GNI covers all of the aspects that need to be covered related to a country, which is both the population within the border as well as the residents living abroad (Battu, 2016). Meanwhile, GDP only focuses on the measures of total economic value within a country's border (Irish Fiscal Advisory Council, 2020). Similarly limited in nature, GNP concerns only with the income generated by its residents regardless of their location (Irish Fiscal Advisory Council, 2020). In other words, GNI covers both populations, one that is within a country's border and therefore limited to a physical location, and the other that is encompassing the status of residency regardless of physical location; meanwhile GDP and GNP only cover one thing or the other (Irish Fiscal Advisory Council, 2020).

This praise to GNI per capita is seen through the lens which shows how this metric assesses a nation's total income, which in itself is regarded as a comprehensive view on the economy (Nolan, 2019). It testifies to the average economy's efficiency and individual prosperity level (Nolan, 2019). However, this also means that this metric is inherently lacking in functions as it only focuses on the average income level and therefore completely hiding the information outside this range, i.e. the very rich and the very poor (Nolan, 2019). Another critique to GNI per capita is related to the dynamic characteristics of population. Especially bearing in mind the large-scale migration globally, it is difficult to accurately record population and earnings in any one place, because the population structures effected by who comes and goes are constantly changing (Rowthorn, 2015). Another negative feedback to GNI per capita is regarding its use of US dollar. The singular use of US dollar in calculating GNI per capita is an attempt at uniformity so that all countries' economies can be weighted and compared using the same measuring tool, which is US dollar as the currency (Eklou, 2023). However, the cross-country comparisons based on US dollar is prone distortion due to exchange rate volatility (Eklou, 2023). Another reason for US dollar usage to be criticized in GNI per capita is related to the concern about varying purchasing power (in simple terms, what people can buy with their income and, consequently, what a dollar is worth) among various countries (Rekacewicz, 2024).

The two critiques to the use of US dollar in GNI per capita, the first being the exchange rate volatility, and the second being the purchasing power parity, have been addressed by the World Bank data used in this paper. The first one is addressed through the fact as mentioned previously that the World Bank data bank calculates using the Atlas method. The second one, however, has yet to be touched upon. Therefore, what is worth mentioning is the GNI per capita provided by the World Bank used in this paper is already adjusted to Purchasing Power Parity (PPP), and hence its official metric name is "GNI per capita, PPP (current international $)".

To understand the mechanics behind this calculation, one needs to understand the reason why purchasing power is important. The amount of money one has is important relative to where that money will be spent (The National Audit Office, 2013). In other words, the money's power only matters locally (The National Audit Office, 2013). Supposedly country A has higher purchasing power than country B, it means that a single dollar can buy more things in country A than in country B (Ortiz-Ospina i Molteni, 2017). It also means that the price levels in country A is lower than in country B (Ortiz-Ospina i Molteni, 2017). As it stands, the higher the purchasing power, the lower the price levels (Ortiz-Ospina i Molteni, 2017). In a country where price levels are 0.5, it means that 1 US dollar can buy double the things compared to a country with price levels of 1 (Ortiz-Ospina i Molteni, 2017). Therefore, to accurately reflect the GNI per capita against the backdrop of PPP, the GNI per capita is adjusted to its PPP (Ortiz-

Ospina i Molteni, 2017). That is why, to differentiate the dollar currency value used in PPP-adjusted metrics from the value circulated in the exchange market, the PPP-adjusted dollar is called “international dollar” (Ortiz-Ospina i Molteni, 2017).

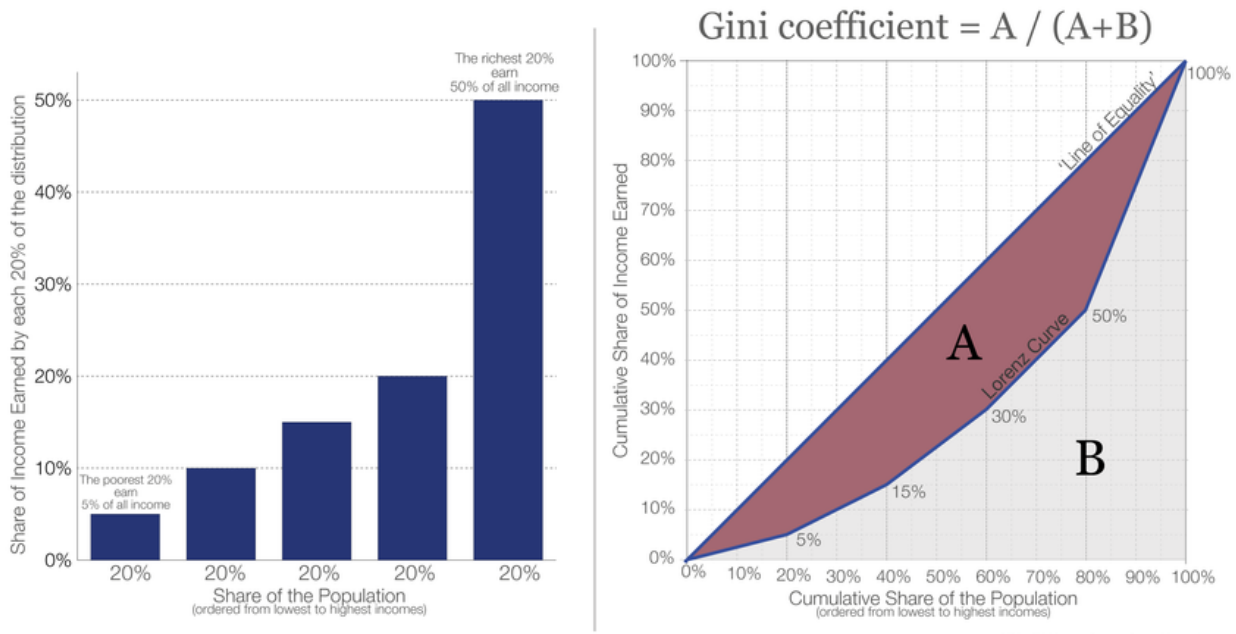
The GNI per capita used in this paper is presented at its real level (as per what is provided by the World Bank), with no numerical manipulations. Besides, the World Bank data bank is considered as a single source of information, meaning that there is no other source that is used when the data for a country is not available in the World Bank data bank. There is no guarantee that the data is always present throughout the years, and therefore, the data points (the number of countries with available data in World Bank) can be varied from one year to another.

V. b. Gini Coefficient as variable

While the explanation of macroeconomic indicator for income level has been done, now is the inequality’s turn. The indicator that is used in this paper to represent income inequality is Gini coefficient, also known as Gini index (The World Bank data bankA, 2024). This indicator measures the inequality on a scale from 0 to 1, where 0 is means perfect equality and 1 refers to perfect inequality (Hassell, 2023). This indicator is typically used to measure income inequality, but also can be used to measure any inequalities, such as wealth distribution or life expectancy (Hassell, 2023). In terms of income inequality, a Gini coefficient 0 is the state where everyone receives the same income (income is distributed equally), while 1 is when one person receives all of the income and everyone else receives nothing (Hassell, 2023).

To understand how the Gini coefficient works, there are several illustrations that can be found in various studies. However, this paper will not employ all. After all, this paper does not concern with the discussions surrounding the validity of how the Gini coefficient works, but it focuses solely on using the Gini coefficient as representative of income inequality level. To illustrate how the Gini coefficient works, one can imagine if two random people bump into each other in the street, and start to compare each other's income, then the income inequality will be the gap between those incomes (Hassell, 2023). Now the Gini coefficient of a society is the average gap between all pairs of people in that society (Hassell, 2023). The bigger the gap, the closer the Gini coefficient is to 1 (Hassell, 2023).

Another illustration that is important to understand in regards to the Gini coefficient is the graph called Lorenz curve (Hassell, 2023). Below is the graph illustration:



The illustration shows a hypothetical population (Hassell, 2023). On the left side, each bar represents one-fifth of the population's level of income (Hassell, 2023). The right side shows the cumulative plot of this data (Hassell, 2023). The right side's A area is what's called the Lorenz curve (Hassell, 2023). The Lorenz curve captures the gap between the line of equality (a situation of perfect equality, where the slope of the diagonal line is 45 degrees constant, meaning that if each bar represents the stages of wealth of one-fifth of the population ("sub-population") and the more to the right a bar is located, the richer the sub-population is, then the increase in wealth is constant from bar to bar), and the actual inequality line (where the slope rises exponentially as the bar moves to the right, favoring only the richest sub-population in the population) (Hassell, 2023). The gap is the Gini coefficient (Hassell, 2023).

While the existence of the Lorenz curve is pivotal to the Gini coefficient, the criticism towards the Gini coefficient especially attacks the very use of the Lorenz curve. Negative feedback to the Lorenz curve is usually directed at its trueness (Ferreira, 2020). The Gini coefficient hinges on the state of continuity of the Lorenz curve (Ferreira, 2020). If there is data missing in the income level, then the Lorenz curve cannot be drawn (Ferreira, 2020). In this case, the missing data will be "guessed" in order to create the Lorenz curve, and therefore, whether the Gini coefficient reflects the true income distributions can be questioned (Ferreira, 2020). Despite this fact, the Gini coefficient is a widespread tool in macroeconomics due to its practicality: it measures the income inequality in a society (the use is often employed for a scale of an economy as big as a country) comprehensively as it captures the average of income inequality in that society (Hassell, 2023).

The Gini coefficient used in this paper is provided by the World Bank data bank. Same as GNI, the Gini coefficient from the World Bank data bank is presented at its real level. The World bank data bank is also considered as a single source of information for this paper, and consequently, the data population is varied from year to year.

V. c. Unemployment level as variable

Besides the GNI per capita and the Gini coefficient being the macroeconomic indicators of income level and income inequality respectively, the next macroeconomic indicator used in this paper is the unemployment level provided by the World Bank data center. The official name of this macroeconomic metric is "Unemployment, total (% of total labor force) (modeled ILO estimate)" (The World Bank data bankC, 2024). The unemployment population

is defined as “the individuals without work, seeking work in a recent past period, and currently available for work” (The World Bank data bankD, 2024). Regarding this, it is important to understand that the unemployment population is calculated based on the total labor force, which is defined as “the economically active portion of the population”, instead of the total population (The World Bank data bankD, 2024).

As its name suggests, the unemployment level is sourced from the International Labor Organization (ILO) database (The World Bank data bankD, 2024). It takes the statistics provided by the national government and complement them with surveys and censuses data from other sources (The World Bank data bankD, 2024). As ILO is an international organization that is a United Nations (UN) agency, ILO has an image of not only being a reputable international organization that deals with the global labor market, but also it has the backing of UN, the only multilateral organization with the highest members (The United Nations Office of the Secretary General's Envoy on Youth, 2013). In itself, it shows the credibility of data provided by ILO. However, more generally, the ILO-sourced data is also a testament to the importance of data that is synergized on an international level. So, instead of relying on the national government only, the data has more legitimacy if it is provided by ILO. This is because of two reasons. Firstly, the data provided by the national governments is prone to politicization (Schaffner i Roche, 2017). Secondly, as the data provided internationally, it means that a methodological problem in one country can be easily spotted and a solution that is available in another country can be borrowed (Webb, 2017). This is also the reason why, although the World Bank data bank has another metric called “Unemployment, total (% of total labor force) (national estimate)”, it is not used in this paper.

As discussed above, having ILO as the provider of statistics on an international level, is not only convenient but also provides legitimacy to the data, it also has its drawbacks. There are four kinds of biases that this kind of statistics suffers from: expert attention bias, countability bias, capitalist bias, and stealth-wealth bias (Mügge, 2020). The expert attention bias affects international statistics because it makes the statistics reliant only on a small circle of statistical experts (Mügge, 2020). Countability bias means that economic data is skewed in favor of countable objects, and away from, for example, unremunerated labor (Mügge, 2020). Capitalist bias means that international statistics dismiss the unequal power relations in the global economy, and solely look at them in terms of numbers and performance (Mügge, 2020). It looks only on the surface level instead of providing a more in-depth context (Mügge, 2020). Stealth-wealth bias is the same as capitalist bias, but instead of overlooking the structural problem like the capitalist bias does, stealth-wealth bias naturalizes the threat posed by individuals that like to operate their economies in secrecy jurisdictions (Mügge, 2020).

Again, same as GNI and Gini coefficient, the unemployment data taken from the World Bank data bank is presented at its real level. Besides, it is regarded as the single source of information, making the data varied yearly.

V. d. GDI as variable

Among the macroeconomic indicators used in this paper, the last one is the Gender Development Index (GDI), which represents the gender metrics. This index is part of the greater Human Development Index (HDI), an index developed by the United Nations Development Program (UNDP), which is defined as “a summary measure of average achievement in key dimensions of human development” (Human Development ReportsA, 2024). The use of HDI as a metric is seen as a progress in measuring economic achievements, putting emphasis on a human-centered approach, from the old way of focusing on a country’s economic growth and metrics, such as GDP (Benjamin, Cooper, Heffetz i Kimball, 2021). Meanwhile, GDI specifically measures gender inequalities in achievement of three basic dimensions of human development: health (a long and healthy life), education (a good quality of education), and command over economic resources (a decent standard of living) (Human Development ReportsB, 2024). The range

of GDI is 0 to 1, with values closer to 1 indicating higher gender equality (UNDP Human Development Report (2021-22), 2022).

The index has drawn criticisms since its inception in 1995. Among the earliest critics to GDI has been in regards to the accuracy of the analysis behind the metrics (Bardhan i Klasen, 1999). A study has shown that GDI does not accurately capture the problems of mortality rate in women: GDI shows that mortality rate in women is negligible in nature, when in fact, when the primary data is looked at and analysis is done adjusted to include gender dimension, this issue is very concerning for women (Bardhan i Klasen, 1999). This also brings into question the reliability of the index (Bardhan i Klasen, 1999). Not only in terms of mortality rate, but also in regards to the income equality between men and women (Bardhan i Klasen, 1999). Although the GDI shows that there is an income inequality between men and women, it fails to demonstrate that women have other means to obtain their needs outside of income earning activities (Bardhan i Klasen, 1999). The critics said that where income inequality is concerned, there should also be a comparison of household consumption (Bardhan i Klasen, 1999). These critics stem from the fact that there is no evidence showing the significance of the gender of the income earners in the household (Bardhan i Klasen, 1999).

Another criticism that is more recent to GDI has been in regards to gender identities (Berik, 2022). The GDI has been criticized to be representing gender as binary at a time when more countries are recognizing non-binary gender identities (Berik, 2022). This is arguably important because GDI claims to demonstrate the gender inequality present in society, and consequently, societal problems need to be seen through the gender lens (Dokmanovic, 2002). In other words, problems are gendered (Hardoon, brak daty). While it has such a high claim, it fails to adequately include the real diversity in gender that exists in the society (Hardoon, brak daty).

It is notable to show that the above criticisms to GDI regarding accuracy and reliability have been addressed in the GDI report, although no solution was presented (Bardhan i Klasen, 1999). Furthermore, in the case of multiple gender identities, the relevance here is low, because this paper sees the problem with gender and its impact on happiness revolves more around the binary categorization of men and women. While this paper holds as true the criticism of GDI in regards to its lack of recognition to multiple gender identities, it does not find the suitability of this issue to the framework that this paper has previously established.

While it is important to understand the criticisms surrounding GDI, it is equally important to recognize the benefits it gives. Among them, GDI is a direct measure of gender divide (Rehal, 2024). It gives a concrete picture of female conditions in a male-dominated world (Rehal, 2024). This is because in GDI, female HDI is expressed as a percentage of the male HDI (Rehal, 2024). Besides, the GDI indicates how much women lag behind their male counterparts in each dimension of human development and how far they need to catch up (Rehal, 2024).

In regards to the characteristics of GDI data used in this paper, it is similar to the other macroeconomic indicators mentioned previously, namely GNI per capita, Gini coefficient, and unemployment level. This is true despite the fact that those three indicators are provided by the World Bank data bank, while the GDI data is available through the annual Human Development Reports by UNDP. As previous indicators are, GDI is presented at its real level. Besides, it is regarded as the single source of information, making the yearly variation of data inevitable.

V. e. Happiness indicator as variable

As all of the four macroeconomic indicators have been presented, now the happiness indicator will be explained. The happiness indicator that is used in this paper is the one published in the annual World Happiness Report (WHR) (World Happiness ReportA, 2024). It is published by the Sustainable Development Solutions Network (SDSN), which is a global initiative by Gallup for UN “that engages scientists, engineers, business and civil society leaders, and development practitioners for evidence-based problem solving” (Sustainable Development Solutions Network, 2017). The motivation behind this initiative is that “the most famous statistics (GDP, household income, and unemployment) focus on the rational side of what people do” and do not explain anything about people’s

happiness (Sustainable Development Solutions Network, 2017). This has become increasingly important because "leaders can no longer assume that the lives of those in their countries improve with a rise in GDP" (Sustainable Development Solutions Network, 2017). John Helliwell, one of the chief editors of the World Happiness Report, mentioned "happiness can change, and does change, according to the quality of the society in which people live" (Sustainable Development Solutions Network, 2017).

The WHR is an important tool in measuring happiness globally because it is the first one to do so since it was first published in 2012 (Layard, 2012). Today, the report plays an important role in measuring global happiness (Cotofan, 2015). It is based on the science of well-being, which uses quantitative methods to understand how different life experiences influence people's happiness and quality of life (Cotofan, 2015). This is important as many believe that the things people find most important in their lives should be a guiding force behind policy design (Cotofan, 2015). It reflects "a worldwide demand for more attention to happiness and well-being as criteria for government policy" (World Happiness ReportB, 2024).

The report shows happiness as an index, ranging from 0 (least happy) to 10 (most happy) (World Happiness ReportB, 2024). It incorporates analysis by experts in economics, neuroscience, and statistics (Cho, 2015). It introduces the concept of social capital, as opposed to financial capital (Cho, 2015). It demonstrates that social capital is important to happiness, and not just financial capital (Cho, 2015). Social capital itself is another name for the quality of society (Cho, 2015). This can be illustrated as the response to questions such as "do we trust each other?", "do we have social support networks?", and "do we trust government and business to be honest?" (Cho, 2015).

While measuring happiness has garnered attention for the last several years since the publication of WHR in 2012, the questions of whether happiness is the right tool to measure progress have been increasingly posed. This is mainly rooted from the fact that happiness level is reliant on the stated happiness (Bond i Lang, 2019). The concern is whether this is a reflection of true happiness (Bond i Lang, 2019). This is an important criticism of the happiness studies that are overly reliant on the surveys as their method of data collection (Bond i Lang, 2019). The criticisms varied from the design of the research, the formation of the questions, and the personal biases of every individual (Gill, 2022). Not only that, in regards to psychology, the happiness survey is also inherently contradictory in nature to what happiness really is about (Samuel, 2024). The happiness survey tend to frame the questions of happiness in terms of their relative happiness in comparison to others (Samuel, 2024). The others can be other people, other places, or other times (Samuel, 2024). Meanwhile, this is counter-productive to happiness that supposedly measures individual happiness here and now (Samuel, 2024). As an old adage says "comparison is the root of unhappiness" (Samuel, 2024).

Regarding this criticism, Daniel Benjamin, who is a prominent voice in the global happiness studies, suggested the re-thinking of happiness studies (Gill, 2022). Instead of a single happiness measure, there needs to be an index of well-being aspects, and weighted accordingly (Gill, 2022). This is aimed at meticulously addressing all the criticisms surrounding happiness by putting the happiness studies into context (Gill, 2022). Instead of trying to pool the survey results in a singular gigantic population, there needs to be a dozen population subsets, with thousands of survey question varieties (Gill, 2022). The analytical work, therefore, is at calibrating the interpretation of this data accordingly (Gill, 2022).

Scholars have agreed, however, that alternatives to the current happiness studies have not taken a crucial position (Gill, 2022). This is because in its current form, despite all the criticisms, happiness studies work. In happiness studies, life satisfaction correlates well with relevant measures of brain activity (Cotofan, 2015). It also does a good job at predicting how people will behave, which is an important indicator in economics (Cotofan, 2015). The happiness studies also evidently show what was originally intended: as a compliment to the traditional economic metrics (Cotofan, 2015). For places where GDP per capita have increased, for example, the happiness level has also increased (Cotofan, 2015). Same thing happened in places where there is an increase in healthy life expectancy, and

a decrease of perceptions of corruption, or of lack of freedom (Cotofan, 2015). In contrast, in countries that have been affected by war, famine, and deprivation, the happiness level has dropped (Cotofan, 2015).

Same as the four macroeconomic indicators, despite having different sources from the happiness indicator (whereas the four macroeconomic indicators are taken from the World Bank data bank as well as the Human Development Reports, while the happiness indicator is available in the annual WHR), the data is presented at its real level. Besides, the WHR is considered as a single source of information, and that is why the data points are varied annually. In this context, it is important to note that the data for 2014 is missing. Therefore, there is only 10 years worth of data from 2012 to 2022.

While the four macroeconomic indicators as well as the happiness indicator have been explained, this paper will try to hypothesize their relations. This is important for the identification of the direction of the correlations between each of the macroeconomic indicators to the happiness indicator, specific for the pearson coefficient analysis. This is because, as have been mentioned in the previous section, the pearson coefficient analysis shows the correlation result in the range from -1 to 1, meaning there will be a negative (inverse) correlation, and a positive (direct) correlation.

In doing so, the hypothesis of correlations between GNI per capita and happiness will be done first. Recalling the theoretical framework that was done earlier in this paper, this paper argues that as GNI per capita increases, happiness increases. In this case, the two indicators are correlated positively. Therefore, the range of the correlation will fall between 0 and 1. This is because, as has been established, generally the higher the income level, the happier the people. While it has been observed in previous studies that there is a saturation point of where happiness level will not increase as the income increases, which is especially true for richer countries, this phenomenon will not change the direction of the correlation. This is because of two reasons. The first reason is that there are more countries that fall below the saturation line than they are not. So, the countries that have the potential of changing the correlation direction (the countries above the saturation line) are outweighed by those that will keep the direction the same (the countries below the saturation line). The second reason is that even if the truth is otherwise, the relations between income and happiness for countries above the saturation line do not necessarily change the overall direction. In other words, the range of coefficients do not change from positive to negative. At the most effect, they will only change in the position of where they might fall within the range. So, instead of having the coefficient closer to 1, it will be closer to 0.

The next hypothesis of correlations will be between Gini coefficient and happiness. In this case, the hypothesis is rather straightforward, happiness is gained when equality is achieved. Therefore, the more equal the income distribution, the happier the people will be. That being said, the correlation between Gini coefficient and happiness indicator will be a negative correlation, this is because of the different mechanisms on how the Gini coefficient works when compared to happiness. In the Gini coefficient, 0 is a condition of perfect equality. This means that the higher the Gini coefficient, the more unequal the income distribution has become. If equality is the goal, the Gini coefficient needs to decrease in order for the goal to be reached. However, in the happiness indicator, the goal is to score as high as possible because in the range from 0 to 10, the closer the indicator is to 10, the happier the people. As a result, the happiness indicator needs to increase for the goal of reaching happiness to be achieved. This is why, this paper hypothesizes that the correlation between Gini coefficient and happiness indicator is negative.

It is also important to hypothesize in terms of the comparison of correlations between GNI per capita to happiness and Gini coefficients to happiness. This is because the theoretical framework has referred to the very issue of absolute income versus relative income. In this case, what yields happiness is when people have positive relative income as opposed to positive absolute income. Also, relative income corresponds to income inequality, and income inequality is represented by Gini coefficients. Meanwhile, absolute income is related to income level, which in turn is referred to by the GNI per capita. It means that the degree of correlation, both in correlation coefficient of linear regression, as well pearson correlation, will be bigger for Gini coefficients than for GNI per capita. Especially for pearson, this is assumed to be true in terms of absolute figure, or in other words, regardless of the positive or

negative sign. This is because this hypothesis tests the strength of the correlation (how big or small the coefficients are) as opposed to the direction of the correlation (the sign of the coefficients).

The next macroeconomic indicator to draw a hypothesis from is the unemployment level. The general idea is that the relation between unemployment level and happiness is negative. This means that as unemployment level goes down, happiness goes up. However, this is true only for some of the countries, because it has been previously established in this paper that unhappiness is not an immediate result of unemployment itself. But rather, there are issues surrounding unemployment that become important in determining unhappiness itself. These issues are the gender makeup of the unemployed population, the distribution of scarce social benefits in the case of poor countries, and the case of employment enjoyability in the case of richer countries.

The first issue is difficult to be contextualized in regards to happiness for this paper. This is because in this issue there is no direct relationship between general unemployment (the figure that this paper used) to happiness, but rather, there is a mediating factor that changes the direction of the relationship one way or the other (which is the gender makeup). However, the second and third issues are easier to draw hypothesis from for this paper. This is because although there are mediating factors between unemployment and happiness (which is the status of rich or poor of the country), this is rather more estimable than what the first issue has. In this case, since unemployment's effect to happiness are polar opposite in two differing groups (it has negative effect for poor countries and positive effect for rich countries), there are three possibilities. Firstly, if there are more poor countries being observed, then the overall correlations will skew negative (as unemployment goes up, happiness goes down). Secondly, if there are more rich countries observed, then it will skew positive (as unemployment goes up, happiness goes up). However, if the number of poor countries and rich countries are the same, then it will not affect happiness.

This, however, cannot be taken at its face value. This is because there has been prior hypothesis established, where in general the relation between unemployment and happiness is negative. So, the three possibilities mentioned above can only be put as a compliment to this hypothesis. Therefore, when the correlations skew negative (more poor countries in the observed data population), it will make the already negative relations to generally begin with become more negative. Meanwhile, if the correlations skew positive (more rich countries in the observed data population), it can balance out the generally negative correlation to be less negative, or even becomes positive if the effect is great. However, there is also the third possibility where there is no skewing effect (the poor and rich countries are equal in amount), in this case the correlation will remain negative.

For the hypothesis on correlations between gender equality and happiness, represented by the GDI and WHR, it is arguable to say that the relations will be positive. It means that the greater the gender equality, the greater the happiness. As GDI captures gender disparity in the country, and where the theoretical framework that has been established believes that women are reporting less happiness than men due to the fact that women are having it more difficult than men in every aspect of life, it means that when GDI shows better equality (better situation for women with men's condition as its measurement base), the overall happiness of the society will shows an increase. This theory goes with a logical explanation, whereas the overall happiness is hinged on the happiness of all groups of people in the society, including women.

This is only true, however, when there is an intervention made to the data analysis. This intervention is called vignettes anchoring, which have been explained in the theoretical framework section. This means that there was a manipulation attempt to the data. This paper, while analyzing the direction of the relations between GDI and happiness, will verify the validity of this attempt. If the correlations indeed show a positive result, it means that the attempt is justified. However, if the result is negative, it means that there is a discrepancy between this paper's findings and the findings of the paper where vignette anchoring is used as an intervention tool.

VI. RESULTS AND DISCUSSIONS

Below are the results of the correlations pairings of each macroeconomic indicator to happiness, presented on a yearly basis from 2012 to 2021 (minus 2014). There are 4 correlations pairing: GNI per capita and happiness, Gini coefficient and happiness, unemployment level and happiness, and GDI and happiness.

For GNI per capita and happiness, the results are as follows:

Statistical category	2012	2013	2015	2016	2017	2018	2019	2020	2021
Correlation coefficient (linear regression)	0.66099 8518	0.63228 1577	0.656 2019 14	0.6719 0715	0.692 03630 7	0.6846 24539	0.654 67978 9	0.612 8755 47	0.6099 78175
Pearson coefficient	0.81301 8154	0.79516 1353	0.810 0629 08	0.8196 99427	0.831 88719 6	0.8274 20413	0.809 12285 2	0.782 8636 84	0.7810 10996
P-value	1.1844E-130	6.1999E-151	2.007 2E-134	3.9935 E-136	1.381 9E-132	1.1719 E-133	1.764 5E-132	3.331 3E-130	9.9064 E-129
Amount of data pairs available	149	151	150	149	148	149	149	146	143

For Gini coefficient and happiness, the results are as follows:

Statistical category	2012	2013	2015	2016	2017	2018	2019	2020	2021
Correlation coefficient (linear regression)	0.04153 062	0.03598 692	0.070 6242 55	0.0494 52612	0.030 85397 3	0.0459 38079	0.065 82541 9	0.008 9704 45	0.2020 24944
Pearson coefficient	-0.20379 0629	-0.18970 2187	-0.265 7522 43	-0.2223 79432	-0.175 65299 1	-0.2143 31703	-0.256 56464 8	-0.094 7124 33	0.4494 7185
P-value	2.25555E-66	3.90685 E-59	1.790 51E-63	7.1287 1E-63	7.900 58E-61	5.1757 1E-70	4.053 81E-52	6.081 52E-45	8.4559 8E-23
Amount of data pairs available	82	73	81	79	74	86	66	53	21

For unemployment and happiness, the results are as follows:

Statistical category	2012	2013	2015	2016	2017	2018	2019	2020	2021
Correlation coefficient (linear regression)	0.00697 2526	0.00013 2896	0.000 2024	5.1045 5E-06	0.005 45217	0.0121 06924	0.022 96325	0.012 3432	0.0240 30101

			62		4		9	33	
Pearson coefficient	0.08350165	0.011528037	0.01422892626	-0.002259325	-0.07383883 5	-0.110031467	-0.151536328	-0.11110010102	-0.155016453
P-value	0.094657568	0.152836503	0.20074741 1	0.179717753	0.31598617	0.967749758	0.626441116	0.021060320	0.080600493
Amount of data pairs available	152	151	152	152	151	152	152	149	145

For GDI and happiness, the results are as follows:

Statistical category	2012	2013	2015	2016	2017	2018	2019	2020	2021
Correlation coefficient (linear regression)	0.057941747	0.284434667	0.28461867 3	0.284237121	0.25787913 9	0.259053609	0.261121854	0.26969225 4	0.256877186
Pearson coefficient	0.24071092	0.533324167	0.53349664 8	0.533138932	0.50781801 8	0.508973093	0.51100083 6	0.51931902 9	0.50683053
P-value	8.10836E-54	6.1999E-151	3.7411E-146	1.9557E-145	3.1386E-144	9.7549E-147	1.6415E-147	3.6185E-146	1.3532E-145
Amount of data pairs available	151	151	152	151	151	152	152	150	146

Now, ranking of the four correlations will be done. Before doing so, it is important to look at the P-value. It has been mentioned in the previous sections that in order for correlations to be statistically significant, the P-value must be less than 0.05. As per data in the four tables above, all of them contain a P-value smaller than 0.05, except one, which is the unemployment and happiness table. From this table, of the 9 years worth of data observed, only one year shows P-value less than 0.05, which is in 2020. For the sake of objectivity, this will be noted.

This means that the hypothesis that seeks to address the significance of the correlations between the four macroeconomics variables with happiness, the verified correlations are only for three variables. They are GNI per capita, Gini coefficient, and GDI. This is because these variables have P-values bigger than 0.05 when each of them are correlated with happiness. Meanwhile, the unemployment level does not. This consequently shows that there is no evidence of significant correlations between unemployment and happiness.

This paper will try to provide an explanation for this. When looking at a lack of proof showing the statistical significance of data, it means that there are too many variances in the data pairs that no pattern emerges. In the

case of unemployment and happiness, this is possible as the people see unemployment in relation to their happiness as very different from person to person. It means that there are too many contexts to look at, and hence, no correlations can be inferred. Following the logic of the theoretical frameworks that have been established previously, where the theory tries to capture the different effects of unemployment to happiness based on the economic level of the country (people relate unemployment to happiness differently in rich countries and poor countries), this means that this theory does not have basis in reality. While in theory it says that unemployment creates unhappiness in poor countries and happiness in rich countries, it can be that unemployment creates unhappiness and happiness equally the same in rich and poor countries simultaneously.

Another possible explanation is that there is a discrepancy in the methodology of coming up with the figures in the indicators whose correlations are being observed. Since this paper is using data taken from international statistics of different sources (unemployment figure is taken from World Bank data bank and happiness figure is taken from WHR), it is possible that they are caused by biases that have been presented in the previous sections of this paper as criticisms to such statistics. To recall, there are four biases, they are expert attention bias, countability bias, capitalist bias, and stealth-wealth bias. Although it is difficult to pinpoint which bias is creating the discrepancy, it is well-reasoned to assume that these biases might have resulted in the differences of possibly choosing of methodologies in these two statistics, which somehow creates the discrepancy.

The next hypothesis that will be addressed is regarding the consistency of ranks. Before doing so, the correlations between unemployment and happiness will be excluded because it has been shown to be lacking proof showing its statistical significance. Therefore, only three correlations will be shown. The first one is ranked by the correlations coefficient of the linear regression analysis, as follows:

Rank	2012	2013	2015	2016	2017	2018	2019	2020	2021
1	GNI per capita to happiness (0.660998518)	GNI per capita to happiness (0.632281577)	GNI per capita to happiness (0.656201914)	GNI per capita to happiness (0.671907 15)	GNI per capita to happiness (0.692036307)	GNI per capita to happiness (0.684624539)	GNI per capita to happiness (0.654679789)	GNI per capita to happiness (0.612875547)	GNI per capita to happiness (0.609978175)
2	GDI to happiness (0.057941747)	GDI to happiness (0.284434667)	GDI to happiness (0.284618673)	GDI to happiness (0.284237121)	GDI to happiness (0.257879139)	GDI to happiness (0.259053609)	GDI to happiness (0.261121854)	GDI to happiness (0.269692254)	GDI to happiness (0.256877186)
3	Gini coefficient to happiness (0.04153062)	Gini coefficient to happiness (0.03598692)	Gini coefficient to happiness (0.070624255)	Gini coefficient to happiness (0.049452612)	Gini coefficient to happiness (0.030853973)	Gini coefficient to happiness (0.045938079)	Gini coefficient to happiness (0.065825419)	Gini coefficient to happiness (0.008970445)	Gini coefficient to happiness (0.202024944)

The second one is ranked by the pearson coefficients (showing absolute value, where all sign is positive), as follows:

Rank	2012	2013	2015	2016	2017	2018	2019	2020	2021
1	GNI per capita to happiness (0.813018154)	GNI per capita to happiness (0.795161353)	GNI per capita to happiness (0.810062908)	GNI per capita to happiness (0.819699427)	GNI per capita to happiness (0.831887196)	GNI per capita to happiness (0.827420413)	GNI per capita to happiness (0.809122852)	GNI per capita to happiness (0.782863684)	GNI per capita to happiness (0.781010996)
2	GDI to happiness (0.24071092)	GDI to happiness (0.533324167)	GDI to happiness (0.533496648)	GDI to happiness (0.533138932)	GDI to happiness (0.507818018)	GDI to happiness (0.508973093)	GDI to happiness (0.511000836)	GDI to happiness (0.519319029)	GDI to happiness (0.50683053)
3	Gini coefficient to happiness (0.203790629)	Gini coefficient to happiness (0.189702187)	Gini coefficient to happiness (0.265752243)	Gini coefficient to happiness (0.222379432)	Gini coefficient to happiness (0.175652991)	Gini coefficient to happiness (0.214331703)	Gini coefficient to happiness (0.256564648)	Gini coefficient to happiness (0.094712433)	Gini coefficient to happiness (0.44947185)

Earlier, it was hypothesized that the position in the ranking for each of the correlations will be the same from year to year. Looking at the tables above, this hypothesis is verified. The ranks are the same for each of the correlations from year to year for each of the coefficients. It is also noteworthy to mention that not only is the fact that the ranks are the same for each coefficient, the position structure (or in other words, the order of the ranks) are the same for both coefficients. This does not only mean that the reliability is ensured (due to the fact that the results are replicable using time as its differentiation base), but also the validity is secured (as both coefficients, meaning calculated using two different methods, results are the same).

Besides verification of hypothesis, it is now time to discuss the main results. To recall the aim of this paper, it tries to explain the degrees of explainability of each macroeconomic indicator to happiness. Since the reliability and validity of the results have already been established, it is worthwhile to explain the results as it relates to the aim. The position in the rank is indicative of the power of the degrees of the explainability of each macroeconomic indicator. In other words, the rank shows the correlation strength of one indicator relative to others. With the results concerned, the strongest correlation is demonstrated by the GNI per capita, which is representative of the macroeconomic indicator of income level. Second to that is the GDI, which is indicative of the macroeconomic indicator of issues surrounding gender. Finally, the position of the macroeconomic indicator that has the weakest correlation with happiness is the Gini coefficient, which symbolizes income equality.

Besides explaining the degrees of explainability, one could also interpret this rank as an explanation showing that the nuances around the macroeconomic indicators and their correlations with happiness is truer for some than for others. This means that, macroeconomically speaking, the nuances in relations between income level and happiness, is stronger than between gender inequality and happiness, which in turn is stronger than income

inequality and happiness. This result directly falsifies the theory that says, for happiness, relative income level is superior to absolute income level. This is also a direct falsification of one of the hypotheses in this paper that says the correlation between Gini coefficient and happiness is greater than the correlation between GNI per capita and happiness. However, it is important to point out that this only applies to macroeconomic levels. This is because all of the data points observed in this paper are at the country level.

Besides the comparison between nuances of both income level and income inequality to happiness, the nuances of both income inequality and gender inequality is also important to look at. This is because both indicate a state of inequalities, just from different perspectives. From the results, it is shown that GDI is more strongly correlated to happiness than Gini coefficient is. It means that gender disparity is more relevant to how happy a society is, compared to income disparity. Another way to interpret this is that a society is happier when gender equality is achieved, rather than when income equality is achieved. This, however, is not parallel to simple logic based on mathematical point of view. The logic looks at income inequality as affecting everyone regardless of who they are in the society. This is different from gender inequality, which affects only half of the population. As the logic continues, happiness of everyone is more closely related to income because income affects everyone, while gender is only an issue for half of everyone. This is different from what the results showed that gender has a higher correlation degree to income, so at the very least this must mean that gender disparity affects everyone and not only women.

Now the direction of the correlations for each of the macroeconomic indicators will be evaluated based on the hypotheses already mentioned in the previous sections. For this, the pearson coefficients will be looked at. It will be started with the correlation between income level and happiness. The results show that the relation between GNI per capita and happiness is positive, and this is true for all the years observed. All years show that the pearson coefficients for the correlation between GNI per capita and happiness are in the range between 0 and 1. This means that there are merits to the analysis behind the hypothesis. There are two reasons why this happens, and they have been mentioned previously. Those reasons are: firstly, despite the fact that there is a saturation line, there are not enough countries above it to change the direction of the correlation; secondly, even if there are more countries above this saturation line, they will not change the direction of the correlation, but they only changes the point where the correlation sits in the pearson's range, which is instead of closer to 1 it will be closer to 0. It is safe to assume that the first reason is more valid than the second reason. This is because from all of the years when the results are observed, if 0.5 will be the threshold, all results are bigger than this threshold. In other words, all results are closer to one. From the table, the results being concerned here fall between 0.7 and 0.8.

The second correlation's direction to be observed is between the GDI and happiness. In this case, the result shows the direction to be positive. This is similar to what has been hypothesized. The hypothesis itself was driven by a logical assumption that says the better the quality of life for women is in a country, the happier the overall happiness of the country. This is because women are reportedly worse off compared to men in all aspects of life, and this brings the overall happiness down because half of the population (women) is unhappy due to feeling unequal compared to the other half (men). More than that, this means the statistical intervention of vignette anchoring being deployed to the analysis of women's condition and happiness is meritorious.

The third and final correlation's direction to be explained is between the Gini coefficients and happiness. The hypothesis was that this relation is negative. This is because the theory suggests that the more equal the income, the happier the people. Basing this, the Gini coefficients work in opposite to the happiness indicator, whereas the lower the Gini coefficients are, the more the equal the income; while for happiness, the higher the indicator is, the happier the people. Therefore, the translation of the theory to the correlation's direction is the lower the Gini coefficient, the higher the happiness indicator. Looking at the results, this is generally true. "Generally" is the operative word here, because from the 9 years observed, this only happened 8 years. The other 1 year, which happened to be the last year observed, the result is positive. This can be explained by looking at the amount of data points available for this year. The amount of data points here are the least from all of the years. Such a small amount

of data can skew the results in a different direction, especially if the population being observed for this particular year only includes the minority in the rest of the years. That being said, this can be considered as an error, and therefore can be ignored.

Ultimately, observing the results by comparing them to the hypotheses, the majority of these hypotheses are verified. The first verified hypothesis is that the ranks are the same throughout the year, for both tools of the analyses (correlation coefficients of linear regression and pearson coefficient). The second verified hypothesis is that the direction of correlation between income level and happiness is positive. The third verified hypothesis is the same as the second, they are only different in the variables of the correlation. Instead of income level and happiness, this hypothesis concerns gender and happiness. The fourth verified hypothesis is the same as the second and the third, only this time it is for income inequality and happiness. Related to the previous three verified hypotheses, there is also a hypothesis that was verified, which is regarding the statistical significance for this correlation. The existence of statistical significance in the three correlations here shows that there are indeed correlations. Meanwhile, there is a hypothesis established that was falsified, which is regarding the statistical significance of correlation between unemployment and happiness. Lastly, and on a related matter the falsified hypothesis, there is a hypothesis where the analysis results cannot explain. This is for the hypothesis that covers the correlation between unemployment and happiness. This is because there is lack of evidence that shows correlation between unemployment and happiness, while the hypothesis assumes this correlation exists.

VII. CONCLUSION

The relations between macroeconomic indicators and happiness are nuanced. As to how nuanced one macroeconomic indicator is to happiness in comparison to another indicator, this paper has made an attempt to measure it. The said macroeconomic indicators are GNI per capita, Gini coefficient, ILO-adjusted unemployment level, and GDI, which represent income level, income inequality, unemployment, and gender equality, respectively. It is important to understand that these indicators are indicative of how the economic activities are being measured in aggregate, and that is why they are macroeconomic in nature. That being said, this paper employs data that is presented on the country level.

Each indicator is presented differently. GNI per capita are presented in international dollar, Gini coefficient and GDI are available in range between 0 to 1 (the difference in the meaning of the value, closer to 1 means inequality for Gini coefficient but equality for GDI), and unemployment level is presented in percentage. In addition to that, there is also the happiness indicator that is presented in range of 0 to 10, where closer to 10 indicates higher state of happiness. Consequently, there is an endless probability of combinations for each country's makeup of these indicators. This paper tries to dissect each of the former 4 indicators (GNI per capita, Gini coefficient, unemployment, and GDI) in its relations to the last indicator (which is happiness).

In doing so, this paper employed different statistical analyses as its methodology. The methodologies used are the linear regression analysis and the pearson coefficient. These two are used in calculating how strong the correlations are. Besides, there are supplementary statistical methods that are used, which are the P-value that is derived from a T-test and natural logarithmic transformation. Each analysis served different purposes. Linear regression analysis, especially its correlation coefficient, and pearson coefficient, is used to calculate the correlation power. Meanwhile, P-value is used to reject null hypothesis. Lastly, natural logarithmic transformation is used to normalize the distribution. This is because normal distribution itself is an important aspect as far as correlation is concerned.

The hypotheses were made before the data were analyzed. There were six hypotheses. Two of them are related to the general correlations, and four are for individual correlations. Firstly, there is indeed a correlation between all of the four indicators individually in relations to happiness. This will be signified by the results of P-value for each of the correlations, where P-value is less than 0.05, the result is statistically significant. This also means that

the null hypotheses (being that there is no evidence of correlations) is rejected. Secondly, the correlations will be assessed based on their ranks. So, since there were four indicators being assessed to happiness, there would have been four correlations. These correlations were ranked against each other. To come up with the correlations results, the linear regression analysis and the pearson coefficient methodologies were used. The correlation coefficients of the regression analysis is first ranked, then the absolute value of the pearson coefficients. The reason why there are two methodologies used is to ensure the validity of the result. Then, the ranks will be replicated on a year-to-year basis from 2012 to 2021. This is done to guarantee the reliability of the research.

Now the correlations were then looked at individually, and using the theories of how each macroeconomic indicator relates to happiness, the individual correlations' hypotheses were formed. These hypotheses are mainly focusing on the directions of each correlation, by looking at their pearson coefficients. Since there were four macroeconomic indicators, there were four individual correlations hypotheses. The first hypothesis stated that the correlations between GNI per capita and happiness would be positive. For the second hypothesis, the correlations between Gini coefficients and happiness would be negative. Thirdly, the hypothesis said that there would be negative correlations between unemployment and happiness. Finally, this paper had hypothesized that the correlations between GDI and happiness would be positive.

The results were showing mixed results in terms of verification of the hypotheses. There were three result groups: verified, falsified, and inconclusive (unable to be neither verified nor falsified). Among the verified hypotheses were rejection of null hypotheses (a state of non-evidence in correlations) for correlations between GNI per capita and happiness, Gini coefficients and happiness, and GDI and happiness. Belonging to this group of verified hypotheses is also the correlations ranking (the ranks are consistent throughout the years for both statistical methodologies employed). Also, the hypotheses about the directions of the correlations for all of the correlations where the null hypotheses were rejected were all verified. Meanwhile, the falsified hypothesis includes rejection of the null hypothesis for correlations between unemployment and happiness. This also related to the inconclusive result for the verification of the last hypothesis, which is the direction of correlation between unemployment and happiness.

Besides all of these hypotheses verifications, this paper also found the degrees of explainability for all the correlations. The degrees of explainability refer to the explaining power each macroeconomic indicator has in regards to its relations to happiness, bearing in mind the nuances surrounding those relations. These degrees of explainability were signified by the ranking positions of each correlation. The results were as follows: income level has the highest degree of explainability, followed by gender inequality, and in last place is inequality. This means that income level has the closest relations to happiness, whereas the higher the income level, the happier the people. This is despite the nuance surrounding the income level and happiness especially one that is known as "Easterlin paradox" where there is a saturation line where there is an income level in which once people passes it, their happiness will not increase. It is followed by gender inequality, whereas the higher the equality, the happier the people. Although lower than the association between income level and happiness, the association between gender inequality and happiness is higher than the association between income inequality and happiness.

There were also two important piece of information that can be inferred from the explanations above, the first one being income level and happiness has a higher correlations power than income inequality and happiness, and the second being gender inequality has higher degree of association to happiness than income inequality has to the same. The first one is evident despite theory that suggests otherwise. The theory mentions that people would rather have equal but low income, rather than high but unequal income. The consequence of this result means that people would rather have high but unequal income than equal but low income. The second information regarding the degree of explainability between the two inequalities to happiness is very interesting to see. This is because logically gender inequality would have less correlation power to happiness because gender issues only revolves around some people of the society (women only) as opposed to income issues that cover all people (men and women). This signifies the knowledge gap that could be filled by future research.

VIII. BIBLIOGRAPHY

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