Redefining Development: Different Times Call for Different Measures

An analysis of the relation between GDP per capita and the Happy Planet Index

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Abstract

This thesis examines the relationship between economic growth and sustainable wellbeing. It evaluates the ability of GDP per capita to capture a how efficiently a country delivers long, happy lives using the limited environmental resources available, as measured by the Happy Planet Index (HPI). The purpose of the study is to see if a measure such as the HPI would be more appropriate than GDP per capita for guiding policy to ensure sustainable development. Using a dataset of 151 countries over 14 years, GDP per capita is compared with HPI scores. The HPI is a composite measure of a country's average life expectancy and experienced wellbeing, divided by the country's per capita ecological footprint. After running a series of correlation analyses and a series of fixed effect panel regressions it is concluded that GDP per capita has a slight ability to predict a country's HPI score. There is proven to be a positive relationship up until the point where a country's GDP per capita is approximately US$1600 - US$3900. There are however ninety countries in the dataset with a GDP per capita above US$3900. This leads to a conclusion that there is a need for more of a pluralism approach in economics where GDP and a measure such as the HPI can be used alongside each other to guide policymaking in a sustainable direction.

Keywords: Happy Planet Index, GDP per capita, sustainable development, degrowth

Table of Contents

1. Introduction

Economic growth, as measured by gross domestic product (GDP) and often presented in GDP per capita, is generally seen as the go to indicator of development and success of a country (Escobar, 2014, O'Neill, 2014, Stern, 2022). With a growing awareness of sustainable development and a pressing need to act to combat the climate crisis, there is however reason to question whether GDP per capita can and should remain the prime indicator of a nation's development and success. Because, the measure of GDP per se does not measure the health of people or the planet (Stern, 2022).

While there are other approaches and indices of measuring countries' development available, none have been able to take the place of GDP as a key guiding indicator in economic decision making (Stern, 2022). One such measure challenging the GDP is the Happy Planet Index (HPI), which was developed as a way of questioning the entrenched belief that GDP growth is synonymous with increasing wellbeing and prosperity (WEAll, 2021b). The HPI is calculated by dividing the life expectancy and experienced wellbeing in a country by its Ecological Footprint, making it possible to compare countries on how efficiently they deliver long, happy lives using the limited environmental resources available (WEAll, 2021b). In other words, the HPI can be interpreted as a measure of *sustainable wellbeing* (WEAll, 2021b). Not much research has been conducted on the relationship between GDP per capita and the HPI on a global scale. This study aims to fill that gap. By conducting an econometric analysis on the relationship between GDP per capita and the HPI, the relevance of GDP as a measure capturing both economic growth and sustainable development is evaluated.

The purpose of this study is to see if and to what extent the measure of GDP per capita captures sustainable wellbeing as measured by the HPI. The aspiration is to be able to contribute to the discussion around whether GDP can and should still be used as a measure of success and development. For this reason, the general research question to be answered in this study is if GDP per capita is a good measure of sustainable development, and thus more specifically, if the measure of GDP per capita has any predictive power over sustainable wellbeing as measured by the Happy Planet Index (HPI).

The paper is organized as follows. Section 1 presented above introduces the study and its purpose. Section 2 gives a background to the relationship between economic growth and sustainable wellbeing, further explaining the need for this study. Section 3 presents previous studies on the relationship between HPI and another indicator of development or economic growth. Section 4 presents the data used in this study. Section 5 gives a description of the methodological approach. Section 6 presents and briefly discusses the result of the correlation and regression analysis described in section 5. Section 7 draws conclusions about the result and provides suggestions for future research.

2. Background

In this section, the relationship between economic growth and sustainable wellbeing is explored. Some limitations of GDP as a measure of a country's success are discussed. This is followed by a description of two theories guiding the assumptions about the relationship between HPI and GDP per capita. Then a brief background to the two measures compared in this study is given.

2.1 Economic growth and sustainable wellbeing

The concept of economic growth, as measured by gross national income (GNI) and by gross domestic product (GDP), has been seen as a central part of development since the 1940s (Escobar, 2014). The concept of growth has become culturally, politically, and institutionally ingrained (Benini et al., 2020) and GDP remains a central key indicator guiding economic decision-making (Stern, 2022). While GDP was never intended to function as an indicator of wellbeing, it has routinely been assumed to be a reliable proxy for standard of living (O'Neill, 2014). There is however reason to question the prominent use of GDP as an indicator of national progress and whether it is in fact a good measure of sustainable development, which is the type of development needed to ensure the needs of the present are met without compromising the ability of future generations to meet their own needs (United Nations, 1987).

In this study, the HPI could be considered a proxy for sustainable development. However, as sustainable *development* implies a change for the better in a sustainable direction, a more appropriate term to describe what the HPI measures is *sustainable wellbeing* as the HPI measures how efficiently countries delver long happy lives using the limited environmental resources available (WEAll, 2021b). A more detailed description of each of the elements of the HPI is given in the *Data* section below.

There is a consensus among researchers and the general public that we are facing a climate crisis and that immediate steps must be taken to be able to mitigate the effects of climate change and to avoid reaching irreversible climate tipping points (Rockström, 2022). There is also an increasing number of researchers pointing to the negative relationship (that is, *negative* in the sense of unsustainable) between economic growth and environmental wellbeing and sustainable development overall. While it is generally agreed that climate change is caused by human activity (Hickel, 2022, Rockström, 2022), it has also been argued that it is not human activity per se that is causing the problem, but rather the economic system so focused around GDP growth guiding human activity in an unsustainable way (Hickel, 2022).

Two schools of thought arguing for the need to rethink what is meant by growth and progress are *degrowth* and *post-growth*. While degrowth is an umbrella term for more radical, academic, political, and social movements that emphasize the need to reduce production and consumption and define goals other than economic growth, post-growth is about the need to decouple well-being from economic growth (Benini et al., 2020). The measure of HPI, which is described in further detail below, could be seen as a measure developed based on ideas of degrowth and post-growth.

In theory there is no contradiction between economic growth and sustainable development. In fact, if economic growth was only generated by productivity increases this could be favorable from an environmental point of view (Hedenus, Persson & Sprei, 2018). In reality however productivity gains tend to lead to increases in consumption and increased demand of natural resources and economic growth and environmental degradation seem to coincide (Hedenus, Persson & Sprei, 2018). During the period 1990-2019, the global annual emissions increased by 54 per cent and the size of the global economy increased by about 120 per cent, a growth primarily fueled by fossil fuels (Stern, 2022).

Rockström (2022) states that the economic system seems to be built on two assumptions: (1) that changes in the environment occur linearly step by step, which would mean it were possible to go back and correct mistakes proven to affect the environment negatively; and (2) that there is no limit to what the biosphere can handle in terms of human impact (waste) and resource extraction (consumption). Research on ecological resilience however denies both these assumptions (Rockström, 2022). Nevertheless, the idea that environmental change happens linearly has led to hope being put to decoupling economic growth and resource use through technological development. However, the European Environment Agency present in a report (Benini et al., 2020) that despite much faith put towards decoupling, technological development has so far been associated with increased consumption and emissions rather than the reverse.

The shortcoming of GDP as a guiding indicator in economic decision making is furthermore that it does not measure everything of value (Stern, 2022). GDP does not measure the health of people, or the environment and it does not account for losses in biodiversity, environmental degradation, or climate change, even though these losses certainly affect the wellbeing of both people and planet (Stern, 2022). These are losses which in the long term in turn risks undermining the economic activities measured by GDP (Stern, 2022).

Another critique towards the measure of GDP as an indicator of national progress is that it does not provide much information on income distribution within countries. In fact, a country with little inequality and a thriving domestic economy could have the same GDP per capita as a country with high exports, high poverty rates and a small but affluent elite (Marks et al., 2006). While an increase in GDP per capita may be interpreted as the average person being better off, this may not be the case if the income increases only reach the people with the highest incomes (O'Neill, 2014).

Despite extensive criticism towards GDP as a measure of development, the need for economic growth in some areas of the world should not be understated. In fact, economic growth is an absolute necessity for the close to seven billion people living in developing countries and suffering from poverty (Stern, 2022). Having GDP as a central key indicator guiding economic decision-making in these countries helps raise wages, promotes access to better education and health care, and raises living standards overall (Stern, 2022).

Furthermore, it should be mentioned that the distribution of the effects of climate change is highly unequal. Despite the Global North being responsible for 92 per cent of all emissions exceeding the planetary boundaries, it is the Global South who suffer most of the damage from climate change, including 82-92 per cent of the economic costs and nearly all of the climate related deaths (Hickel, 2022). These numbers show the great responsibility which lies with the Global North to rethink their economies and do more to combat the climate crisis.

2.2 Assumed relationship

Two well known concepts which could be used to predict the relationship between GDP per capita and sustainable wellbeing are the basic economic principle of *diminishing marginal utility of income* and the *Environmental Kuznets Curve* (EKC). As early as 1890, Alfred Marshall wrote about how the additional benefit a person gets from increases in income diminishes with every increase (Marshall, 1920). This is still considered a basic economic principle and would in the here undertaken study imply that the relationship between GDP per capita and the element wellbeing of the HPI would have a positive but decreasing relationship as GDP per capita increases. The EKC shows with an inverted U-shape that as gross national income (GNI) per capita increases, pollution and other forms of environmental degradation tend to first rise and then fall, because as income rise, societies are assumed to have both the means and willingness to pay for environmental protection (Smith & Todaro, 2020, pp. 507-508). Assuming that the EKC model holds, a similar inverted U-shaped relationship could be assumed between economic growth and the element Ecological Footprint of the HPI. It should nevertheless be mentioned that while the EKC has been influential in describing the relationship between economic growth and environmental degradation, the validity of the EKC is an empirical question and seems to hold for some countries and in some instances, but not for all (Smith & Todaro, 2020, p. 508).

2.3 The two measures introduced

2.3.1 GDP

The predecessor of GDP, GNP (gross national product) was developed by Simon Kuznets in the 1930s as a way for America to get out of the great depression (O’Neill, 2014). Being able to measure the state of the economy using a single number made it easier to evaluate the success of economic policies (O’Neill, 2014). In 1946, GNP became the official economic policy in the US (O’Neill, 2014) and since the 1940s, the United Nations has led an international effort to establish procedures for measuring (first) GNP (and later GDP) that all countries are encouraged to follow (Victor, 2014). In 1991, GNP was replaced by gross domestic product (GDP), and has since been considered the go to indicator of progress (O'Neill, 2014).

While Kuznets was the person who developed the measure of GNP, he himself warned of its limitations and stated as early as 1934 that the welfare of a nation cannot be inferred from a measure of national income (O'Neill, 2014). Later he also became an outspoken critic of the way GNP was being used and interpreted, and emphasized in 1962 that goals of growth should specify growth of what and why (O'Neill, 2014). Nevertheless, the measure of GDP remained a key guiding indicator of national progress (O'Neill, 2014).

2.3.2 HPI

The HPI was developed by the New Economics Foundation (NEF) in 2006, an independent British think tank with the aim to "create a new economy that by 2040 works for people and within environmental limits" (New Economics Foundation, 2022). The NEF is part of the Wellbeing Economy Alliance (WEAll), a "collaboration of organisations, alliances, movements and individuals working towards a wellbeing economy, delivering human and ecological wellbeing" (WEAll 2022) and as of 2019, it is the WEAll that hosts the HPI (Happy Planet Index, 2022a).

The developers of the HPI describe a crisis of persistent inequalities, accelerating climate breakdown and rapid biodiversity loss as being closely interconnected and stemming from the same core problem, namely that "our economies are structured, governed and measured to promote short-term economic growth over long-term collective wellbeing" (WEAll, 2021b, p. 1). They question the entrenched belief that GDP growth is synonymous with increasing wellbeing and prosperity, and argue that GDP growth does not mean a better life for the general population, as GDP in itself is not able to capture inequality, social relations, health or the planetary limits (WEAll, 2021b). More details of how the HPI and its elements are measured is presented below section 4, *Data*.

3. Previous Studies

This section presents results from previous studies on the HPI and its relation to other measures of economic growth or development, showing where there seems to be a knowledge gap in the literature, indicating the relevance this study. While there is some previous research on the relationship between the HPI measure and other measures of development, interestingly however, the HPI has not been subject to many academic studies. Using only the search word “Happy Planet Index” in the database *EconLit*, from the American Economic Association, no more than 10 academic articles appear, even fewer with an approach relevant to this study (5 December 2022).

3.1 Correlation between HPI and other measures

There have been some studies conducted on the relationship between the HPI and other measures. These are studies covering different countries with varying results.

Churilova, Salin, Shpakovskaia, and Sitnikova (2019) have examined the links between several indicators of development, including GDP per capita and HPI using cluster and correlation analysis. 132 countries were grouped into eight clusters based on their socioeconomic status, which range from “most successful countries” to “most disadvantaged countries” (Churilova et. al., 2019). Exactly how these clusters are determined is however somewhat ambiguous in the article. Nevertheless, the correlation between each of the measures are presented separately for each of the clusters. The correlation between GDP per capita and HPI are as follows for each of the clusters; (1) the most successful countries: -0.19, (2) successful countries: 0.59, (3) wealthy countries: 0.39, (4) promising countries: 0.34, (5) developing countries: -0.38, (6) problematic countries:0.04, (7) disadvantaged countries: 0.14, (8) the most disadvantaged countries: 0.54 (Churilova et. al., 2019). The two groups with the strongest correlation between HPI and GDP per capita were cluster (2) successful countries (Japan, Israel, France, Slovenia, Italy, Spain, Czech Republic, Greece, Estonia, Cyprus, Poland, Lithuania, Slovakia, Portugal, Hungary, Latvia, Croatia) and (8) the most disadvantaged countries (Pakistan, Angola, Tanzania, Nigeria, Cameroon, Zimbabwe, Mauritania, Madagascar, Senegal, Uganda, Sudan, Togo, Benin, Yemen, Afghanistan, Malawi, Cote d’Ivoire, Ethiopia, Mali, Democratic Republic of Congo, Liberia, Guinea-Bissau, Sierra Leone, Mozambique, Burundi, Burkina Faso, Chad, Nigeria, Central African Republic) (Churilova et. al., 2019). These are two groups of countries with little in common. The group with the strongest negative correlation was cluster (5) developing countries (Iran, Turkey, Algeria, Jordan, Tunisia, Dominican Republic, Uzbekistan, Gabon, Egypt) (Churilova et. al., 2019). The main takeaway from this study is that correlation between GDP per capita and HPI varies across different country groups and that there does not seem to be a clear pattern on a global scale.

In a study from 2016, Opati investigated the correlation between the HPI and GDP per capita in Romania between the years 2006-2013 and found that for Romania, there was a strong correlation between HPI and GDP per capita.

Kranjac, Henny and Sikimic (2012) have studied the relationship between level of EU funds and the sustainability of a country. The countries covered in the study were Romania, Bulgaria, Slovakia, Estonia, Poland, Czech Rep., Latvia, Lithuania and Hungary. The authors use the HPI as an indicator of the level of sustainability in a country. Their correlation analysis between EU funds and HPI shows a significant negative relationship between EU funds and the HPI (Pearson's correlation coefficient –0.538). The conclusion drawn from this study is thus that EU funds have a significant negative contribution to sustainable development among the countries studied.

In a study by Murat and Gürsakal (2015) a canonical correlation analysis was used to assess the relation between the Human Development Index (HDI - a composite measure of health, knowledge and standard of living as measured by life expectancy, mean years of schooling and GNI per capita) and HPI for 150 countries. The canonical correlation analysis is described as a “multivariate method which assess the relation between two sets of variables that include two or more variables through linear combinations” (Murat & Gürsakal, 2015). This study concluded that there is a positive correlation between HPI and HDI, and especially the variables Life Expectancy at Birth of the HDI and Happy Life Years (life expectancy × wellbeing) of the HPI contributed to this strong correlation.

Based on this compilation of previous studies it can be concluded that the relationship between HPI and GDP per capita seems to vary greatly depending on the group of countries studied, and that the results from the previous studies are inconclusive with regards to the relationship between

GDP per capita and HPI on a global scale. Furthermore, a study covering the relationship between HPI and GDP per capita on a global, regional and income level scale is lacking in the literature.

4. Data

This study uses data on HPI and GDP per capita from 151 countries over the time period 2006-2019. These countries and this time interval have been chosen because of the availability in data on both HPI and GDP per capita. A full list of the countries included in the study can be found in the Appendix 1. For the reader to be able to fully comprehend the implications of the result it is important that the reader is familiar with the data used in the study. This section presents the data used starting with data on GDP per capita data followed by the HPI data. Some limitations to the measures are presented, followed by a description of the different country groupings included in the study. Last the distribution of the two measures is shown using two boxplot diagrams.

4.1 GDP per capita

The data on economic growth used in this study is GDP per capita (current US$), that is the gross domestic product as described in current U.S. dollars divided by midyear population in a given country. This data has been retrieved from the World Bank database (The World Bank, 2022a). The reason for choosing GDP per capita and not any other measure of economic growth such as GDP or GNI as the independent variable is because it is considered to be a more common and established way of talking about the development or wellbeing of a nation in the public discourse.

4.2 HPI

The data on HPI and its elements of average life expectancy, experienced wellbeing and Ecological Footprint, used in this study has been retrieved from the HPI database (Happy Planet Index 2022b). The HPI is measured on a scale from 1 to 100. If a country achieves the borderline of what is considered a good score on all three components of the HPI, the country receives a score of 58.1. In 2019 the highest scoring country, Costa Rica had a HPI score of 62.1 while the global average was 43.1. No country however delivers well on all three indicators of the HPI and less than a third of the countries consumed within the environmental limits (WEAll, 2021b).

Some prominent findings from the HPI data according to WEAll (2021b) are that: (1) often, long happy lives tend come at the expense of the environment, with wealthy western nations with high incomes scoring highly on life expectancy and wellbeing, but having high Ecological Footprints, causing these countries, which are often described as successful and developed, to not score highly on the Happy Planet Index (WEAll, 2021b). (2) One region that stands out in the dataset is Latin America with 11 out of the 20 top scoring countries on the HPI 2019 being Latin American Counties (Abdallah & Marks, 2021). Latin American countries thus are considered to be able to demonstrate that it is possible to build an economy that delivers relatively high wellbeing and high life expectancy without having a large ecological footprint (WEAll, 2021b). (3) Costa Rica, the country ranking the highest on the HPI in 2019 is an interesting case as it has a per capita ecological footprint that is one third of the ecological footprint of the US, while the wellbeing and life expectancy scores are marginally higher than in the US (WEAll, 2021b). All this while the US is the country with the highest GDP in the world.

As mentioned previously, the HPI is calculated using three elements: wellbeing, life expectancy and ecological footprint. The mean of life expectancy and the mean of experienced wellbeing in a given year are multiplied, producing what is termed as *happy life years*. Happy life years is then divided by the country's per capita Ecological Footprint for the same given year. This calculation then gives the "average number of "Happy Life Years" produced per unit of demand on the natural environment from the country's residents." (WEAll, 2021a, p. 2).

4.2.1 Life expectancy

The measure of life expectancy used in the HPI comes from the UN Human Development Report, which each year present data on life expectancy that is then commonly used as an overall indicator of the standard of health in a country (WEAll, 2021a). More exactly life expectancy is the average number of years a person in a given country is expected to live assuming prevailing patterns of age-specific mortality rates are unchanged throughout the person's life (WEAll, 2021a). For reference, the countries with the highest average life expectancy in 2019 were Hong Kong (84.9 years), Japan (84.6 years) and Switzerland (83.8 years) (Abdallah & Marks, 2021). The countries with the lowest average life expectancy were Central African Republic (53.3 years), Chad (54.2 years), Lesotho 54.3 years) (Abdallah & Marks, 2021).

4.2.2 Wellbeing

Data on wellbeing is given by the Gallop World Polls Ladder of Life questionnaire gathered for the World Happiness Report (WEAll, 2021a). The same question of experienced wellbeing is asked to a sample of around 1 000 individuals per year from the age of 15 in more than 150 countries (WEAll, 2021a). More specifically, the question asked is:

> *Please imagine a ladder with steps numbered from zero at the bottom to 10 at the top. Suppose we say that the top of the ladder represents the best possible life for you; and the bottom of the ladder represents the worst possible life for you. On which step of the ladder do you feel you personally stand at the present time, assuming that the higher the step the better you feel about your life, and the lower the step the worse you feel about it? Which step comes closest to the way you feel?* (WEAll, 2021a, p. 9)

Wellbeing is thus reported on a scale of 1-10 called the Ladder of life. For reference, the countries with the highest level of experienced wellbeing in 2019 were Finland (7.78 on the Ladder of life), Switzerland and Denmark (both scoring 7.69 on the Ladder of life) (Abdallah & Marks, 2021).The countries with the lowest levels of experienced wellbeing were Afghanistan (2.38 on the Ladder of life), Zimbabwe (2.69 on the Ladder of life) and the Central African Republic (3.08 on the Ladder of life) (Abdallah & Marks, 2021).

4.2.3 Ecological Footprint

The data on Ecological Footprint, expressed in global hectares (gha), used in the HPI is produced by the Global Footprint Network’s National Footprint and Biocapacity Accounts (WEAll, 2021a). In short, the Ecological Footprint is a consumption-based measure showing how many global hectares is needed per capita to sustain a country’s typical consumption patterns (WEAll, 2021a). A global hectare is a biologically productive hectare with world average productivity in a given year (WEAll, 2021a). The total biocapacity worldwide has been estimated to around 12 billion gha (WEAll, 2021a). This is then divided by world population giving a per capita Ecological Footprint threshold, which can then be added together to become a country threshold (WEAll, 2021a). As the global population increases, this threshold defining a country’s consumption as environmentally sustainable falls; in 2006 the Ecological Footprint threshold was at 1.74 gha per capita, and by 2019 it had decreased to 1.56 gha per capita (WEAll, 2021a). The interpretation of this number is that if everyone in the world 2019 consumed within 1.56 gha then the planet's resources would be able to renew themselves sustainably (WEAll, 2021a). For reference, the countries with the highest per capita Ecological Footprints in 2019 were Qatar (15.04 gha), Luxemburg (12.59 gha) and Mongolia (10.08 gha) (Abdallah & Marks, 2021). The countries with the lowest Ecological Footprints were Yemen, (0.52 gha), Burundi (0.59 gha) and Rwanda (0.61 gha) (Abdallah & Marks, 2021).

4.2.4 Limitations and missing data

While the WEAll have been able to present data on all three elements of the HPI for 151 countries, they have had some problems with missing data, especially with the elements of wellbeing and Ecological footprint (Abdallah & Marks, 2021). How this was handled is described below.

Because the World Poll cannot always be conducted in every country every year, 17 percent of the possible wellbeing data from 2006 – 2019 were missing (WEAll, 2021a). WEAll handled this by estimating the level of wellbeing. If there was data available for the two adjacent years, the year in between was estimated as the average of them, and if there was a two- or three-year gap in the availability of data, a mini-linear trend was estimated between them (WEAll, 2021a).

WEAll have also needed to estimate the Ecological Footprint in some instances where data has been missing. Up until 2017, there was readily available data for most countries but for year 2017 data for five countries (Hong Kong, Iceland, Taiwan, Vanuatu and Uruguay) needed to be estimated using stepwise linear regressions of Ecological Footprint (for all countries where data was available) against a range of country-specific variables (WEAll, 2021a).

For 2018 and 2017 there was no data available on Ecological Footprint from the Global Footprint Network's National Footprint and Biocapacity Accounts. Thus, WEAll needed to estimate Ecological Footprint data from CO2 emissions data, given that CO2 emissions represent the main component of the ecological footprint (WEAll, 2021a). Data on territorial CO2 emissions from the Global Carbon Atlas was used in a general linear model to predict change in ecological footprint based on change in CO_2, with country fixed effects and a linear year effect that was allowed to vary by country (WEAll, 2021a).

It should also be mentioned that the HPI is a composite indicator based on three sub-indicators. The use of such a composite indicator is advantageous for summarizing a complex and multidimensional issues (OECD, 2004), in this case sustainable development or sustainable wellbeing. Such an indicator helps offer a rounded assessment of countries' performance and can indicate which countries represent the priority for improvement efforts (OECD, 2004). Some possible downsides of using such a composite indicator may be that it could send misleading policy messages and may invite stakeholders to draw simplistic conclusions (OECD, 2004). In the case of the HPI this could mean a risk of the index being interpreted as measure of happiness instead of a measure of environmental efficiency of supporting well-being in a given country (Schepelmann, Goossens & Makipaa, 2010). For this study however, the fact that the HPI is a composite indicator is not considered to be a problem as the aim of the study is to see if and to what extent the measure of GDP per capita captures sustainable wellbeing as measured in the HPI.

Furthermore, a possible limitation to the measure of HPI is that while life expectancy and ecological footprint are objective indicators, wellbeing is subjective. It should however be noted that the reported wellbeing corresponds to objectively measured facts such as mental and physical health (Marks et al., 2006).

4.2.5 Calculating the HPI

Instead of simply dividing Happy Life Years by Ecological Footprint, some technical adjustments are made in the index equation to ensure that no single component dominates the overall score (WEAll, 2021a). A constant is added for each of the elements to ensure relative standard deviation does not vary between the elements (WEAll, 2021a). By adding the constant β to the wellbeing score it is ensured that the measure Happy Life Years is equally sensitive to changes in life expectancy and wellbeing (WEAll, 2021a). By adding the constant ε to the measure Ecological footprint it is ensured that this measure has the same relative standard deviation as that of Happy Life Years (WEAll, 2021a). Thus, adding a constant to adjust for relative standard deviation ensures that the Happy Planet Index is equally sensitive to changes in the Happy Life Years measure and in the Ecological Footprint (WEAll, 2021a).

Furthermore, two scaling constants (α and γ) are included so that a HPI score of 100 would indicate excellent performance on all three indicators, that is a life expectancy of 85 years, a wellbeing score of 10 out of 10, and an Ecological Footprint defined as environmentally sustainable for the year in question (WEAll, 2021a). See Equation 1 below.

Equation 1

$$HPI = \frac{\alpha \times LE \times (W + \beta) - \gamma}{EF + \varepsilon}$$

where

α = 0.75
LE = Life Expectancy in years
W = Wellbeing in
β = 2.92
γ = 54.92
EF = Ecological Footprint in gha
ε = 6.39

4.3 Country classification

The countries in the dataset used have been organized into different groups depending on geographical region and country income level, as measured by GNI per capita. The reason for looking at different country groups separately is to see if different patterns of the relationship between GDP per capita and HPI can be detected depending on country group, as can be assumed from previous studies.

The income level country grouping used in this study is the World Bank’s country classification of high-, upper middle-, lower middle-, and low income countries based on the GNI per capita

(Hamadeh, Van Rompaey, Metreau & Grace Eapen, 2022). For simplicity the current country classification has been used for the same country over all 14 years observed. This has been done to simplify the analysis and not have countries belong to different income groups depending on the year. High-income economies are defined as those with a GNI per capita of US$13,205 or more, upper middle-income economies are those with a GNI per capita between US$4,256 and US$13,205, lower middle-income economies are those with a GNI per capita between US$1,086 and US$4,255, low-income countries are defined as those with a GNI per capita of US$1,085 or less (The World Bank, 2022b). A full list of the countries in the different income groups can be found in the Appendix 2.

The distinction of the geographical regions used in the analysis comes from groupings made by WEAll in their presentation of HPI data and also used by the World Bank (Abdallah & Marks, 2021). The groups are Latin America, North America and Oceania, Western Europe, Middle East, Africa, South Asia, Eastern Europe and Central Asia, East Asia. A full list of the countries in each region group can be found in Appendix 3.

4.4 Distribution of the two measures

For the reader to get an idea of the distribution of the data of the two measures, the two boxplots below can be useful. Whereas the HPI is measured on a scale of 0-100, with a global mean of 43.2231 over the 14 years observed, the GDP per capita in the observed countries ranges from 167.3765 USD to 123678.7 USD, giving an overall mean across all 14 years observed of 14300.53 USD. As can be seen from the boxplots below, the distribution of HPI tends to be quite similar from year to year with the largest number of observations being in the middle of the spectrum. The observations of GDP per capita on the other hand shows that the largest number of observations tend to be at the bottom of the spectrum.

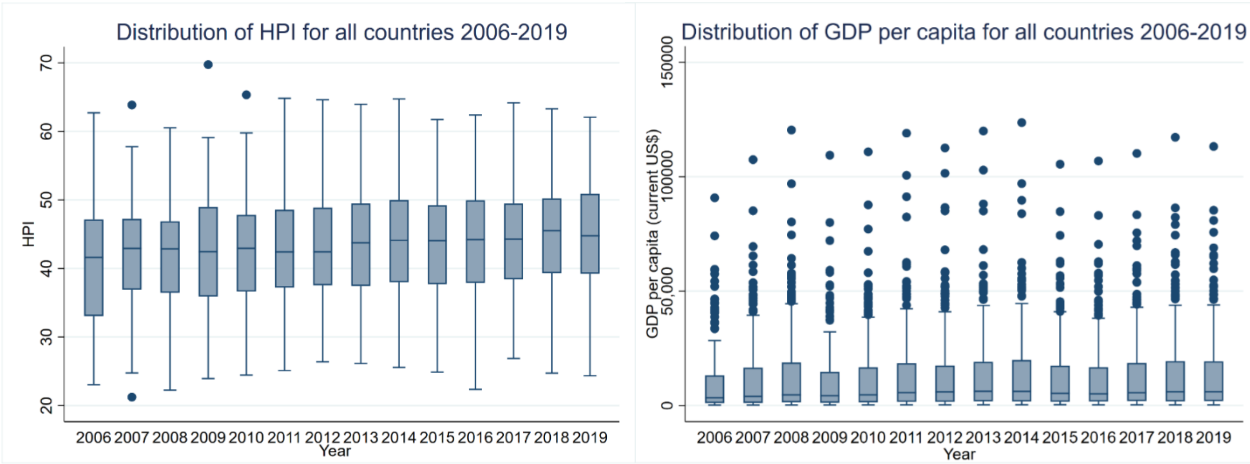

Figure 1 and 2

The above figures are box plots showing the spread of the two measures over the 14 years observed. For each year, the blue vertical line gives the minimum and maximum values (excluding outliers). The blue rectangular box shows the 25th percentile to the 75th percentile of observations. The horizontal line in the middle of the blue box shows the median. The dots are outliers.

5. Methodology

To answer the research questions, an econometric study has been performed using the statistics software, STATA. First, to test whether GDP per capita can be considered good proxy for indicating sustainable development or sustainable wellbeing, a correlation analysis between HPI and GDP per capita has been conducted. Second, to see whether measure of GDP has any predictive power over sustainable development as measured by the Happy Planet Index (HPI) a regression analysis has been conducted. Because while correlation is a good way of summarizing a direct relationship between two variables, a regression allows for prediction and a more precise explanation of a numeric response. And because correlation analysis assumes a linear relationship, a regression analysis is needed to test and estimate a nonlinear relationship between GDP per capita and HPI.

5.1 Correlation

Determining the correlation between the two variables, GDP per capita and HPI, is one step in understanding their relation. If the correlation between GDP per capita and HPI is zero or close to zero, it is reasonable to assume that there is no linear dependence between the two variables whatsoever. In other words, that the measure of GDP does not capture sustainable development as measured by the HPI and that the HPI measure does not say anything about a country's economy in terms of domestic production. If the correlation would be 1, that would mean that there is a strong positive correlation between GDP and HPI. In other words, an increase in GDP would also tend to lead to an increase in HPI, and vice versa. On the other hand, if the correlation is -1, the variables have a perfect negative correlation, meaning that an increase in GDP would tend to lead to a decrease in HPI, and vice versa (Westerlund, 2012).

The reason for using pairwise correlation instead of simply correlation is because if using only the command correlate in STATA, the software only calculates correlations where all variables included have no missing observations, so if one variable has a missing observation, the entire row is removed. Thus, using pairwise correlation ensures that the correlation between GDP per capita and Ecological Footprint is calculated including observations where there may be missing values for Ecological Footprint for example.

5.2 Regression

In this study, regression analysis is used to assess the causal relationship between GDP per capita and HPI. Both the linear relationship and nonlinear relationship between HPI and GDP per capita will be tested. The aim of the regression analysis is to obtain unbiased, consistent and efficient estimations of the marginal effect of GDP per capita on HPI. For this aim to be reached, the specification of the models is essential.

When running regressions, it is important to look out for some econometric problems. One economic problem is if the explanatory variable is correlated with the error term, known as endogeneity. To avoid endogeneity in the panel data analysis, a Hausman test can be conducted to see if there is a correlation between the unique errors and the regressors in the model (Verbeek, 2017). In panel data analysis, the Hausman test also helps decide whether a random or fixed effects model should be used for the analysis. The null hypothesis in the Hausman tests is that the s that the preferred model is random effects (Verbeek, 2017). When conducting the Hausman test for this panel data set it produced a p-value the result was to reject the null hypothesis and use a fixed effects regression model. The exact result of the Hausman test can be found in Appendix 4.

Furthermore, the intuitive reason for using a fixed effects regression model in this study that because the point of interest in this study is to see to what extent GDP per capita can explain HPI *within* countries and not between countries, a fixed effects regression model is preferred. The fixed effects model concentrates on differences within individuals, explaining to what extent y_{it} differs from $\bar{y}_i$ rather than explaining why $\bar{y}_i$ is different from $\bar{y}_j$ (Verbeek, 2017). Because the question of interest in this study is to assess the relationship between HPI and GDP per capita for each country specifically it is not helpful knowing for example if GDP per capita in Costa Rica has any effect on HPI in Sweden. The baseline regression model used is therefore:

Equation 2

$$Y_{it} = \beta_1 X_{it} + \alpha_i + u_{it}$$

In the model all variables are indexed with an *i* for the individuals (countries) (*i* = 1,…, N) and a *t* for the time period (year) (*t* = 1,…, T) (Verbeek, 2017). Y_{it} is the dependent variable HPI. X_{it} is the independent variable GDP per capita. β_1 represents the marginal effect of increased GDP on HPI also described as the slope coefficient of the population regression line. α_i is the entity or country fixed effect. u_{it} is the assumed individual and identically distributed random variables over individuals and time (Stock & Watson, 2020).

Furthermore, time fixed effects can be added to the model. Using time fixed effects helps control for variables that are constant across countries but vary over time. This could mean controlling for economic shocks over time. By including both country and time fixed effects in the model, any unobserved variable which fits these two characteristics are controlled for (Stock & Watson, 2020). Including time fixed effects in the regression gives the following regression equation.

Equation 3

$$Y_{it} = \beta_1 X_{it} + \alpha_i + \lambda_t + u_{it}$$

This model follows the same structure as equation 2, with the only difference being λ_t, accounting for time fixed effect. (Stock & Watson, 2020)

However, even if both country and time fixed effects are included in the regression model, these fixed effects do not control for country specific characteristics that vary over time, which can still be a source of omitted variable bias (Stock & Watson, 2020). These omitted variables will be absorbed in the population regression error u_{it} (Stock & Watson, 2020). In this study, such an omitted variable could be for example the level of education in a country.

In panel data, variables are typically autocorrelated and standard errors need to allow both for this autocorrelation and for potential heteroskedasticity (Stock & Watson, 2020). One way of doing this is to use clustered standard errors, which allow for heteroskedasticity and for arbitrary correlation within an entity (cluster) but treat the errors as uncorrelated between entities (Stock & Watson, 2020). Clustered standard errors are valid whether or not there is heteroskedasticity, autocorrelation or both (Stock & Watson, 2020).

To see the effects of these different econometric "tools" has for explaining the relationship between GDP per capita and HPI, this study implements the following regression equations:

Linear regressions:

(1) $HPI = \beta_1 \times GDP\ per\ capita + Country\ Fixed\ Effects$
(2) $HPI = \beta_1 \times GDP\ per\ capita + Country\ Fixed\ Effects$ (Clustered standard errors)
(3) $HPI = \beta_1 \times GDP\ per\ capita + Country\ Fixed\ Effects + Time\ Fixed\ Effects$
(4) $HPI = \beta_1 \times GDP\ per\ capita + Country\ Fixed\ Effects + Time\ Fixed\ Effects$ (Clustered standard errors)

Nonlinear regressions:

(5) $HPI = \beta_1 \times GDP\ per\ capita + \beta_2 \times GDP\ per\ capita^2 + Country\ Fixed\ Effects$

(6) $HPI = \beta_1 \times GDP\ per\ capita + \beta_2 \times GDP\ per\ capita^2 + Country\ Fixed\ Effects$ (Clustered standard errors)

(7) $HPI = \beta_1 \times GDP\ per\ capita + \beta_2 \times GDP\ per\ capita^2 + Country\ Fixed\ Effects + Time\ Fixed\ Effects$

(8) $HPI = \beta_1 \times GDP\ per\ capita + \beta_2 \times GDP\ per\ capita^2 + Country\ Fixed\ Effects + Time\ Fixed\ Effects$ (Clustered standard errors)

The result from these different regression models will be presented on a global scale as well as for the different country groups separately.

If statistically significant, the results from the nonlinear regressions will be used to estimate maximum point to get a numeric response of up until which point the relationship between HPI and GDP per capita is estimated to be positive. In addition, using the statistics software STATA, it is also possible to plot a local regression, which can be interpreted as the “real” relationship between HPI and GDP per capita. This will be plotted visually along with the linear and the nonlinear regression, to see how well the different models can be assumed to explain the real relationship.

5.3 Transformation of variables

By transforming variables and manipulating them in systematic ways, they can become better suited for answering the research question and fit better into a model or assumption. By creating logarithmic variables for both the dependent and independent variable, the data becomes normally distributed and more appropriate for statistical analysis. By analyzing the data on a logarithmic scale, the *relationship* between the observations becomes clearer, rather than their absolute differences (Sundell n.d.). The interpretation of the regression coefficient or b-coefficient when both the independent and the dependent variables are logarithmic is, when the independent variable increases by one percent, the dependent variable increases with the percentage given by the b-coefficient (Sundell n.d.). Furthermore, because of the assumption of a non-linear relationship between HPI and GDP per capita a model with a polynomial effect is designed by adding the log squared GDP per capita to the model.

6. Result

6.1 Visual depiction

The following figures are visual depictions of GDP per capita and the HPI worldwide in 2019. Figure 3 shows GDP per capita (2019) measured in US$, where the the darker the country, the higher the GDP per capita (Our World in Data, 2022). Figure 4 comes from WEAll (2022) and shows how countries ranked on the HPI in 2019, on a scale from bad to good, indicated by colours from dark red to dark green. Looking at these two figures, there does not seem to be a clear pattern between countries scoring highly on the HPI and levels of GDP per capita.

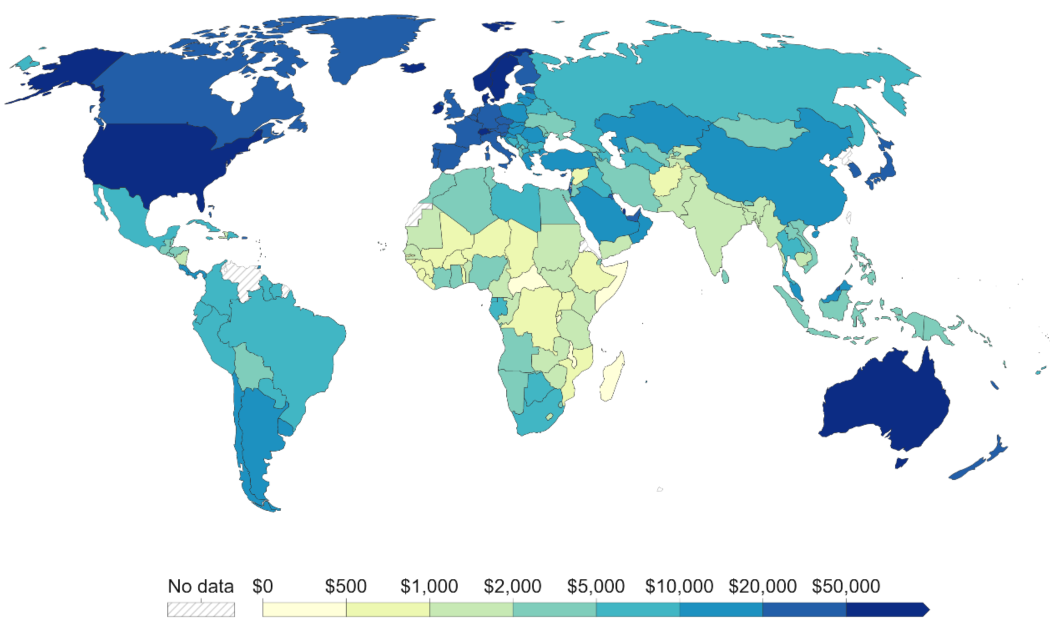

Figure 3: Map of GDP per capita (USD 2019)

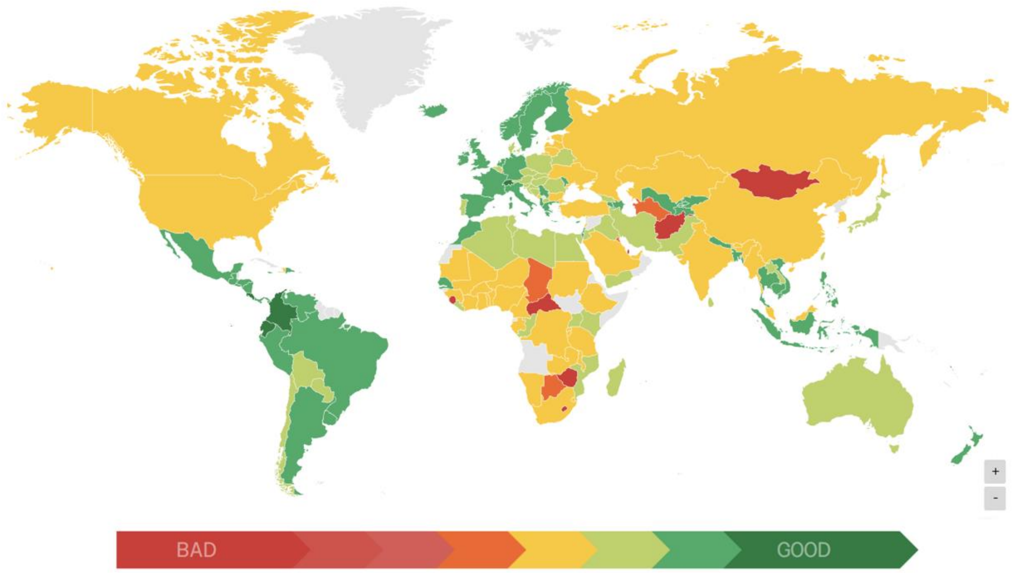

Figure 4: Map of HPI rank 2019

6.2 Correlation

The following correlation matrix illustrates the pairwise correlation between the HPI and the indicators of HPI as GDP per capita on a global scale covering the entire dataset with all 151 countries over 14 years. A correlation matrix for each region and income group are presented separately in Appendix 5. Overall, the correlation in the twelve groups follows the global pattern. The correlation between HPI and GDP per Capita at 0.079 is not significant, indicating that a country with a high GDP cannot be expected to have a high HPI score, and vice versa.

Pairwise correlation (Globally)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.992	1.000					
(3) Life expectancy	0.558	0.574	1.000				
(4) Wellbeing	0.520	0.511	0.732	1.000			
(5) Footprint (gha)	0.164	-0.167	0.592	0.676	1.000		
(6) GDP per capita	0.079	0.078	0.618	0.720	0.792	1.000	
(7) ln GDP per Cap~a	0.243	0.249	0.818	0.814	0.806	0.819	1.000

Table 1: Pairwise correlations on a global scale

There are however some differences in correlation between the different groups worth mentioning. On a global level, the correlation between HPI and GDP per capita is 0.079. For high income countries, the correlation is -0.030. For upper middle income countries, the correlation is -0.068. For lower middle income countries, the correlation is 0.109. For low income countries, the correlation is 0.283. Thus, here a pattern could be detected. That is that while there does not seem to be a strong correlation between GDP per capita and the HPI for either country income group, there are slight differences indicating that as income increases, the correlation between GDP per capita and sustainability decreases.

Looking closer at the correlation between the different elements of the HPI and GDP per capita, some other conclusions can be drawn. The correlation between GDP per capita and Ecological Footprint are on a similar level for high income countries, upper middle income countries and lower middle income countries; 0.547, 0.495 and 0.498 respectively. For low income countries however, the correlation between GDP per capita and Ecological Footprint is 0.182. This could be interpreted as a rejection of the environmental Kuznets curve on a general level, as the Ecological Footprint does not seem to decrease as country income increases. Furthermore, the correlation between GDP per capita and wellbeing increases as the country income increases, whereas for life expectancy there is not such a clear correlation pattern dependent on country income (see Appendix 5). Two regions deviating more than others from the global trend are North America and Oceania, and the Middle East which both have a moderately negative correlation between HPI and GDP per capita.

6.3 Regression analysis

6.3.1 Linear regressions

The following table shows the regression results of the four linear regressions tested, showing the extent to which GDP per capita can be expected to be able to predict HPI linearly. The same table but for all different income groups and region groups can be found in Appendix 6.

Linear regression (Globally)

	Dependent variable			
	Logarithm HPI			
	(1)	(2)	(3)	(4)
ln GDP per capita	0.0786***	0.0786***	-0.0121	-0.0121
	(0.00732)	(0.0185)	(0.00932)	(0.0244)
Constant	3.073***	3.073***	3.769***	3.769***
	(0.0629)	(0.159)	(0.0762)	(0.203)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	Yes	Yes
Clustered standard errors	No	Yes	No	Yes
N	1868	1868	1868	1868
R^2	0.063	0.063	0.206	0.206
Adjusted R^2	-0.020	0.062	0.130	0.200

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Linear regressions on a global scale

On a global level, there seems to be a minimal linear relationship, with a 0.0786 percent increase in HPI as GDP per capita increases by 1 percent when only country fixed effects are included in the regression. The R^2 value of 0.063 indicates that 6.3 per cent of the variation in HPI can be explained by the variation in GDP per capita. A similar pattern holds for high income countries, upper middle income countries and lower middle income countries, with the regression coefficient ranging between 0.0590 and 0.0681. For low income countries the regression coefficient of regression 1 and 2 is slightly higher at 0.185, with an R^2 value of 0.151, indicating that a 1 percent increase in GDP per capita is estimated to increase HPI with 0.185 percent, and that 15 % of the variation in HPI can be explained by the variation in GDP per capita.

Regression 1 and 2 proved statistically significant for four out of eight region groups (Latin America, North America and Oceania, Africa, Eastern Europe and Central Asia). Out of these regions, Africa was the region with the highest regression coefficient at 0.202 and R^2 value of 0.153. For the country groups which had a statistically significant result for regression 3 with both time and country fixed effects (high income countries, low income countries, Latin America, Africa, South Asia and East Asia), the regression coefficient was slightly lower in regression 3 than in regression 1 and 2.

The non-statistically significant result for the income groups with a p-value > 0.05, indicates that the result of the regression analysis is expected to be due to chance in more than 5 % of the cases in those country groups. Regression 4 with country and time fixed effects and clustered standard errors did not produce a statistically significant result for any of the country groups.

6.3.2 Nonlinear regression

On a global level, there seems to be a stronger nonlinear than linear relationship between HPI and GDP. This seems to hold for all country income and region groups where the regression result is statistically significant. The region groups Eastern Europe and Central Asia, and Africa are the only groups in the dataset for which all four nonlinear regression models are statistically significant, see Appendix 7.

Table 3 below shows the results of the nonlinear regressions on a global scale. For the nonlinear regression model, the maximum point of the estimated curve can be calculated. For regression 5 and 6, the maximum point is calculated to be where the GDP per capita of a country is US$ 3413. For regression 7 (and 8), the maximum point is calculated to be US$ 1597. This manual calculation of the maximum points of the estimated nonlinear regressions can be further complemented by the local regression estimation described in the subsequent section.

Nonlinear regression (Globally)

	Dependent variable			
	Logarithm HPI			
	(5)	(6)	(7)	(8)
	ln HPI	ln HPI	ln HPI	ln HPI
ln GDP per capita	0.325***	0.325**	0.208***	0.208
	(0.0486)	(0.119)	(0.0460)	(0.125)
ln GDP per capita^2	-0.0156***	-0.0156*	-0.0140***	-0.0140*
	(0.00303)	(0.00667)	(0.00286)	(0.00682)
Constant	2.140***	2.140***	2.939***	2.939***
	(0.192)	(0.517)	(0.186)	(0.560)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	Yes	Yes
Clustered standard errors	No	Yes	No	Yes
N	1868	1868	1868	1868
R^2	0.077	0.077	0.217	0.217
adj. R^2	-0.005	0.076	0.141	0.211

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Nonlinear regressions on a global scale

One group which stands out in the dataset is Africa, which shows statistical significance for all nonlinear regressions tested and with higher regression coefficients and R^2 value than any other group in the dataset. Deriving the maximum point of regression 5 and 6 gives an assumed positive relationship between GDP per capita and HPI up until a GDP per capita of 3904 US$. For regression 7 and 8, the same calculation shows a positive relationship up until a GDP per capita of 2984.9 US$.

6.3.3 Local Regression

Using the statistics software STATA, it is possible to plot not only a linear and a nonlinear regression, but also a *local* regression, providing a more accurate depiction of the relationship between HPI and GDP per capita. The figure above shows that up until approximately ln 8 GDP per capita there is a positive relationship between GDP per capita and HPI. Ln 8 GDP per capita gives a GDP per capita of 2981 US$, which is in between the numbers estimated in the regression models calculated above.

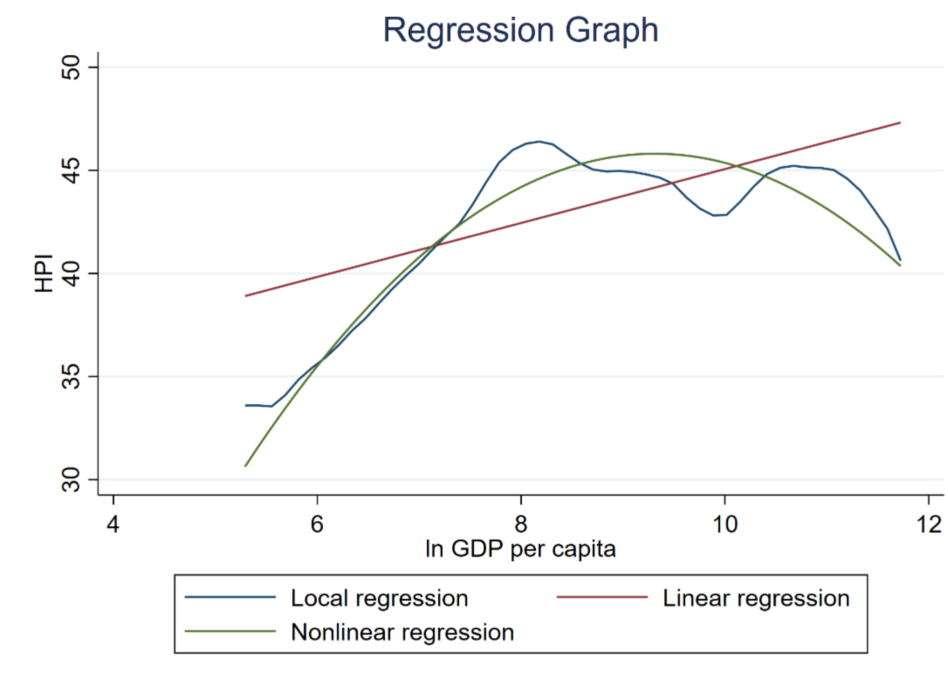

Figure 5: Linear, nonlinear and local regressions on a global scale

7. Concluding discussion

To answer the research question presented in the introduction; the results of this study show that GDP per capita has a somewhat predictive power over a country's sustainable wellbeing as measured by the HPI. As concluded by previous studies, this study also shows that the relationship between HPI and GDP per capita is not consistent across all different regions or income levels. The critiques of GDP per capita as a measure which does not capture wellbeing or environmental sustainability seem to be accurate when a country reaches a certain level of GDP per capita. As was assumed in section 2 *Background* there was proven to be nonlinear relationship between HPI and GDP per capita. This relationship is estimated to be positive up until a GDP per capita somewhere between approximately US$1600 and US$3900. In the dataset used in this study, 90 out of 151 countries had a GDP per capita above 3900 in 2019. A list of these countries can be found in Appendix 8. While economic growth and sustainable wellbeing in itself is not a contradiction, the Ecological Footprint tends to be the element which causes the positive relationship between HPI and GDP per capita to fail, as a high number in the denominator (high Ecological Footprint) brings down the score of the HPI.

This finding is important for policy implication and highlights the need for pluralism in economics. We need not discard the measure of economic growth entirely but keep it in mind along with the measure of sustainable wellbeing. Because while the need for economic growth in low- and lower middle income countries especially should not be understated, it should be remembered that there are more ways in which the success of a country can and should be evaluated. Because while the measure economic growth was never intended to be an indicator of the overall welfare of a country, it has often come to be used as such. Furthermore, the measure of economic growth evolved in an era where the challenges facing society are very different than those today. At the time when Kuznets developed the measure of economic growth, there was a need to maximize wartime production, for which the measure economic growth expressed in a single number proved immensely useful in evaluating the success of economic policies (O'Neill, 2014). Today however, there is rather a pressing need of a sustainable development to ensure the wellbeing of all people within the planetary boundaries to not jeopardize the wellbeing of future generations. This calls for another measure, such as the HPI, to complement GDP as guiding indicator in policymaking for a sustainable economy and for development in a more sustainable direction.

What such pluralism in economics would look like in practice remains to be studied. As seen from there result from this study however, there is reason for 90 countries in this dataset to implement such a pluralism approach to ensure a development in a more sustainable direction.

What a sustainable economy which is not based on GDP growth could mean in a Swedish context has been illustrated in the research project "Beyond GDP Growth: Scenarios for sustainable building and planning" (Hagbert et al, 2018). Collaborative economy, local self-sufficiency, automation for quality of life and circular economy in the welfare state are presented as four alternatives to organizing societies and the economy which goes beyond the current economic logic

(Hagbert et al, 2018). A similar report of what a sustainable economy that is not based on GDP growth could mean in an international context remains to be researched.

Furthermore, if the HPI were to be reported on as frequently as GDP per capita, the narrative of what is considered desirable would likely shift and become more in line with the ideas of degrowth and post-growth. This could have implications on geopolitical structures and lead to an ideological shift where countries with the highest GDP per capita are no longer considered the most successful ore developed.

Lastly, it must be mentioned that the HPI, just as GDP, has its limitations. It is a composite indicator based on one element of a subjective measure. Nevertheless, the comparison of the measures HPI and GDP per capita opens up to further discussions around the impact of the measure used to determine success and development. It shows that there is a need for further research on the use of the HPI as a guiding indicator of sustainable wellbeing in decision making. The study shows that different times call for different measures and that there is a need to broaden the definition and understanding of what is meant by a country's success and development.

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Appendix

Appendix 1

Countries

Afghanistan	Egypt	Luxembourg	Singapore
Albania	El Salvador	Madagascar	Slovakia
Algeria	Estonia	Malawi	Slovenia
Argentina	Eswatini	Malaysia	South Africa
Armenia	Ethiopia	Mali	South Korea
Australia	Finland	Malta	Spain
Austria	France	Mauritania	Sri Lanka
Azerbaijan	Gabon	Mauritius	Sudan
Bahrain	Georgia	Mexico	Sweden
Bangladesh	Germany	Moldova	Switzerland
Belarus	Ghana	Mongolia	Taiwan
Belgium	Greece	Montenegro	Tajikistan
Benin	Guatemala	Morocco	Tanzania
Bhutan	Guinea	Mozambique	Thailand
Bolivia	Haiti	Myanmar	Togo
Bosnia and Herzegovina	Honduras	Namibia	Trinidad and Tobago
Botswana	Hong Kong	Nepal	Tunisia
Brazil	Hungary	Netherlands	Turkey
Bulgaria	Iceland	New Zealand	Turkmenistan
Burkina Faso	India	Nicaragua	Uganda
Burundi	Indonesia	Niger	Ukraine
Cambodia	Iran	Nigeria	United Arab Emirates
Cameroon	Iraq	North Macedonia	United Kingdom
Canada	Ireland	Norway	United States of America
Central African Republic	Israel	Pakistan	Uruguay
Chad	Italy	Palestine, State of	Uzbekistan
Chile	Jamaica	Panama	Vanuatu
China	Japan	Paraguay	Venezuela
Colombia	Jordan	Peru	Vietnam
Comoros	Kazakhstan	Philippines	Yemen
Congo (Brazzaville)	Kenya	Poland	Zambia
Congo (Kinshasa)	Kuwait	Portugal	Zimbabwe
Costa Rica	Kyrgyzstan	Qatar	
Cote d'Ivoire	Laos	Romania	

Croatia	Latvia	Russia
Cyprus	Lebanon	Rwanda
Czech Republic	Lesotho	Saudi Arabia
Denmark	Liberia	Senegal
Dominican Republic	Libya	Serbia

Appendix 2

High Income Countrues
Australia
Austria
Bahrain
Belgium
Canada
Chile
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hong Kong SAR, China
Hungary
Iceland
Ireland
Israel
Italy
Japan
Korea, Rep.
Kuwait
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Netherlands
New Zealand
Norway
Panama
Poland
Portugal
Qatar
Romania
Saudi Arabia
Singapore
Slovak Republic
Slovenia
Spain
Sweden
Switzerland
Trinidad and Tobago
United Arab Emirates
United Kingdom
United States
Uruguay

Upper middle income countries
Albania
Argentina
Armenia
Azerbaijan
Belarus
Bosnia and Herzegovina
Botswana
Brazil
Bulgaria
China
Colombia
Costa Rica
Dominican Republic
Ecuador
Gabon
Georgia
Guatemala
Iraq
Jamaica
Jordan
Kazakhstan
Libya
Malaysia
Mauritius
Mexico
Moldova
Montenegro
Namibia
North Macedonia
Paraguay
Peru
Russian Federation
Serbia
South Africa
Thailand
Turkiye
Turkmenistan

Lower Middle Income Cuntries
Algeria
Bangladesh
Benin
Bhutan
Bolivia
Cambodia
Cameroon
Comoros

Congo, Rep.
Cote d'Ivoire
Egypt, Arab Rep.
El Salvador
Eswatini
Ghana
Haiti
Honduras
India
Indonesia
Iran, Islamic Rep.
Kenya
Kyrgyz Republic
Lao PDR
Lebanon
Lesotho
Mauritania
Mongolia
Morocco
Myanmar
Nepal
Nicaragua
Nigeria
Pakistan
Philippines
Senegal
Sri Lanka
Tajikistan
Tanzania
Tunisia
Ukraine
Uzbekistan
Vanuatu
Vietnam
West Bank and Gaza
Zimbabwe

Low income countries
Afghanistan
Burkina Faso
Burundi
Central African Republic
Chad
Congo, Dem. Rep.
Ethiopia
Guinea
Liberia
Madagascar
Malawi
Mali
Mozambique
Niger
Rwanda
Sierra Leone

Sudan
Togo
Uganda
Yemen, Rep.
Zambia

Appendix 3

Latin America
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Dominican Republic
Ecuador
El Salvador
Guatemala
Haiti
Honduras
Jamaica
Mexico
Nicaragua
Panama
Paraguay
Peru
Trinidad and Tobago
Uruguay
Venezuela, RB

N. America & Oceania
Australia
Canada
New Zealand
United States

Western Europe
Austria
Belgium
Cyprus
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Ireland
Italy
Luxembourg
Malta
Netherlands
Norway
Portugal
Spain
Sweden
Switzerland

United Kingdom

The Middle East
Algeria
Bahrain
Egypt, Arab Rep.
Iran, Islamic Rep.
Iraq
Israel
Jordan
Kuwait
Lebanon
Libya
Morocco
Qatar
Saudi Arabia
Tunisia
Turkiye
United Arab Emirates
West Bank and Gaza
Yemen, Rep.

Africa
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Central African Republic
Chad
Comoros
Congo, Dem. Rep.
Congo, Rep.
Cote d'Ivoire
Eswatini
Ethiopia
Gabon
Ghana
Guinea
Kenya
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritania
Mauritius
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Sierra Leone

South Africa
Sudan
Tanzania
Togo
Uganda
Zambia
Zimbabwe

South Asia
Afghanistan
Bangladesh
Bhutan
India
Nepal
Pakistan
Sri Lanka

Eastern Europe & Central Asia
Albania
Armenia
Azerbaijan
Belarus
Bosnia and Herzegovina
Bulgaria
Croatia
Czechia
Estonia
Georgia
Hungary
Kazakhstan
Kyrgyz Republic
Latvia
Lithuania
Moldova
Montenegro
Montenegro
North Macedonia
Poland
Romania
Russian Federation
Serbia
Slovak Republic
Slovenia
Tajikistan
Turkmenistan
Ukraine
Uzbekistan

East Asia
Cambodia
China
Hong Kong SAR, China
Indonesia
Japan
Korea, Rep.
Lao PDR
Malaysia
Mongolia
Myanmar
Philippines
Singapore
Thailand
Vanuatu
Vietnam

Appendix 4

Hausman Test

xtreg ln_HPI ln_GDPperCapita, fe
estimates store fixed
xtreg ln_HPI ln_GDPperCapita, re
estimates store random
hausman fixed random
asdoc hausman fixed random

```
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference       Std. err.
-------------+----------------------------------------------------------------
ln_GDPperC~a |   .0785727     .0622225        .0163502        .0042481
------------------------------------------------------------------------------
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  14.81
Prob > chi2 = 0.0001
```

Hausman (1978) specification test

	Coef.
Chi-square test value	14.814
P-value	0

Appendix 5

Pairwise correlation (Globally)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.992	1.000					
(3) Life expectancy	0.558	0.574	1.000				
(4) Wellbeing	0.520	0.511	0.732	1.000			
(5) Footprint (gha)	-0.164	-0.167	0.592	0.676	1.000		
(6) GDP per capita	0.079	0.078	0.618	0.720	0.792	1.000	
(7) ln GDP per Cap~a	0.243	0.249	0.818	0.814	0.806	0.819	1.000

Pairwise correlations (Latin America)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.994	1.000					
(3) Life expectancy	0.641	0.634	1.000				
(4) Wellbeing	0.643	0.611	0.696	1.000			
(5) Footprint (gha)	-0.374	-0.415	0.201	0.413	1.000		
(6) GDP per capita	0.048	0.014	0.527	0.579	0.718	1.000	
(7) ln GDP per Cap~a	0.235	0.211	0.690	0.683	0.620	0.934	1.000

Pairwise correlations (North America & Oceania)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.998	1.000					
(3) Life expectancy	0.496	0.531	1.000				
(4) Wellbeing	0.261	0.282	0.379	1.000			
(5) Footprint (gha)	-0.971	-0.967	-0.380	-0.052	1.000		
(6) GDP per capita	-0.509	-0.505	0.008	-0.357	0.407	1.000	
(7) ln GDP per Cap~a	-0.530	-0.528	0.014	-0.337	0.437	0.990	1.000

Pairwise correlations (Western Europe)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.992	1.000					
(3) Life expectancy	0.375	0.320	1.000				
(4) Wellbeing	0.175	0.142	0.030	1.000			
(5) Footprint (gha)	-0.794	-0.836	-0.248	0.402	1.000		
(6) GDP per capita	-0.277	-0.348	0.115	0.642	0.701	1.000	
(7) ln GDP per Cap~a	-0.137	-0.199	0.101	0.789	0.617	0.961	1.000

Pairwise correlations (Middle East)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.993	1.000					
(3) Life expectancy	-0.064	-0.101	1.000				
(4) Wellbeing	-0.228	-0.258	0.639	1.000			
(5) Footprint (gha)	-0.793	-0.830	0.531	0.720	1.000		
(6) GDP per capita	-0.637	-0.678	0.549	0.745	0.918	1.000	
(7) ln GDP per Cap~a	-0.573	-0.594	0.671	0.854	0.880	0.891	1.000

Pairwise correlations (Africa)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.994	1.000					
(3) Life expectancy	0.678	0.679	1.000				
(4) Wellbeing	0.600	0.591	0.108	1.000			
(5) Footprint (gha)	-0.119	-0.125	0.238	0.338	1.000		
(6) GDP per capita	0.094	0.083	0.354	0.357	0.811	1.000	
(7) ln GDP per Cap~a	0.143	0.141	0.317	0.410	0.756	0.899	1.000

Pairwise correlations (South Asia)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.997	1.000					
(3) Life expectancy	0.354	0.361	1.000				
(4) Wellbeing	0.723	0.722	0.069	1.000			
(5) Footprint (gha)	-0.342	-0.336	0.213	0.198	1.000		
(6) GDP per capita	0.060	0.074	0.768	0.050	0.530	1.000	
(7) ln GDP per Cap~a	0.162	0.175	0.773	0.170	0.542	0.944	1.000

Pairwise correlations (Eastern Europe & central Asia)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.996	1.000					
(3) Life expectancy	0.184	0.213	1.000				
(4) Wellbeing	0.154	0.144	0.293	1.000			
(5) Footprint (gha)	-0.719	-0.721	0.251	0.519	1.000		
(6) GDP per capita	-0.316	-0.302	0.625	0.572	0.758	1.000	
(7) ln GDP per Cap~a	-0.436	-0.420	0.620	0.479	0.790	0.904	1.000

Pairwise correlations (East Asia)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.991	1.000					
(3) Life expectancy	0.101	0.129	1.000				
(4) Wellbeing	0.392	0.367	0.605	1.000			
(5) Footprint (gha)	-0.626	-0.639	0.618	0.428	1.000		
(6) GDP per capita	-0.107	-0.069	0.852	0.530	0.673	1.000	
(7) ln GDP per Cap~a	-0.080	-0.052	0.938	0.646	0.739	0.898	1.000

Pairwise correlations (high income countries)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.993	1.000					
(3) Life expectancy	0.465	0.461	1.000				
(4) Wellbeing	0.345	0.324	0.439	1.000			
(5) Footprint (gha)	-0.741	-0.771	-0.031	0.305	1.000		
(6) GDP per capita	-0.030	-0.059	0.537	0.651	0.547	1.000	
(7) ln GDP per Cap~a	0.005	-0.011	0.643	0.685	0.520	0.938	1.000

Pairwise correlations (upper middle income countries)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.994	1.000					
(3) Life expectancy	0.654	0.691	1.000				
(4) Wellbeing	0.698	0.669	0.387	1.000			
(5) Footprint (gha)	-0.582	-0.592	-0.086	0.086	1.000		
(6) GDP per capita	-0.068	-0.089	0.116	0.360	0.495	1.000	
(7) ln GDP per Cap~a	-0.091	-0.115	0.109	0.331	0.490	0.965	1.000

Pairwise correlations (lower middle income countries)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.993	1.000					
(3) Life expectancy	0.687	0.693	1.000				
(4) Wellbeing	0.682	0.655	0.415	1.000			
(5) Footprint (gha)	-0.278	-0.302	0.256	0.245	1.000		
(6) GDP per capita	0.109	0.114	0.456	0.277	0.498	1.000	
(7) ln GDP per Cap~a	0.150	0.154	0.444	0.343	0.480	0.927	1.000

Pairwise correlations (low income countries)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) HPI	1.000						
(2) ln HPI	0.996	1.000					
(3) Life expectancy	0.720	0.724	1.000				
(4) Wellbeing	0.565	0.562	-0.101	1.000			
(5) Footprint (gha)	-0.377	-0.373	-0.289	0.157	1.000		
(6) GDP per capita	0.283	0.273	0.307	0.215	0.182	1.000	
(7) ln GDP per Cap~a	0.276	0.266	0.315	0.235	0.259	0.930	1.000

Appendix 6

Linear regression (High income countries)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.0590***	0.0590**	-0.0396*	-0.0396
	(0.0159)	(0.0194)	(0.0158)	(0.0210)
_cons	3.162***	3.162***	4.094***	4.094***
	(0.165)	(0.201)	(0.160)	(0.214)
N	592	592	592	592
R^2	0.025	0.025	0.373	0.373
adj. R^2	-0.062	0.023	0.301	0.357

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Upper middle income countries)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.0629***	0.0629***	-0.0259	-0.0259
	(0.0120)	(0.0169)	(0.0184)	(0.0283)
_cons	3.256***	3.256***	3.964***	3.964***
	(0.105)	(0.148)	(0.151)	(0.229)
N	477	477	477	477
R^2	0.059	0.059	0.221	0.221
adj. R^2	-0.021	0.057	0.130	0.198

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Lower middle income countries)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.0681***	0.0681	-0.00483	-0.00483
	(0.0118)	(0.0347)	(0.0188)	(0.0550)
_cons	3.242***	3.242***	3.720***	3.720***
	(0.0888)	(0.261)	(0.132)	(0.393)
N	536	536	536	536
R^2	0.064	0.064	0.139	0.139
adj. R^2	-0.020	0.062	0.036	0.116

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Low income countries)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.185***	0.185***	0.108**	0.108
	(0.0288)	(0.0472)	(0.0359)	(0.0545)
_cons	2.372***	2.372***	2.763***	2.763***
	(0.186)	(0.304)	(0.218)	(0.328)
N	254	254	254	254
R^2	0.151	0.151	0.318	0.318
adj. R^2	0.074	0.147	0.212	0.278

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Latin America)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.0864***	0.0864***	0.0571*	0.0571
	(0.0130)	(0.0201)	(0.0247)	(0.0317)
_cons	3.199***	3.199***	3.428***	3.428***
	(0.112)	(0.173)	(0.201)	(0.254)
N	266	266	266	266
R^2	0.153	0.153	0.286	0.286
adj. R^2	0.080	0.150	0.181	0.246

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (North America & Oceania)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.141**	0.141*	0.0449	0.0449
	(0.0452)	(0.0358)	(0.0703)	(0.160)
_cons	2.245***	2.245*	3.212***	3.212
	(0.487)	(0.386)	(0.740)	(1.679)
N	54	54	54	54
R^2	0.166	0.166	0.518	0.518
adj. R^2	0.098	0.150	0.291	0.345

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Western Europe)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	-0.0376	-0.0376	-0.0366	-0.0366
	(0.0293)	(0.0372)	(0.0244)	(0.0352)
_cons	4.246***	4.246***	4.158***	4.158***
	(0.314)	(0.398)	(0.257)	(0.369)
N	250	250	250	250
R^2	0.007	0.007	0.593	0.593
adj. R^2	-0.080	0.003	0.531	0.569

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (The Middle East)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.0168	0.0168	0.0167	0.0167
	(0.0240)	(0.0256)	(0.0311)	(0.0226)
_cons	3.588***	3.588***	3.521***	3.521***
	(0.217)	(0.232)	(0.274)	(0.192)
N	214	214	214	214
R^2	0.002	0.002	0.085	0.085
adj. R^2	-0.090	-0.002	-0.070	0.021

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Africa)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.202***	0.202***	0.0903***	0.0903
	(0.0210)	(0.0453)	(0.0247)	(0.0665)
_cons	2.146***	2.146***	2.820***	2.820***
	(0.147)	(0.318)	(0.165)	(0.447)
N	444	444	444	444
R^2	0.186	0.186	0.429	0.429
adj. R^2	0.109	0.184	0.355	0.411

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (South Asia)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	-0.0179	-0.0179	0.139*	0.139
	(0.0246)	(0.0382)	(0.0589)	(0.0939)
_cons	3.950***	3.950***	2.951***	2.951**
	(0.174)	(0.270)	(0.377)	(0.587)
N	85	85	85	85
R^2	0.007	0.007	0.212	0.212
adj. R^2	-0.083	-0.005	-0.034	0.055

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (Eastern Europe & Central Asia)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.101***	0.101***	-0.0164	-0.0164
	(0.0149)	(0.0164)	(0.0188)	(0.0299)
_cons	2.848***	2.848***	3.803***	3.803***
	(0.131)	(0.144)	(0.156)	(0.245)
N	379	379	379	379
R^2	0.116	0.116	0.447	0.447
adj. R^2	0.046	0.114	0.380	0.426

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Linear regression (East Asia)

	Dependent variable			
	(1)	(2)	(3)	(4)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.00942	0.00942	-0.0615*	-0.0615
	(0.0123)	(0.0334)	(0.0254)	(0.0561)
_cons	3.700***	3.700***	4.234***	4.234***
	(0.106)	(0.288)	(0.204)	(0.461)
N	176	176	176	176
R^2	0.004	0.004	0.146	0.146
adj. R^2	-0.090	-0.002	-0.016	0.072

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 7

Nonlinear regression (High income countries)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.108	0.108	-0.278	-0.278
	(0.241)	(0.237)	(0.199)	(0.211)
lnGDPpc2	-0.00242	-0.00242	0.0118	0.0118
	(0.0119)	(0.0119)	(0.00986)	(0.0107)
_cons	2.916*	2.916*	5.287***	5.287***
	(1.219)	(1.176)	(1.006)	(1.047)
N	592	592	592	592
R^2	0.025	0.025	0.374	0.374
adj. R^2	-0.064	0.021	0.301	0.358

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Upper middle income countries)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.636**	0.636**	0.315	0.315
	(0.230)	(0.186)	(0.224)	(0.260)
lnGDPpc2	-0.0335*	-0.0335**	-0.0197	-0.0197
	(0.0134)	(0.0110)	(0.0129)	(0.0151)
_cons	0.804	0.804	2.502*	2.502*
	(0.987)	(0.795)	(0.971)	(1.119)
N	477	477	477	477
R^2	0.072	0.072	0.226	0.226
adj. R^2	-0.009	0.068	0.133	0.200

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Lower middle income countries)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.789***	0.789	0.616***	0.616
	(0.155)	(0.401)	(0.157)	(0.490)
lnGDPpc2	-0.0494***	-0.0494	-0.0421***	-0.0421
	(0.0106)	(0.0263)	(0.0106)	(0.0312)
_cons	0.632	0.632	1.460*	1.460
	(0.566)	(1.530)	(0.582)	(1.904)
N	536	536	536	536
R^2	0.104	0.104	0.167	0.167
adj. R^2	0.021	0.100	0.066	0.143

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Low income countries)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	1.011*	1.011	-0.109	-0.109
	(0.482)	(0.775)	(0.483)	(0.640)
lnGDPpc2	-0.0640	-0.0640	0.0165	0.0165
	(0.0373)	(0.0601)	(0.0369)	(0.0473)
_cons	-0.283	-0.283	3.463*	3.463
	(1.559)	(2.494)	(1.576)	(2.146)
N	254	254	254	254
R^2	0.161	0.161	0.318	0.318
adj. R^2	0.082	0.155	0.209	0.275

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Latin America)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCa pita	0.738***	0.738*	0.678***	0.678
	(0.163)	(0.295)	(0.165)	(0.326)
lnGDPpc2	-0.0381***	-0.0381*	-0.0353***	-0.0353
	(0.00951)	(0.0166)	(0.00927)	(0.0178)
_cons	0.442	0.442	0.737	0.737
	(0.696)	(1.303)	(0.733)	(1.476)
N	266	266	266	266
R^2	0.205	0.205	0.328	0.328
adj. R^2	0.134	0.199	0.226	0.288

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Nort America and Oceania)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCa pita	2.524	2.524*	1.166	1.166
	(2.241)	(0.744)	(2.163)	(1.801)
lnGDPpc2	-0.111	-0.111*	-0.0522	-0.0522
	(0.105)	(0.0348)	(0.101)	(0.0881)
_cons	-10.50	-10.50	-2.802	-2.802
	(12.00)	(3.978)	(11.61)	(9.249)
N	54	54	54	54
R^2	0.185	0.185	0.522	0.522
adj. R^2	0.100	0.153	0.276	0.333

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Western Europe)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	-0.691	-0.691	0.729	0.729*
	(0.650)	(0.817)	(0.442)	(0.273)
lnGDPpc2	0.0308	0.0308	-0.0361	-0.0361*
	(0.0306)	(0.0388)	(0.0208)	(0.0135)
_cons	7.709*	7.709	0.104	0.104
	(3.454)	(4.303)	(2.352)	(1.386)
N	250	250	250	250
R^2	0.012	0.012	0.599	0.599
adj. R^2	-0.080	0.004	0.535	0.573

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (The Middle East)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	-0.242	-0.242	-0.314	-0.314
	(0.179)	(0.175)	(0.183)	(0.178)
lnGDPpc2	0.0149	0.0149	0.0193	0.0193
	(0.0102)	(0.0101)	(0.0105)	(0.0108)
_cons	4.691***	4.691***	4.915***	4.915***
	(0.788)	(0.770)	(0.808)	(0.730)
N	214	214	214	214
R^2	0.013	0.013	0.102	0.102
adj. R^2	-0.083	0.004	-0.057	0.034

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Africa)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	1.128^{***}	1.128^{**}	0.713^{***}	0.713^{*}
	(0.212)	(0.349)	(0.189)	(0.318)
lnGDPpc2	-0.0682^{***}	-0.0682^{*}	-0.0456^{***}	-0.0456^{*}
	(0.0155)	(0.0253)	(0.0137)	(0.0210)
_cons	-0.942	-0.942	0.741	0.741
	(0.717)	(1.203)	(0.647)	(1.195)
N	444	444	444	444
R^2	0.223	0.223	0.445	0.445
adj. R^2	0.148	0.219	0.371	0.426

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (South Asia)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.427	0.427	0.439	0.439
	(0.340)	(0.260)	(0.349)	(0.297)
lnGDPpc2	-0.0316	-0.0316	-0.0215	-0.0215
	(0.0241)	(0.0200)	(0.0246)	(0.0207)
_cons	2.398^{*}	2.398^{*}	1.912	1.912
	(1.195)	(0.843)	(1.247)	(1.112)
N	85	85	85	85
R^2	0.029	0.029	0.222	0.222
adj. R^2	-0.073	0.005	-0.038	0.052

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (Eastern Europe and Central Asia)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	0.211	0.211*	0.213	0.213
	(0.129)	(0.0930)	(0.108)	(0.118)
lnGDPpc2	-0.00674	-0.00674	-0.0144*	-0.0144
	(0.00786)	(0.00648)	(0.00669)	(0.00721)
_cons	2.405***	2.405***	2.910***	2.910***
	(0.532)	(0.318)	(0.444)	(0.498)
N	379	379	379	379
R^2	0.118	0.118	0.455	0.455
adj. R^2	0.045	0.114	0.386	0.432

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Nonlinear regression (East Asia)

	Dependent variable			
	(5)	(6)	(7)	(8)
	ln_HPI	ln_HPI	ln_HPI	ln_HPI
ln_GDPperCapita	-0.186	-0.186	-0.163	-0.163
	(0.106)	(0.252)	(0.104)	(0.238)
lnGDPpc2	0.0123	0.0123	0.00687	0.00687
	(0.00660)	(0.0143)	(0.00683)	(0.0135)
_cons	4.448***	4.448**	4.594***	4.594***
	(0.417)	(1.092)	(0.412)	(1.047)
N	176	176	176	176
R^2	0.025	0.025	0.152	0.152
adj. R^2	-0.073	0.014	-0.016	0.073

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 8

STATA command: asdoc list CountryName if GDPperCapita > 3900 & Year == 2019

	CountryName
1.	Albania
2.	Algeria
3.	Argentina
4.	Armenia
5.	Australia
6.	Austria
7.	Azerbaijan
8.	Bahrain
9.	Belarus
10.	Belgium
11.	Bosnia and Herzegovina
12.	Botswana
13.	Brazil
14.	Bulgaria
15.	Canada
16.	Chile
17.	China
18.	Colombia
19.	Costa Rica
20.	Croatia
21.	Cyprus
22.	Czechia
23.	Denmark
24.	Dominican Republic
25.	Ecuador
26.	El Salvador
27.	Estonia
28.	Finland
29.	France
30.	Gabon
31.	Georgia
32.	Germany
33.	Greece
34.	Guatemala
35.	Hong Kong SAR, China
36.	Hungary
37.	Iceland
38.	Indonesia
39.	Iraq
40.	Ireland
41.	Israel
42.	Italy
43.	Jamaica
44.	Japan
45.	Jordan
46.	Kazakhstan

47. Korea, Rep.
48. Kuwait
49. Latvia
50. Lebanon
51. Libya
52. Lithuania
53. Luxembourg
54. Malaysia
55. Malta
56. Mauritius
57. Mexico
58. Moldova
59. Mongolia
60. Montenegro
61. Namibia
62. Netherlands
63. New Zealand
64. North Macedonia
65. Norway
66. Panama
67. Paraguay
68. Peru
69. Poland
70. Portugal
71. Qatar
72. Romania
73. Russian Federation
74. Saudi Arabia
75. Serbia
76. Singapore
77. Slovak Republic
78. Slovenia
79. South Africa
80. Spain
81. Sweden
82. Switzerland
83. Thailand
84. Trinidad and Tobago
85. Turkiye
86. Turkmenistan
87. United Arab Emirates
88. United Kingdom
89. United States
90. Uruguay