Introduction To Data Science
Group Assignment

Measuring progress towards the UN Sustainable Development Goal 8: Decent work and economic growth

Chelsea 2
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1. Introduction

The Sustainable Development Goals (SDGs) are 17 different goals set out by the United Nations as an urgent call for action through combined partnership of developing and developed countries into the future. **Sustainable development goal 8** states "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all." Two sub-targets formed the main focus of this report:

Sustainable development goal target 8.1: Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries.

Sustainable development goal target 8.6: By 2020, substantially reduce the proportion of youth not in employment, education or training (NEET).

The objective of this report is to assess the performance of the populated continents in accordance with the two sub-targets of SDG 8 presented above. Exploratory data analysis using the programming language R was used to identify trends between continents and countries following the 7% GDP growth as well as to identify the key indicators between countries linking their NEET trends. Grouped, weighted and normalised indices and a range of data frames were used to produce various data visualisation methods presenting a wide spread of results which would be later discussed in this report.

2. Methodology

2.1 Definition of key terms

2.1.1. Least-Developed Countries (LDCs): Countries that were identified by the UN to be a 'Least-Developed Country'.

2.1.2. Growth: In SDG 8.1, 'growth' is used twice when referring to economic growth and GDP growth. Both definitions can be taken to mean the same. Growth assesses the upward increase of a given variable. When comparing growth between LDCs and non-LDCs, the 7% per annum benchmark was used as a key indicator for positive growth for the former. Comparing this against lower benchmarks for the latter would help provide the growth comparisons.

2.1.3. NEET: Youth (aged 15-24 years) not in education, employment or training. The NEET rate is mainly calculated as the percentage of this group relative to the total youth population.

2.1.4. Sustain/ Substantially Reduce: These words form key frames for the sub-targets identified by SDG 8. Placing a numerical value on these targets proves to be a difficult task due to the disparities being not only within LDCs and non LDCs but also within these groups individually. 'Sustain' can be identified to be 'consistently and continuously over a period of time'. For the purpose of this research paper, 'substantially reduce' is defined as a decrease in normalised NEET by 2%.

2.2 Derivation and Justification of formula

2.2.1. Average GDP per Capita growth: To analyse economic growth, the average GDP Growth was calculated where each year *t*.

$$\boldsymbol{GDP\ Growth} = \frac{GDP\ per\ Capita_t - GDP\ per\ Capita_{t-1}}{GDP\ per\ Capita_{t-1}} \times 100\%$$

2.2.2. Weighted NEET: To obtain a continent-level measure of NEET that reflects differences in country population sizes, a population-weighted NEET percentage was calculated. For each continent c, country *i, j* and year t, the weighted NEET value is defined as:

$$\boldsymbol{NEET_{c,t}} = \sum_{i\ \epsilon\ c} \left(\frac{Population_{i,t}}{\sum_{j\ \epsilon c} Population_{j,t}} \right)$$

2.2.3. Normalised NEET Change: This metric rescales the absolute change in NEET by dividing it by the baseline level. As a result, the indicator reflects the proportion of initial NEET that was eliminated over the period, facilitating f air comparison across countries regardless of their starting positions. For each country *i* and year *t* (between 2005 - 2020), the normalised NEET change is defined as:

$$\boldsymbol{Normalised\ NEET\ Change} = \frac{\frac{NEET_{i,\min(t)} - NEET_{i,\max(t)}}{\max(t) - \min(t)}}{NEET_{i,\min(t)}}$$

2.3 Data Cleaning

2.3.1. World Population CSV file: The population dataset was obtained from the United Nations and provides population estimates for individuals aged 0–14 and 0–24. This dataset was used to compute population-weighted NEET values for each continent, which helps address missing NEET observations in certain years and produces more reliable aggregate measures. Country names were standardised to ensure consistency with the naming conventions in the primary datasets (e.g., "Viet Nam" was corrected to "Vietnam"). The file also included regional population entries, which were excluded as they do not correspond to individual countries and would be removed automatically during the joining process.

2.3.2. Target 1: The range of years observed for this question was between 1990 and 2020.

2.3.3. Target 2: The range of years observed for this question was between 2005 to 2020. The concept of NEET was only introduced in the United Kingdom in the middle of the 1990s hence, data before 1990 was not considered (Lecerf, 2017). When taking a further look, Oceania was observed to have no NEET data from 2001 to 2003. Thus, a 15-year range was chosen for analysis.

3. Results

3.1 Target 1 (SDG 8.1)

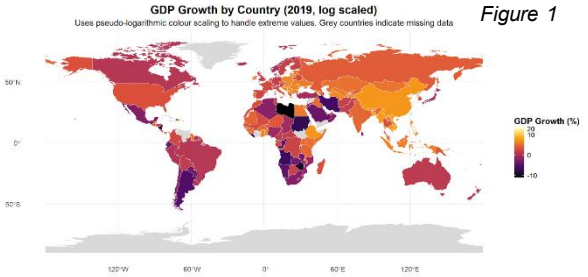


Figure 1

Figure 1 clearly shows that GDP growth is uneven globally in 2019. The year analysed was 2019 due to 2020 being an outlier under Covid where many countries had negative GDP growth. The choropleth indicates that Asian countries had the highest GDP growth out of all of the continents in 2019 and further analysis accentuated this as East Timor (an Asian country) had the highest GDP growth.

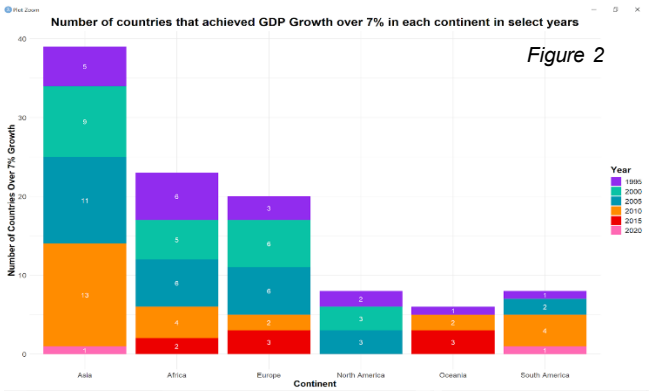


Figure 2

Figure 2 shows how many countries in each continent achieved GDP growth above 7% at five-year intervals. Oceania sees the fewest LDCS achieve the GDP growth target compared to Asia which sees the highest. This shows Asia's large set of rapidly industrialising economies and Africa's episodes of large commodity growth, compared to Oceania's predominantly mature economies. A key limitation of the graph is that it ignores differences in continent size: Africa, Asia, and Europe each have over 40 countries, whereas South America and Oceania have fewer than 15, affecting the comparability of counts.

Figure 3 shows that between 1990 and 2021, mean GDP growth is generally positive worldwide across continents. High GDP growth is seen in Asia in the 2000s which could reflect the expansion of countries like China, India and other Southeast Asian countries. It is clear that 2009 is an outlier, likely to be caused by the global Financial Crisis which affected more developed continents like Europe and North America. For all continents, 2020 is an outlier as mean GDP growth is negative globally, likely to be caused by Covid which affected North America the most.

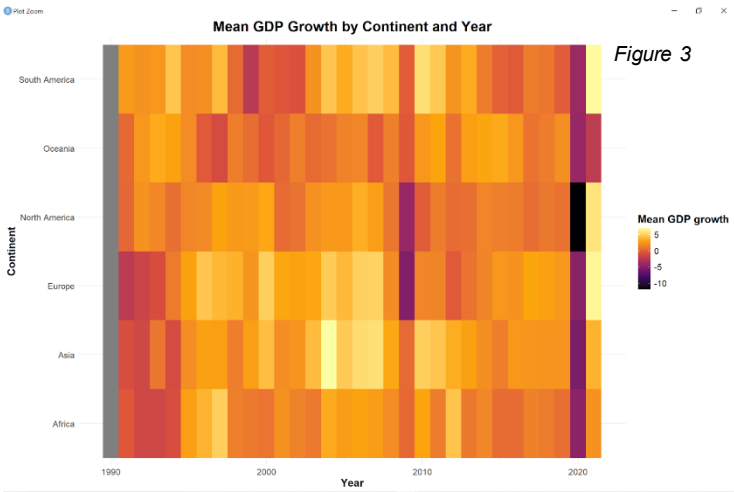


Figure 3

Figure 4 indicates that South America has the widest variation in GDP growth which highlights the existence of both high-growth countries, like Guyana. as well as countries facing economic struggles, like Bolivia, being in the continent. The boxplot shows an extreme outlier for North America where Annual GDP growth was -11.9% in 2020. Outliers can be seen in other continents in 2020 and 2009.

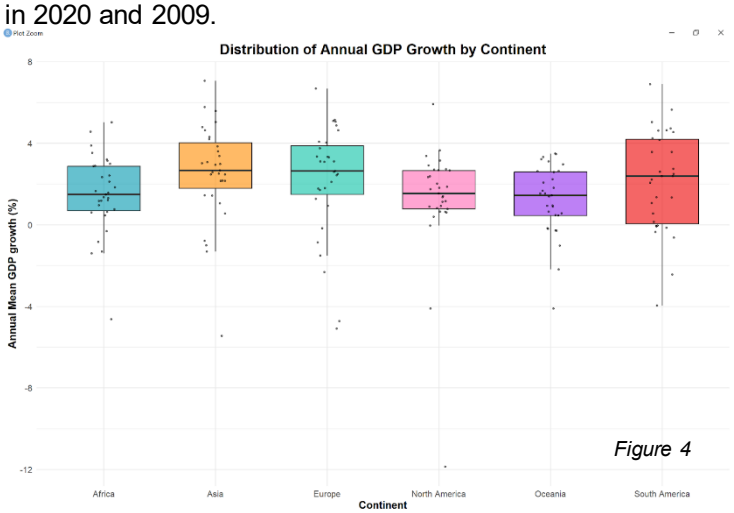


Figure 4

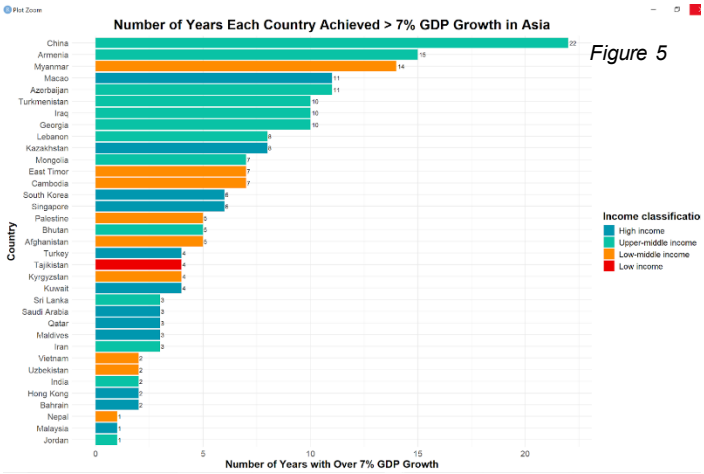


Figure 5

Figure 5 shows that China recorded the most years of >7% GDP growth in Asia, reflecting rapid industrialisation and its large labour force. Other countries such as Armenia and Azerbaijan also experienced multiple strong years of growth for the LDCs, compared to Japan which recorded none. Of the eight UN-classified LDCs in Asia, Bangladesh and Laos have not surpassed 7% growth, likely due to political instability and corruption in Bangladesh, and high debt and reliance on China in Laos, though both have approached 6%. In contrast, several LDCs such as Afghanistan and Cambodia achieved the UN's 7% target several times, whilst Nepal reached it only once. Yemen could not be analysed due to a lack of complete data.

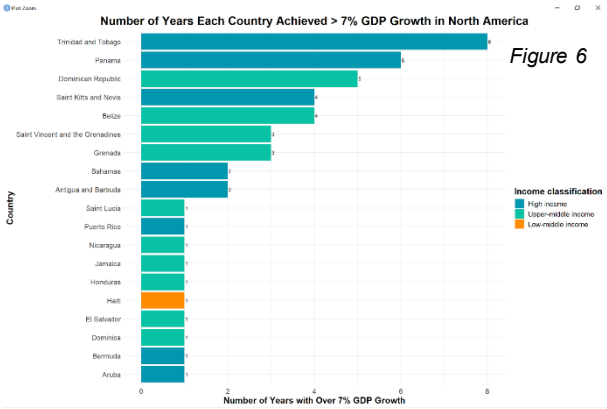


Figure 6

Figure 6 shows that Trinidad and Tobago, Panama, and the Dominican Republic each recorded more than five years of GDP growth above 7%. Trinidad and Tobago's high volatility reflects its dependence on the energy sector and limited diversification. In contrast, highly developed economies such as the USA and Canada show no years above 7%, consistent with their more stable growth patterns. Haiti is the only UN-classified LDC in North America and recorded just one growth year above 7% in 1995, which can be linked to the restoration of democracy after the 1991–1994 coup. Haiti has since not approached this level, reaching only a peak of about 4.2% in 2009. It continues to face major economic challenges including political instability, gang violence, and climate vulnerability.

Figure 7 shows the number of years in which each European country recorded GDP growth greater than 7%. No country exceeded this threshold for more than ten years and only 16 of 42 countries never achieved this. North Macedonia is the only developing country in this zero-growth group; the rest are advanced economies. Overall, the rarity of >7% growth in Europe aligns with expectations, as high-income economies typically grow at only 2–3% annually (Team, 2024).

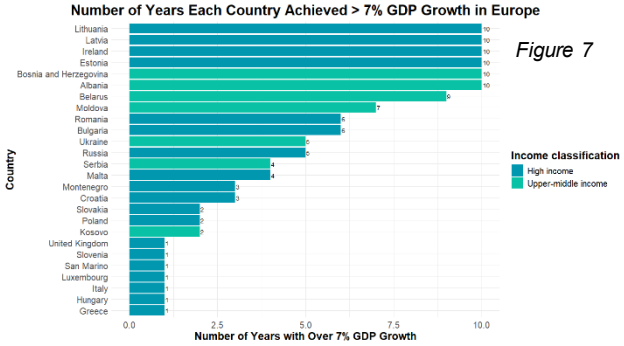


Figure 7

Figure 8 shows the number of years each South American country achieved GDP growth above 7%. Consistent with UN classifications, no South American country is classified as an LDC. Guyana reports the most >7% growth years, reaching the threshold in seven years, driven largely by extraordinary expansion in 2020 and 2021 (44% and 19%) following the start of major offshore oil production. Other countries such as Argentina and Uruguay recorded fewer such years, reflecting more moderate and variable growth over the period.

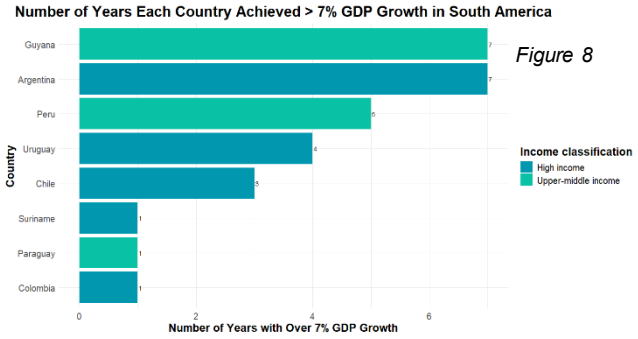


Figure 8

Figure 9 shows the number of years each country in Africa achieved GDP growth over 7%. There are 32 LDCs in Africa according to the UN. Ethiopia is one and has achieved 12 years with GDP growth over 7% which could be due to lots of investment and economic reforms. Several other African countries see LDCs over 7% GDP growth.

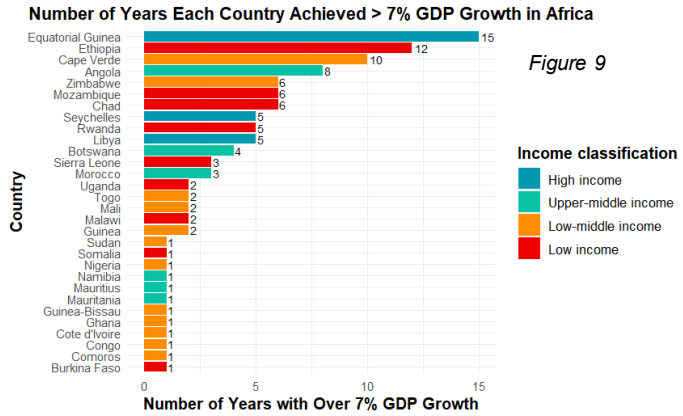


Figure 9

Figure 10 shows the number of years each country in Oceania achieved GDP growth over 7%. There are 3 LDCs in Oceania according to the UN: Solomon Islands, Kiribati and Tuvalu. All 3 have achieved at least one year with GDP growth over 7% with Tuvalu achieving it the most.

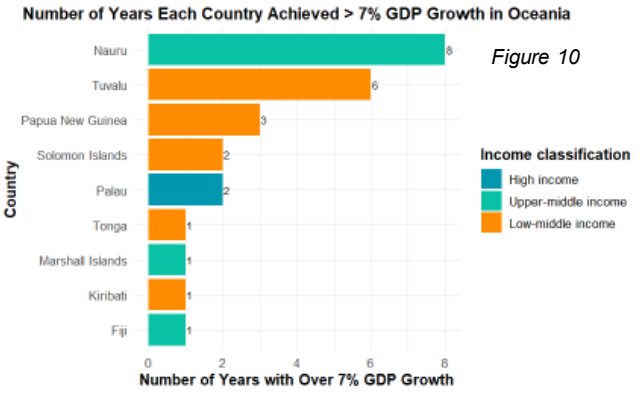


Figure 10

3.2 Target 2 (SDG 8.6)

Figure 11 displays Weighted NEET trends from 2005 to 2020. Apparent spikes in Africa and Oceania in 2007–2008, as well as the sharp decline in Asia between 2005 and 2007, are attributable to missing data rather than genuine shifts. During those years, Oceania's values reflected only New Zealand, Africa had data for just three countries, and Asia saw an increase in reporting countries, lowering its weighted NEET.

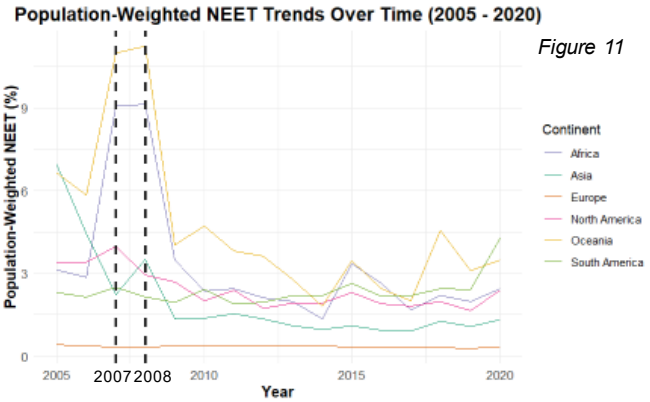


Figure 11

Figure 12 below is a boxplot for all continents in 2015 and 2020. It is observed that for continents Africa, Asia, Oceania and South America experienced an increase in NEET whilst Europe and North America experienced a decrease. However, this does not imply their NEET worsened in these regions as there was a significant amount of missing data which resulted in such discrepancies.

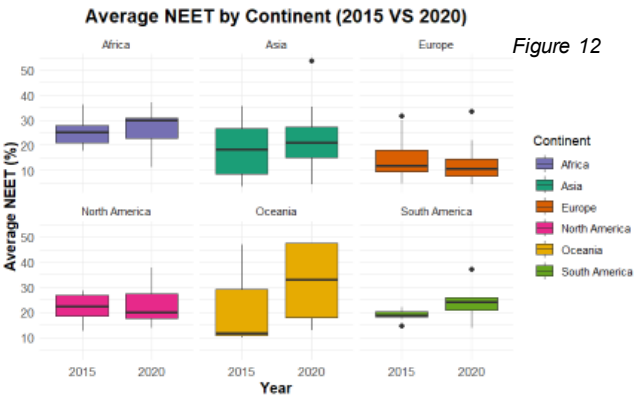


Figure 12

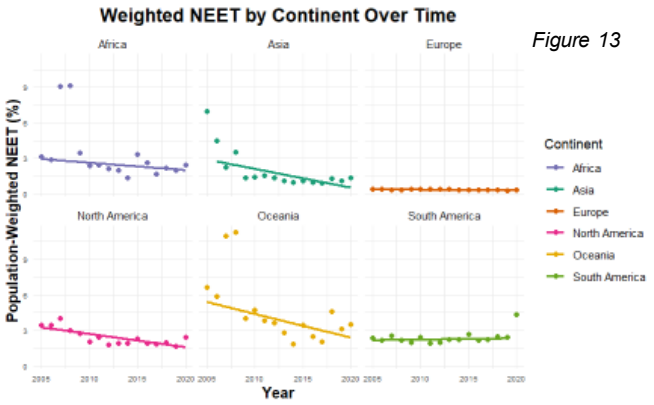


Figure 13

Figure 13 above shows most continents are observed to have a decreasing NEET over time with the exception of Europe which remained relatively flat and South America which increased slightly from 2.31% in 2005 to 2.41% in 2019.

Table 1

Continent	Change in Weighted NEET (2005 to 2020)
Africa	-0.702%
Asia	-5.63%
Europe	-0.0802%
North America	-1.02%
South America	1.97%
Oceania	-3.16%

Table 1 above summarises changes in population-weighted NEET between 2005 and 2020. Asia and Oceania show substantial reductions over this period, while Africa and North America exhibit only modest declines. Europe records a negligible change, and South America is the only continent with an overall increase in weighted NEET.

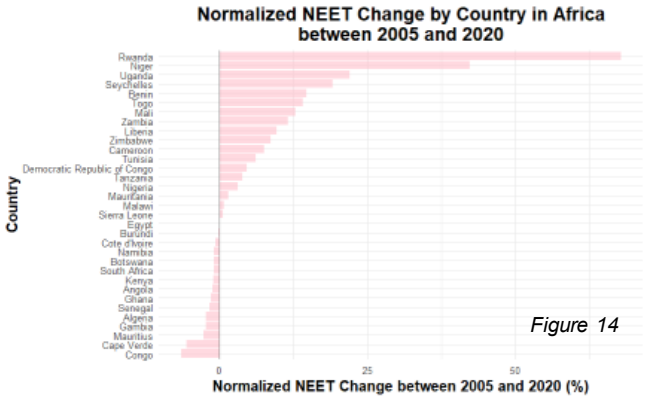


Figure 14

Figure 14 above shows that throughout 2005 to 2020, most of the countries in Africa experienced an increase in normalised NEET. Rwanda led the increase with 68% while Congo led the decrease with -6.3%.

From **Figure 15** below it is observed that more countries in Asia experienced an increase in normalised NEET between 2005 and 2020. Laos led this increase with 58% while Bhutan led the decrease with -10%.

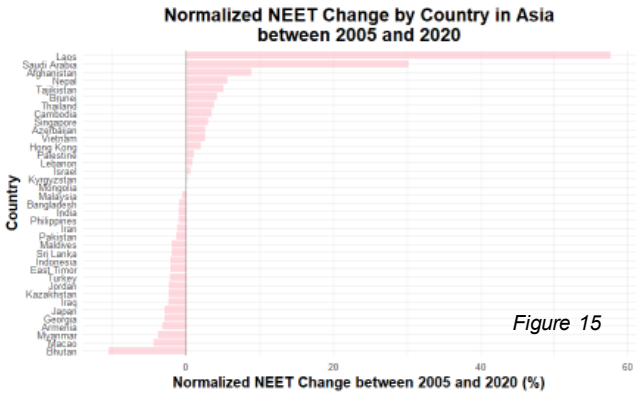
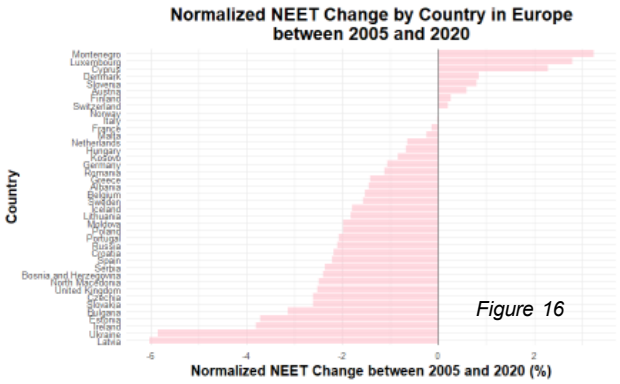


Figure 16 below shows that throughout 2005 and 2020, most of the countries in Europe experienced a substantial decrease in normalised NEET. Belarus was removed from the figure as it experienced an increase in normalised NEET by 453%. Latvia led the decrease with 6.04%.



From **Figure 17**, it is observed that most countries in North America experienced an increase in normalised NEET. Curacao (excluded from figure due to relatively large increase) led the increase with 123%. Trinidad and Tobago led the decrease with 9.6%.

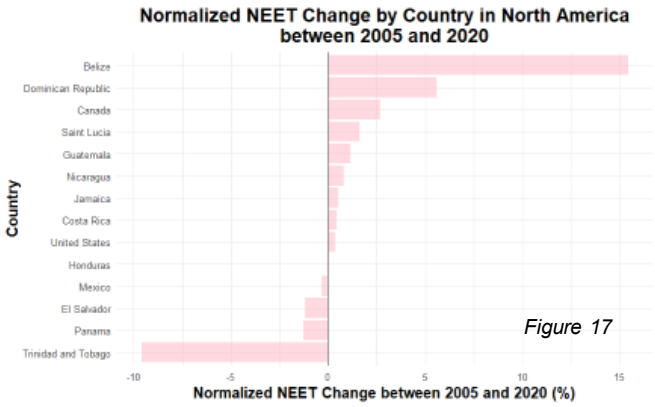


Figure 18 shows that most countries in South America experienced an increase in normalised NEET with Guyana leading the increase with 5.67% while Colombia led the decrease with -0.979%.

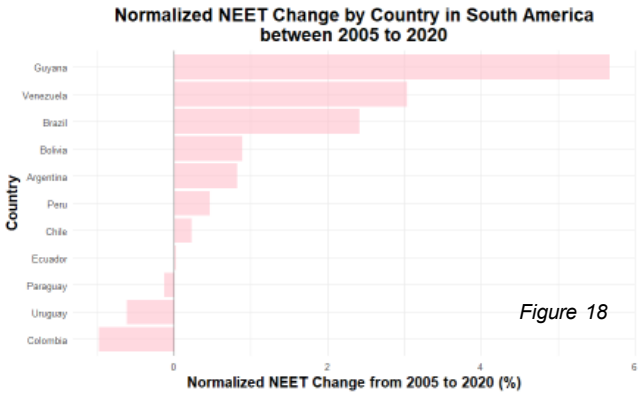
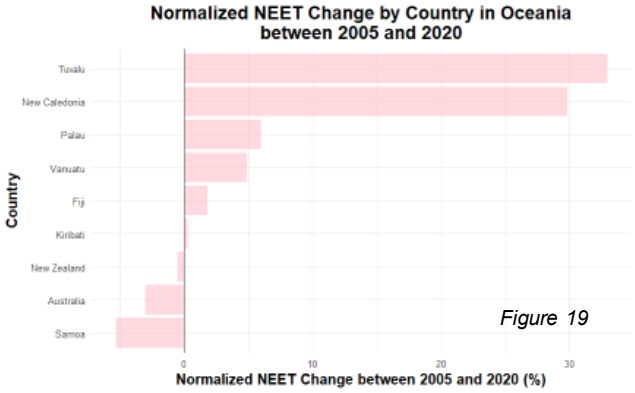


Figure 19 shows that most countries in Oceania experienced an increase in normalised NEET. Tuvalu 32.9% while Samoa led the decrease with -5.28%.



From **Figure 12** and **Figure 14** to **Figure 19** above, it is observed that most countries experienced an increase in normalised NEET which is contrary to what is observed in the continents from **Figure 13** and the **Table 1**. This is due to the fact that countries which led the increase within the continents had relatively smaller population size compared to countries which experienced a decrease in NEET. As a result, when looking at weighted NEET figures, the impact of the increase in NEET was much smaller than the impact of countries which experienced a decrease in NEET.

One example is in Asia (**Figure 15**). Although Laos experienced an increase of 58%, their population only accounts for about 0.6% of Asia's population. On the other hand, India experienced a 1% decrease and on average represents more than 60% of Asia's population. The combined impact of these two countries is approximately -0.25%.

4. Discussion

4.1 Limitations:

4.1.1. Lack of Data: Missing GDP per capita data for certain LDCs which prevented analysis of sustained economic growth. Lack of NEET data in many countries also led to certain years having much higher NEET (e.g. North America in 2007 and 2008).

4.1.2. Quality of Data: Accuracy of data from countries affect the result. For example, India's large informal labour market leads to reported NEET data being higher than reality.

4.1.3. Misalignment Between Data Period and SDG Timeline: The UN SDG goals discussed in this research paper were introduced in 2015. However, given the short timeframe (5 years), this paper chose to look at data from as early as 1976 for GDP per capita.

4.2 Strengths:

4.2.1. Robust Exploration of Limitations: This paper explored the weighted NEET values based on population size and normalised NEET changes. This helps minimise the impacts of the lack of data, allowing countries to be compared more accurately and fairly.

4.2.2. Appropriate use of Visualisation Techniques: A wide variety of graphs and tables were used to explore the two questions, allowing for clearer representation of results and observations of trends.

4.2.3. Integration of Both Absolute and Relative Measures: Provides multidimensional perspective, preventing pitfalls when relying on a single indicator.

4.2.4. Quality of data sources: All CSV files came from reliable sources such as WorldBank and UN.

5. Conclusion

In conclusion, from 1976 to 2020, only 3 continents achieved the UN's SDG 8 targets of sustained economic growth and 7% annual growth in LDCs. Oceania and Africa saw the most consistent growth periods for LDCs with some frequent momentum being maintained. Asia, with only 4 LDCs achieving the target, saw some high-growth periods within these, but the remaining LDCs struggled to maintain consistency. Regions such as South America and Europe with few LDCs had more stable but uneven growth. The continents with the higher variation in LDCs achieving the target can be understood to have a variety of external factors affecting the spread of growth within, compared to a less spread distribution formed by even development occurring over history.

Identifying reducing youth NEET rates was similarly challenging: Europe had relatively low NEET levels which again links to its even spread of growth within the continent. Asia and Oceania saw the most substantial decrease, thereby meeting target 8.6 successfully compared to an arguably smaller decrease in Africa and North America. However, these were mainly led by large developing countries with many other countries observing an increase in NEET over the period 2005 to 2020. This heterogeneity complicates the assessment of whether continents as a whole made substantial progress toward reducing NEET by 2020.

Overall, progress towards SDG target 8 was partial and uneven. External and country-level differences were the main factors preventing uniform continent wide concentration toward SDG 8 with clustering in areas proving to be an indicator towards accelerated or slowed growth.

6. References

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