

Introduction to Data Science

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Introduction

In September 2015, at the UN Sustainable Development Summit in New York, the 2030 Agenda for Sustainable Development was adopted by all UN Member States. This agenda aims to ‘provide a shared blueprint for peace and prosperity for people and the planet, now and into the future’. We will be looking at Sustainable Development Goal (SDG) 8, which aims to promote decent work and economic growth. Specifically, we measured targets 8.1: Sustain per capita economic growth, aiming for at least 7% GDP growth in least developed countries (LDCs) and 8.6: By 2020, significantly reduce the proportion of youth not in employment, education or training (NEET). (United Nations, 2015)

In this report, we will be measuring and tracking countries’ progress towards these two goals using data on GDP per capita obtained from World Bank and youth NEET rates. We will analyse the trends across six continents – Asia, Africa, North America, South America, Europe, and Oceania, and primarily focus on the timeframe from 2016-2021 to assess the effectiveness of SDG 8.

Methodology

Our methodology can be split into several rough stages consisting of data cleaning, aggregation, analysis and visualisation.

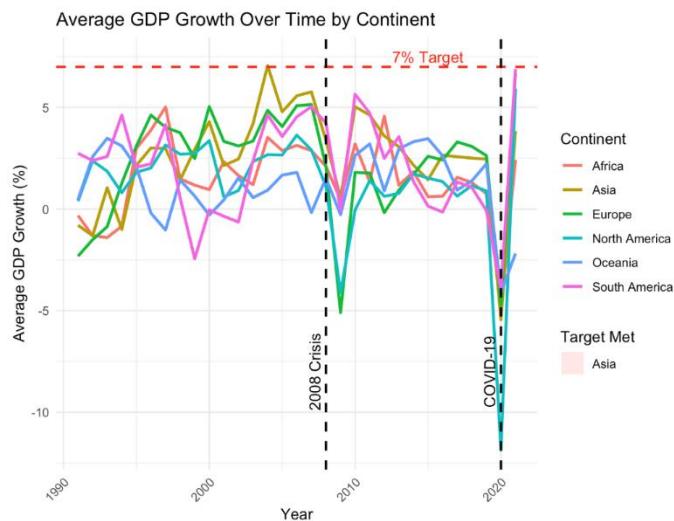
We chose to primarily focus on the years 2016-2021, as this would best allow us to measure the progress made by countries following the adoption of SDG 8. To do this, we filtered for only countries with data available in both 2016 and 2021 when calculating trends over the whole period and selected only for countries with data every year from 2016 to 2021 inclusive when performing any time series analysis. This was to prevent any individual countries with data available for only some years skewing the trend. For example, in Oceania, Australia only had NEET data in 2016 and 2017 and including this incomplete data would distort the analysis of Oceania’s overall trend.

We merged the continent data with the NEET data and GDP data to allow us to perform analyses for each continent. At this stage, we also considered performing NEET and GDP analysis weighted with respect to the population of each country. For example, in North America, the USA would shift the average more than Canada as it has a much larger population. We decided against this, as we wanted to analyse the efforts of every country on reducing their NEET proportion and promoting growth, as the SDG was agreed upon by every country, and the UN goals aimed to improve standards of living in every country, not a small number of countries with large populations. There are certainly disadvantages to this approach, as some would say China making progress towards SDG 8 is more impactful than Macau making similar progress, but we chose to evaluate the metrics on a country not population basis.

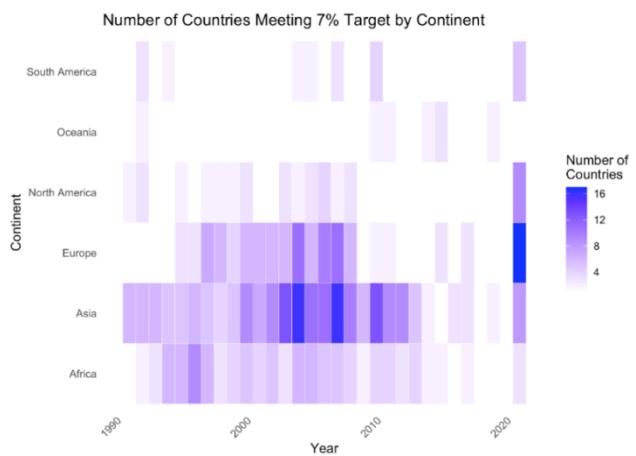
We performed comparative analysis between continents to identify regions which were most successful in achieving reductions in NEET or strong GDP growth. We also used a variety of visualisations to present these findings. We used box plots to demonstrate trends in the median and the change in the variance of regions. We used line graphs to view overall trends for individual countries, as line plots allowed us to compare more countries simultaneously. We used bar graphs to present our findings for trends in averages as it provides a clear comparison between regions and countries.

We used R to perform all our analysis. We used several packages including dplyr for data wrangling, ggplot2 for visualisation, tidyr for reshaping data, readr for reading data and xtable for generating tables with LaTeX formatting.

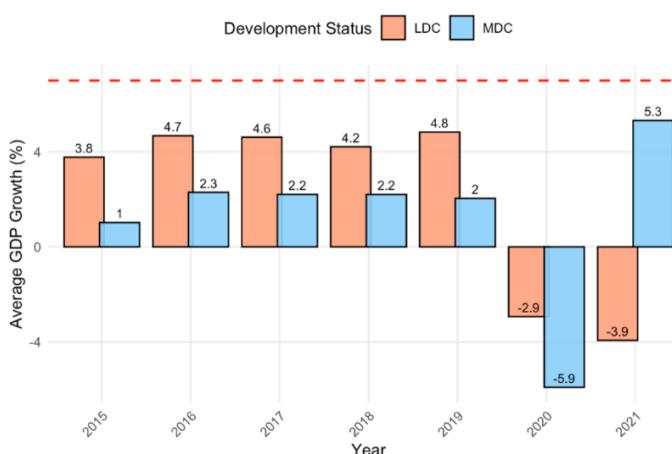
Results



similar growth rate back-to-back. Additionally, most countries exceeded the 2% growth rate that many countries target, suggesting that there has been progress towards SDG 8. That being said, there is a reduction in economic growth after 2015 when compared to previous years, particularly following the 90s and the global financial crisis.



Economic Growth Comparison: LDCs vs MDCs in Asia
Average GDP Growth (%) per Year



Asia enjoyed extremely high average GDP growth, with the continental average even breaking 7% in 2004. Africa's average growth rate lagged behind the European and American growth rate, however. Europe and North America saw more stable growth due to their economic maturity. The impact of COVID-19 is clear as there was a significant global economic contraction, though most countries recovered considerably in 2021. This graph shows the high amount of variability year on year in general for GDP growth, with very few cases where countries had a

Asia and Africa have consistently had the most countries exceeding the target growth rate, showcasing the potential growth for developing economies. Europe and North America rarely met the 7% target due to their lower ceilings for economic growth being more developed economies. Asia saw particularly strong growth during the 2000s, with more than 8 countries exceeding 7% GDP growth almost every year. Following 2015, and the adoption of SDG 8, it appears as if the number of countries exceeding the 7% target growth rate decreased, implying that the SDG 8 was unsuccessful in inspiring economic growth in developing countries.

Pre-pandemic, LDCs in Asia outperformed MDCs, though only two LDCs in Asia saw growth rates greater than 7% and each country only sustained it for a year. Following the pandemic however, MDCs recovered far more effectively than the LDCs. This highlights the difference in resources, infrastructure and policy response between LDCs and MDCs and showcases MDCs' greater economic resilience.

Table 1: Years LDCs Exceeded 7% GDP Growth (With Continents)

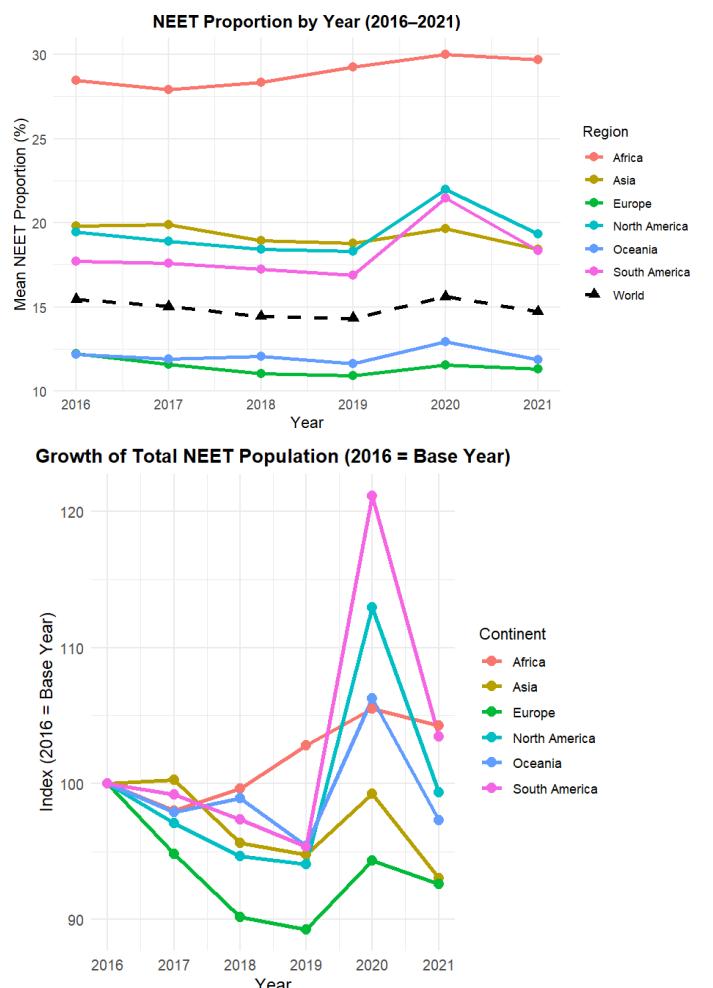
Country	Continent	Year	GDP Growth Rate (%)
Bhutan	Asia	2016	7.191508
Guinea	Africa	2016	7.987768
Myanmar	Asia	2016	9.638075
Guinea	Africa	2017	7.508403
Nepal	Asia	2017	7.731269
Tuvalu	Oceania	2019	12.84794
Rwanda	Africa	2021	8.285561

We can see that the world average NEET proportion was trending downwards before COVID, although COVID meant that the world average NEET proportion spiked to a level greater than that of 2016. In 2021, however, the NEET proportion recovered. The continents with the lowest NEET proportion are Europe and Oceania, with the Americas and Asia maintaining a similar NEET proportion. Africa had a significantly higher NEET proportion than every other continent however, maintaining a NEET percentage above 27%. North and South America appear to be the continents most affected by COVID, seeing the largest increase in NEET proportion in 2020.

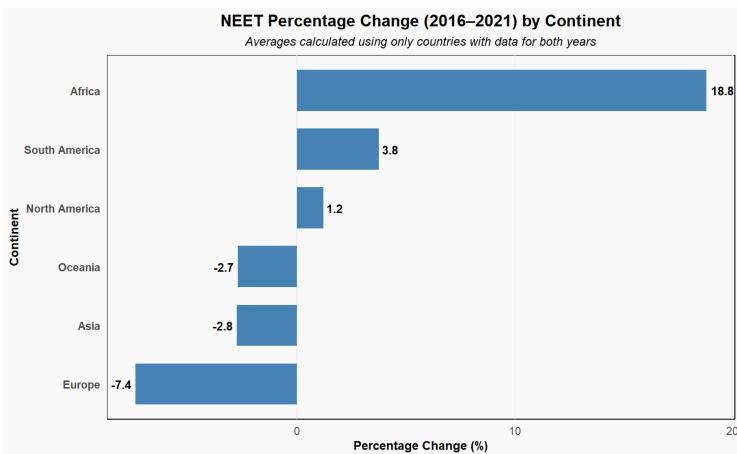
Now, comparing countries in indexed form allows us to better measure their progress towards achieving target 8.6. We can see that Europe has made the greatest strides towards reducing NEET proportion. However, every continent barring Africa was on track to reduce their NEET proportion, with most countries' progress getting interrupted by COVID. This particularly large increase in youth unemployment may have been due to most countries targeting their furlough schemes and unemployment benefits towards full time workers, rather than focusing on young people. Additionally, economic shocks and waves of layoffs would most likely affect young people the most, as these are often the workers with the least experience, and are likely the ones to be laid off first.

Europe saw a reduction in NEET percent of 7.4%. This was the lowest of any continent. Africa saw a significant rise of 18.8% in their NEET proportion. Examining continents' data reveals more information. Most European countries saw large reductions in NEET proportion; however,

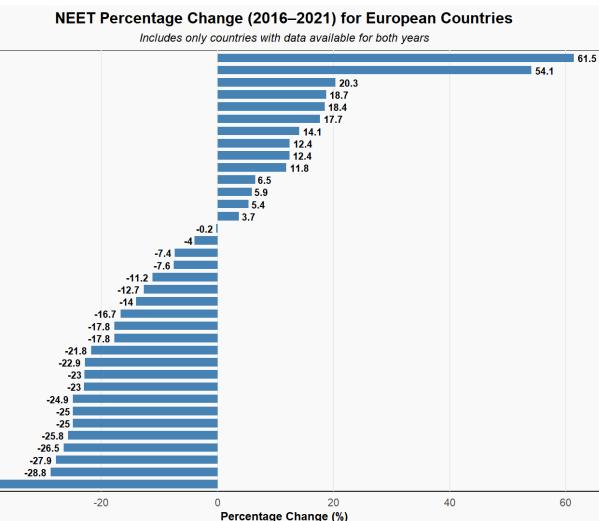
In this table, we can see which LDCs met the target growth rate of 7% and the year in which they achieved this. The number of countries achieving the target each year appears to be falling, with 3 in 2016, 2 in 2017 and only one in 2019. Guinea was also the only country to exceed the GDP growth rate target for more than a year.



a small number of countries significantly increased the average. Not shown on the graph is Belarus, which had a reported NEET proportion increase of 1510%, which is likely due to inaccurate data. Luxembourg and Malta also had large increases in NEET proportion, though their relatively small populations may skew this result as well.



Interestingly, many of the richer European countries can be seen as being some of the worst in terms of progress towards target 8.6, with 8 out of the top 10 richest European countries in terms of GDP per capita seeing increases in NEET. This may reflect the more complex labour markets in these countries, overwhelmingly demanding high skill workers which may make it more difficult for young people to find jobs.



In Asia, Singapore saw the greatest increase in NEET proportion, while Armenia saw the largest reduction. Both cases were extreme, with Singapore seeing a 51.2% increase in NEET while Armenia saw a 35.8% decrease. It should be emphasised that these are simply percentage change values, so a country could see a small increase in NEET percent leading to a large percentage change. However, this is still a useful metric in evaluating whether countries achieved target 8.6 as we want to evaluate the countries' reduction in NEET.

Discussion

There are many obstacles to achieving the growth target for developing countries. They may have experienced significant political instability, such as was the case with Afghanistan. They may also be experiencing war, such as was the case for Ethiopia, who was affected by the Tigray war from 2020 to 2022. These circumstances limit these countries' potential to grow as their access to resources and infrastructure is compromised. Although some countries such as Bhutan and Rwanda were able to sustain strong GDP growth in multiple years, overall, the GDP target was not met in the majority of cases.

Another factor harming LDCs' growth is that their economies are often heavily commoditised. Relying on industries such as oil and minerals will always lend itself to inherent volatility in terms of GDP growth. Additionally, these industries are often associated with high levels of inequality, with low career earnings growth potential. This can contribute towards a higher NEET proportion and make it hard for countries to decrease their NEET proportion. High levels of inequality and low youth labour participation rates can also reduce economic growth.

Another thing that may be contributing to the high NEET proportion in many countries is the disparity in gender employment. In the majority of African countries, the female to male NEET ratio is above 2, and is all the way at 7.2 in Afghanistan (International Labour Organization, 2019). Neglecting raising female workforce participation, whether due to societal or cultural norms or otherwise, can be very harmful, and make it much more difficult to reduce NEET proportion considering that the male NEET is far lower than the female NEET.

The COVID-19 Pandemic also made it much more difficult to pursue target 8.6. While many countries had reduced their NEET proportion following SDG 8, the pandemic meant that NEET levels spiked higher than 2016 levels, undoing much of the progress.

Some potential successful intervention these countries can take is to continue investing in infrastructure. Tuvalu, in Oceania, saw its record growth for an LDC of 12.85% due to its investment into the construction sector and infrastructure projects (Government of Tuvalu, 2022). Of course, Tuvalu has the unique advantage of receiving income due to its country internet domain extension, but the principles of using supply side policy to enable greater GDP growth are robust. In Asia, trade agreements have also been a large source of growth.

These countries would also benefit from focusing on more sustainable growth, as opposed to simply aiming for the 7% growth target. As shown in the graphs, MDCs were able to recover far more effectively from the pandemic, whilst some LDCs still haven't recovered 2 years on. Diversifying economies and building economic resilience could be helpful for LDCs to ensure that they can maintain consistent growth into the future.

In terms of target 8.6, European initiatives have been the most effective at reducing the NEET proportion. Vocational training and apprenticeships have contributed to lower youth unemployment rates. Countries such as Germany have integrated vocational training heavily into their educational pathways, resulting in greater youth participation in the workforce. Focusing on the disparity between male labour force participation rates and female labour force participation could also prove to be effective.

Our capability for analysis was also somewhat limited. In terms of the data, we were constrained in our analysis for certain continents. For example, in Oceania, only New Zealand had data for every year from 2016-2021. Australia, the country with the largest population in Oceania, only had data for 2016 and 2017, limiting our analysis. Furthermore, any trends following the adoption of SDG 8 couldn't be assessed probability due to the effects of COVID. Countries trending downwards in NEET or upwards in GDP growth could simply be a coincidence for those three years, and only three years is not a large enough sample to try and observe any trend or pattern.

Conclusion

Progress towards SDG 8.1 is difficult to judge. It's unlikely that any significant progress has been made towards this goal, and there have only been 7 instances of LDCs exceeding the target set out in 8.1, out of a possible 45 countries over a 5-year timespan, meaning the target was reached in around 3% of cases. Asia would be the most successful continent in terms of meeting this goal, with Asian LDCs hovering at around a 4.5% growth rate, which is still relatively strong, if not the 7% target set out in SDG 8. Africa would be the next most successful continent, with 3 instances of an African country exceeding the 7% growth rate.

Progress towards target 8.6 seems to be much more positive, with many countries seeing strong reductions in their NEET proportion. Overall, the global NEET proportion was trending downwards before COVID. The most successful continent in this regard would be Europe, which saw a 7.4% decrease in NEET proportion. This was much stronger than any other continent, but Asia and Oceania both saw reductions in their NEET proportions as well. Of course, the extent to which this can be seen as significantly reducing the NEET proportion is debatable, as it's unlikely that a 2% reduction could be seen as significant. However, many countries did manage individual significant reductions in NEET, which should be seen as a positive in reaching target 8.6 and achieving SDG 8.

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