Environmental Economic Module 7QQMM906
Group Four Data report:
Decoupling and policy comparison between countries

Report Roadmap

Submission date: 23rd November 2025

Word count: 1,620 words
2132(total)-47(cover)-0(figure)-91(table)-187*2(title)= 1,620

Member Name (student ID, GitHub account)

Tanmay **Kharmarbha** (K25116081, trmarbaniang)

Marvin **Lee** (K25059492, e4e421)

Wei Ting **Tan** (K25127065, weiting WT003)

Table of Contents

Meet our Team

Tanmay **Kharmarbha**

R programming
Data visualisation

K25116081

Marvin **Lee**

Project management
GitHub Maintenance
Report Formulation

K25059492

Wei Ting **Tan**

Data gathering
Policy research
Report visual design

K25127065

1. Part I: Motivation & Data Context

1a. Dataset Selection and Research Questions

From decoupling and country policy, we see the potential of setting up a data analysis for the correlation of country emission and their GDP. We gathered emission data from EDGAR - Emissions Database for Global Atmospheric Research , GDP and GNI data from several databases (country economy, database earth, Trading Economics, UNdata). The detailed structure of the dataset is documented in section 2b. Links to the selected databases are included in the reference section.

1a1. Our two research questions

1. To what extent have major Asian countries decoupled CO2 emissions from economic growth?
2. Which economic sectors have been the primary drivers of successful (or failed) decoupling?

The findings in this report can help governments understand their progress and trends in decoupling. Facilitating further decoupling by showing successful decoupling cases with country data.

1b. Data Significance and Relevance

Currently the debate of green growth and degrowth continues, with countries reaching decoupling in GDP and carbon emissions, we decided to analysis the decoupling process of countries. This data of emission and GDP allows us to analysis the decoupling progress of the selected countries, which we will specify in section 2b.

The significance of this data (to be added)

2. Part II: Technical Implementation

In this project, we implemented two parallel workspaces. First is GitHub for code management, second is the Word document on OneDrive for final report. Both access-controlled by authorising account.

2a. Coding Setup and Documentation

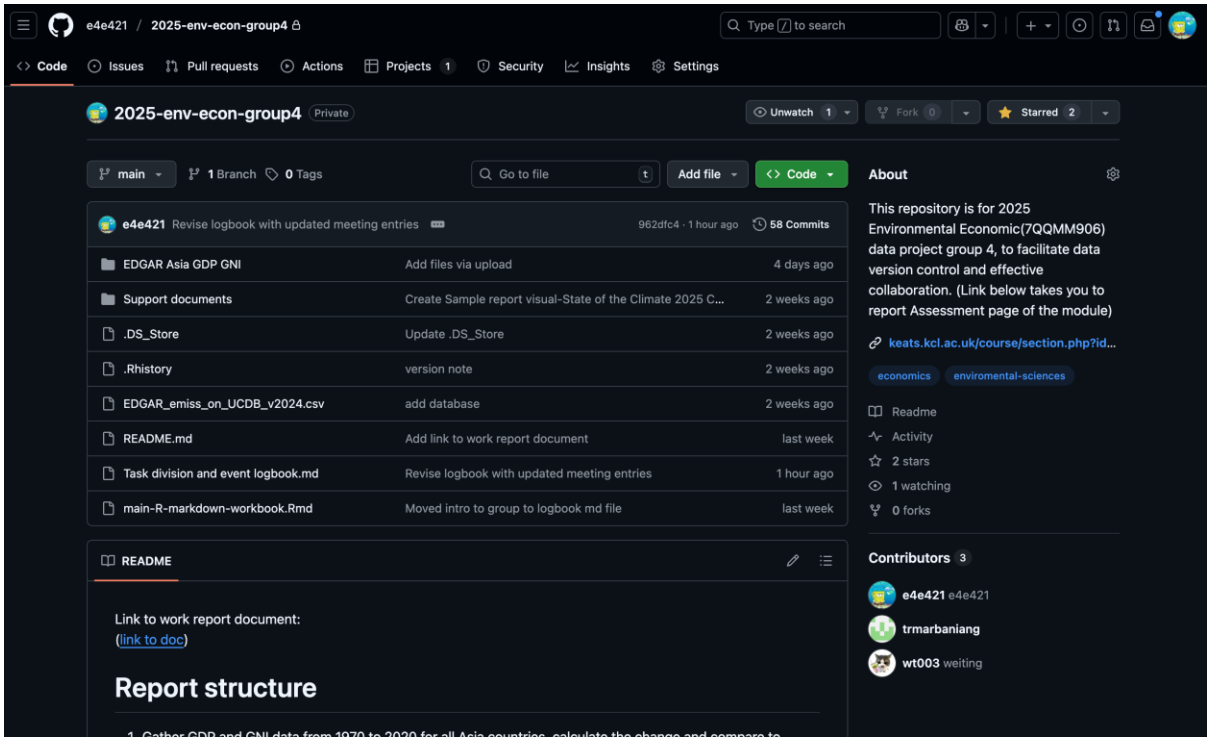
2a1. Data Pipeline and workflow

Based on research questions, we download our database and turn it into csv format. Commit the csv file onto GitHub and set the GitHub desktop file pathway to the local computer. At this point we divide into two group functions, one process the csv file in local R studio with frequent commit to GitHub to ensure code trackability, another one

updates the documentation in README.md and final report word docx. We estimate the outcome of the data analysis and compare them with our research questions. After data analysis and visualisation, we move on to the online word docx file to form our technical reflection and suggestions.

2a2. GitHub environment

We created a GitHub repository for our project on 8 Nov 2025, under Marvin's account (e4e421). With regular commits and updates, documented with naming convention. The following is the screenshot of GitHub repository on 23 Nov 2025.



2a3. R language

We chose R as the main data processing tool.

2b. Data Preparation and Management

Our research includes two main datasets. The first one is the regional emission data from EDGAR - Emissions Database for Global Atmospheric Research. The second one is regional GDP and GNI data from the World Bank, database earth, Country Economy and UN data .

2b1. Data gathering and brief description

2b1.1. EDGAR - Emissions Database for Global Atmospheric Research

The first dataset downloaded from EDGAR - Emissions Database for Global Atmospheric Research (link: https://edgar.jrc.ec.europa.eu/dataset_ucdb), the file is named "EDGAR

global emissions in urban areas v2024.xlsx". The Excel file contains three worksheets. The first is named "citation and references", containing links and source names. Second is named "List of variables", containing the variables of the third worksheet. Third is named "EDGAR_emiss_on_UCDB_2024", the main data worksheet.

We extracted the third worksheet, exported it as csv file, and committed the csv file to GitHub for easy control.

Data characteristics of EDGAR_emiss_on_UCDB_2024

ID_UC_G0	UC_name	UC_country	(See below)
1	Apia	Samoa	...
2	Nuku'alofa	Tonga	...
3	Ewa Beach	United States	...
...	...	...	...

This dataset includes 11687 cities in 192 countries.

Data points at following years: 1975, 1990, 2000, 2005, 2010, 2015, 2020, 2022

Data columns include 6 sectors in 4 emission categories:

CO2_Agriculture	GWP_100_AR5_GHG_Agriculture	NOx_Agriculture	PM2.5_Agriculture
CO2_Energy	GWP_100_AR5_GHG_Energy	NOx_Energy	PM2.5_Energy
CO2_Industry	GWP_100_AR5_GHG_Industry	NOx_Industry	PM2.5_Industry
CO2_Residential	GWP_100_AR5_GHG_Residential	NOx_Residential	PM2.5_Residential
CO2_Transport	GWP_100_AR5_GHG_Transport	NOx_Transport	PM2.5_Transport
CO2_Waste	GWP_100_AR5_GHG_Waste	NOx_Waste	PM2.5_Waste

2b1.2. GDP and GNI databases

The second dataset contains GDP and GNI for 43 Asian countries, following the data year of the EDGAR dataset. All values are in USD currency.

Data points at following years: 1975, 1990, 2000, 2005, 2010, 2015, 2020, 2022

Country	Region	1975	...	2022
China	East Asia	163,429,530,659.6	...	17,963,171,479,205.3
Japan	East Asia	532,861,438,884.7	...	4,232,173,916,086.7
...	...	...	...	...
Kazakhstan	Central Asia	missing	...	225,496,328,925.5

2b2. Data scoping and cleaning

After examining the first dataset and focusing on our research question. We chose the data entry of top 5 emitting Asia countries.

2b3. Data Aggregation and merging

To be added

2c. Data Processing structures for research questions

2c1. Research question 1

Question 1: "To what extent have major Asian countries decoupled CO2 emissions from economic growth?"

- Process:
  - Select Countries: top 5 emitters (countries to be chose by calculation of emission).
  - Calculate Carbon Intensity: For each country, calculate Total CO2 / GDP for each year. Plot these trends on a single chart.
  - Identify Decoupling Types: For each country, analyse the trends of Total CO2 and GDP separately.
    - Absolute Decoupling: GDP is going up, and Total CO2 is going down.
    - Relative Decoupling: GDP is growing faster than CO2 emissions (both are up, but the ratio is falling).
    - No Decoupling: CO2 is growing as fast or faster than GDP.

Analysis: Simple Linear Regression on Carbon Intensity

- For each country, model Carbon Intensity as a function of Time.
- Statistical Test: Linear Regression / Linear Model (lm()).
- Regression for direction and rate of change, to see the trend of change. Get a p-value for the slope to see if the decrease (or increase) is statistically significant.

2c2. Research question 2

Question 2: "Which economic sectors have been the primary drivers of successful (or failed) decoupling?"

- Process:
  - Sectoral Contribution to Change: For a key period (e.g., 1975-2022), calculate:
    - Change in Total CO2 from 1975 to 2022.
    - Change in CO2 from each sector (Energy, Industry, Transport, etc.) over the same period.
    - The sector's contribution to the total change = (Sector Change / Total Change) * 100.

  - Example: If a country's emissions grew by 1000 tons, and the Energy sector grew by 800 tons, then the Energy sector was responsible for 80% of the increase. Conversely, if a country's emissions fell by 500 tons, and the industry sector fell by 400 tons, then Industry was responsible for 80% of the decrease.
- Process:
  - Calculate each sector's contribution to the total change in emissions over the period (e.g., 1975-2022).
  - Formulate statement of sectoral change and contribution.

3. Part III: Descriptive Analysis and Export of Results for Presentation

Note: Please provide a screenshot of the code that you used to generate and export the tables or figures.

3a. Summary Statistics Table

Sample result table:

Country	GDP 1975	...	GDP 2022	CO2 1975	...	CO2 2022
1						
2						
3						
4						
5						

3b. Data Visualization and Exploration

3b1. Research question 1

Question 1: "To what extent have major Asian countries decoupled CO2 emissions from economic growth?"

Figure:

1. Line Charts with two lines
   x-axis: years
   y-axis: GDP, CO2 emission
   Each country has their panel

2. Line Charts with two lines
   x-axis: years
   y-axis: Carbon Intensity (carbon emission per GDP capita)
   Each country has their panel

3b2. Research question 2

Question 2: "Which economic sectors have been the primary drivers of successful (or failed) decoupling?"

Figure:

Stacked bar chart
x-axis: Countries
y-axis: Co2 emissions
Stacking group: industries

3c. Optional, only for advanced groups: Introductory Regression Analysis

Chart:

Linear Regression:
For each country, carbon intensity over time from 1975-2022.

4. Part IV: Discussion and Conclusions

4a. Key Findings Summary

4b. Policy and Research Implications

Type here(find article)

4c. Technical Reflection

5. Reference

Countryeconomy. (2018). Bangladesh GDP - Gross Domestic Product 2017. Available at: https://countryeconomy.com/gdp/bangladesh. [Accessed: 19 November 2025].

Countryeconomy. (2019). Taiwan GDP - Gross Domestic Product 2018. countryeconomy.com. Available at: https://countryeconomy.com/gdp/taiwan. [Accessed: 19 November 2025].

Countryeconomy. (2021). Afghanistan GDP - Gross Domestic Product 2020. Available at: https://countryeconomy.com/gdp/afghanistan. [Accessed: 19 November 2025].

database.earth. (n.d.a). Annual GDP (Gross Domestic Product) by Country in 1975 (World Map). Available at: https://database.earth/economy/gdp/1975. [Accessed: 18 November 2025].

database.earth. (n.d.b). Annual GDP (Gross Domestic Product) by Country in 1980 (World Map). Available at: https://database.earth/economy/gdp/1980. [Accessed: 18 November 2025].

database.earth. (n.d.c). Annual GDP (Gross Domestic Product) by Country in 1985 (World Map). Available at: https://database.earth/economy/gdp/1985. [Accessed: 18 November 2025].

database.earth. (n.d.d). Annual GDP (Gross Domestic Product) by Country in 1990 (World Map). Available at: https://database.earth/economy/gdp/1990. [Accessed: 18 November 2025].

database.earth. (n.d.e). Annual GDP (Gross Domestic Product) by Country in 1995 (World Map). Available at: https://database.earth/economy/gdp/1995. [Accessed: 18 November 2025].

database.earth. (n.d.f). Annual GDP (Gross Domestic Product) by Country in 2000 (World Map). Available at: https://database.earth/economy/gdp/2000. [Accessed: 18 November 2025].

database.earth. (n.d.g). Annual GDP (Gross Domestic Product) by Country in 2005 (World Map). Available at: https://database.earth/economy/gdp/2005. [Accessed: 18 November 2025].

database.earth. (n.d.h). Annual GDP (Gross Domestic Product) by Country in 2010 (World Map). Available at: https://database.earth/economy/gdp/2010. [Accessed: 18 November 2025].

database.earth. (n.d.i). Annual GDP (Gross Domestic Product) by Country in 2015 (World Map). Available at: https://database.earth/economy/gdp/2015. [Accessed: 18 November 2025].

database.earth. (n.d.j). Annual GDP (Gross Domestic Product) by Country in 2020 (World Map). Available at: https://database.earth/economy/gdp/2020. [Accessed: 18 November 2025].

database.earth. (n.d.k). Annual GDP (Gross Domestic Product) by Country in 2022 (World Map). Available at: https://database.earth/economy/gdp/2022. [Accessed: 18 November 2025].

database.earth. (n.d.l). Annual GNI (Gross National Income) by Country in 1975 (World Map). Available at: https://database.earth/economy/gni/1975 [Accessed 19 November 2025].

database.earth. (n.d.m). Annual GNI (Gross National Income) by Country in 1980 (World Map). Available at: https://database.earth/economy/gni/1980 [Accessed 19 November 2025].

database.earth. (n.d.n). Annual GNI (Gross National Income) by Country in 1985 (World Map). Available at: https://database.earth/economy/gni/1985 [Accessed 19 November 2025].

database.earth. (n.d.o). Annual GNI (Gross National Income) by Country in 1990 (World Map). Available at: https://database.earth/economy/gni/1990 [Accessed 19 November 2025].

database.earth. (n.d.p). Annual GNI (Gross National Income) by Country in 1995 (World Map). Available at: https://database.earth/economy/gni/1995 [Accessed 19 November 2025].

database.earth. (n.d.q). Annual GNI (Gross National Income) by Country in 2000 (World Map). Available at: https://database.earth/economy/gni/2000 [Accessed 19 November 2025].

database.earth. (n.d.r). Annual GNI (Gross National Income) by Country in 2005 (World Map). Available at: https://database.earth/economy/gni/2005 [Accessed 19 November 2025].

database.earth. (n.d.s). Annual GNI (Gross National Income) by Country in 2010 (World Map). Available at: https://database.earth/economy/gni/2010 [Accessed 19 November 2025].

database.earth. (n.d.t). Annual GNI (Gross National Income) by Country in 2015 (World Map). Available at: https://database.earth/economy/gni/2015 [Accessed 19 November 2025].

database.earth. (n.d.u). Annual GNI (Gross National Income) by Country in 2020 (World Map). Available at: https://database.earth/economy/gni/2020 [Accessed 19 November 2025].

database.earth. (n.d.v). Annual GNI (Gross National Income) by Country in 2022 (World Map). Available at: https://database.earth/economy/gni/2022 [Accessed 19 November 2025].

Trading Economics. (2019). North Korea GDP. Tradingeconomics.com. Available at: https://tradingeconomics.com/north-korea/gdp. [Accessed: 19 November 2025].

Trading Economics. (2019). Yemen GDP. Available at: https://tradingeconomics.com/yemen/gdp. [Accessed: 19 November 2025].

Trading Economics. (n.d.). Lebanon GDP | 1988-2019 Data | 2020-2021 Forecast | Historical | Chart | News. Available at: https://tradingeconomics.com/lebanon/gdp. [Accessed: 19 November 2025].

UNdata. (n.d.a). UNdata | record view. Available at: https://data.un.org/Data.aspx?q=North+korea&d=SNAAMA&f=grID%3A103%3BcurrID%3AUSD%3BpcFlag%3A0%3BcrID%3A408%2C410%2C807. [Accessed: 19 November 2025].

UNdata. (n.d.b). UNdata | record view | GNI at current prices - US dollars. Available at: https://data.un.org/Data.aspx?q=afghanistan&d=SNAAMA&f=grID%3a103%3bcurrID%3aUSD%3bpcFlag%3a0%3bcrID%3a4 [Accessed: 19 November 2025].

UNdata. (n.d.c). UNdata | record view | GNI at current prices - US dollars. Available at: https://data.un.org/Data.aspx?q=yemen&d=SNAAMA&f=grID%3a103%3bcurrID%3aUSD%3bpcFlag%3a0%3bcrID%3a720%2c886%2c887 [Accessed: 19 November 2025].

World Bank. (n.d.). GDP (current US$) - Syrian Arab Republic | Data. Available at: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=SY. [Accessed: 19 November 2025].