Productivity versus Participation: Divergent Growth Paths in North America and East Asia

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```
import sys, os
print("sys.executable:", sys.executable)
print("CONDA_DEFAULT_ENV:", os.environ.get("CONDA_DEFAULT_ENV"))
```

```
sys.executable: /Users/jackson/anaconda3/bin/python
CONDA_DEFAULT_ENV: base
```

Introduction

Our study examines how labour-force utilization, income levels and short-run growth interact in two North-American economies—the United States and Canada—and two large East-Asian economies—China and Japan—during the period 1990 to 2023.

Data

```
→ Loading raw table: gdp_raw from '../data/gdp.csv'
→ Loading raw table: emp_raw from '../data/emp.csv'
→ Loading raw table: gdp_growth_raw from '../data/gdp_growth.csv'
All raw tables loaded into SQLite.

--- gdp_raw ---
['Country Name', 'Indicator Name', '1990', '1991', '1992', '1993', '1994', '1995', '1996', '
('Canada', 'GDP per capita (constant 2015 US$)', 31700.54627, 30654.33314, 30563.37882, 3103
('China', 'GDP per capita (constant 2015 US$)', 905.0324572, 975.4629156, 1100.646116, 1239.
('United Kingdom', 'GDP per capita (constant 2015 US$)', 30876.37063, 30441.48135, 30481.034
('Japan', 'GDP per capita (constant 2015 US$)', 28422.21312, 29308.27409, 29462.65397, 29232
('United States', 'GDP per capita (constant 2015 US$)', 39200.06581, 38637.83981, 39447.9472
```

```
--- emp_raw ---
['Country Name', 'Indicator Name', '1990', '1991', '1992', '1993', '1994', '1995', '1996', '1
('Canada', 'Employment to population ratio, 15+, total (%) (modeled ILO estimate)', None, 59
('China', 'Employment to population ratio, 15+, total (%) (modeled ILO estimate)', None, 76.8
('United Kingdom', 'Employment to population ratio, 15+, total (%) (modeled ILO estimate)', N
('Japan', 'Employment to population ratio, 15+, total (%) (modeled ILO estimate)', None, 62.4
('United States', 'Employment to population ratio, 15+, total (%) (modeled ILO estimate)', No

--- gdp_growth_raw ---
['Country Name', 'Indicator Name', '1990', '1991', '1992', '1993', '1994', '1995', '1996', '1
('Canada', 'GDP growth (annual %)', 0.202947863, -2.091055179, 0.890466255, 2.657706883, 4.49
('China', 'GDP growth (annual %)', 3.920251368, 9.262786085, 14.22452959, 13.8837293, 13.0368
('United Kingdom', 'GDP growth (annual %)', 0.733755484, -1.103121612, 0.401082056, 2.4898309
('Japan', 'GDP growth (annual %)', 4.840929057, 3.523357235, 0.900586066, -0.459219716, 1.083
('United States', 'GDP growth (annual %)', 1.885965585, -0.108312889, 3.522497184, 2.7517958
Reading tables into pandas DataFrames...

Cleaning data...

Merging datasets...

Saving merged cleaned data into database as 'econ_cleaned'...

Generating summary statistics...
                GDP_count      GDP_mean      GDP_std       GDP_min  \
Country Name
Canada                 34  39357.078405  4856.836357  30563.378820
China                  34   5073.229508  3583.630683    905.032457
Japan                  34  32770.738504  2371.821778  28422.213120
United Kingdom         34  40583.327987  5456.617589  30441.481350
United States          34  51521.551093  7640.364126  38637.839810

                    GDP_max  Employment_count  Employment_mean  \
Country Name
Canada          45227.14474                33        60.712303
China           12175.19611                33        69.123242
Japan           36990.33011                33        59.238939
United Kingdom  47551.22966                33        57.831939
United States   65875.17788                33        60.468424

                Employment_std  Employment_min  Employment_max  \
Country Name
Canada                1.629455          57.548          63.041
```

```
China                4.132756          62.523          76.840
Japan                1.957756          56.440          62.608
United Kingdom       1.511241          54.713          60.335
United States        1.872493          56.598          63.506

                GDP_Growth_count  GDP_Growth_mean  GDP_Growth_std  \
Country Name
Canada                        34         2.135410        2.185206
China                         34         8.797740        2.924949
Japan                         34         0.963596        2.050458
United Kingdom                34         1.859416        2.990588
United States                 34         2.491121        1.757601

                GDP_Growth_min  GDP_Growth_max
Country Name
Canada               -5.038233        5.286957
China                 2.238638       14.230861
Japan                -5.693236        4.840929
United Kingdom      -10.296919        8.575951
United States        -2.576500        6.055053

All tasks completed!
```

Income levels and their growth paths Income levels and their growth paths

```
import os

# show the current working directory
print("CWD:", os.getcwd())

# list files/folders there so you can see where your .db lives
print("Contents:", os.listdir("."))


#| echo: false
#| message: false
# ============== 0.  SETUP ===================================================

!pwd
import sqlite3
import pandas as pd
```

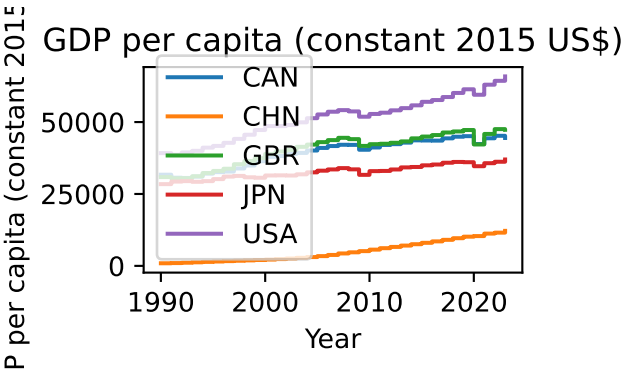
```
import numpy as np
import matplotlib.pyplot as plt
from pathlib import Path
import pycountry                    # pip install pycountry

# ---- output folders ------------------------------------------------------
OUT_FIG = Path("figures")
OUT_DAT = Path("processed")
OUT_FIG.mkdir(exist_ok=True, parents=True)
OUT_DAT.mkdir(exist_ok=True, parents=True)

INDICATORS = ["GDP", "Employment", "GDP_Growth"]

# ============== 1.  LOAD CLEAN PANEL ========================================
DB_PATH = "economic_data.db"
with sqlite3.connect(DB_PATH) as con:
    df = pd.read_sql_query("SELECT * FROM econ_cleaned", con)

if df.empty:
    raise RuntimeError("econ_cleaned table is empty - check SQL pipeline.")

# ============== 2.  ENRICH  - add ISO-3 codes  ===============================
def name_to_iso3(name):
    try:
        return pycountry.countries.lookup(name).alpha_3
    except LookupError:
        # handle special cases
        mapping = {
            "South Korea": "KOR",
            "United States": "USA",
            "United Kingdom": "GBR"
        }
        return mapping.get(name, None)

df["iso3"] = df["Country Name"].apply(name_to_iso3)
if df["iso3"].isna().any():
    missing = df[df["iso3"].isna()]["Country Name"].unique()
    raise ValueError(f"ISO-3 lookup failed for: {missing}")

# ============== 3.  BASIC CLEANING ===========================================
df[INDICATORS] = df[INDICATORS].apply(pd.to_numeric, errors="coerce")
```

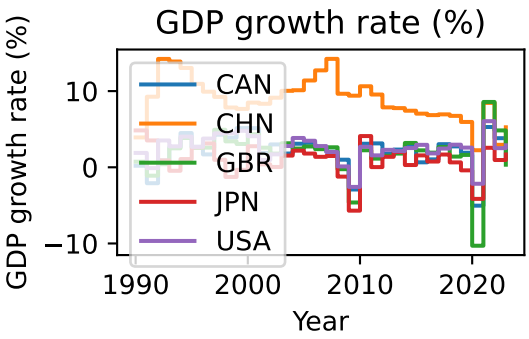
```python
# forward-fill within each country to patch occasional NaNs
df = (df.sort_values(["iso3", "Year"])
        .groupby("iso3")
        .apply(lambda g: g.ffill())
        .reset_index(drop=True))

#| echo: true
def lineplot(ind_col, ylab):
    plt.figure()
    for iso, g in df.groupby("iso3"):
        plt.plot(g["Year"], g[ind_col], label=iso)
    plt.title(ylab)
    plt.xlabel("Year")
    plt.ylabel(ylab)
    plt.legend()
    plt.tight_layout()
    plt.savefig(OUT_FIG / f"{ind_col}_trend.png", dpi=300)
    plt.plot()

lineplot("GDP",          "GDP per capita (constant 2015 US$)")
lineplot("GDP_Growth",   "GDP growth rate (%)")
lineplot("Employment",   "Employment-to-population 15+ (%)")
```

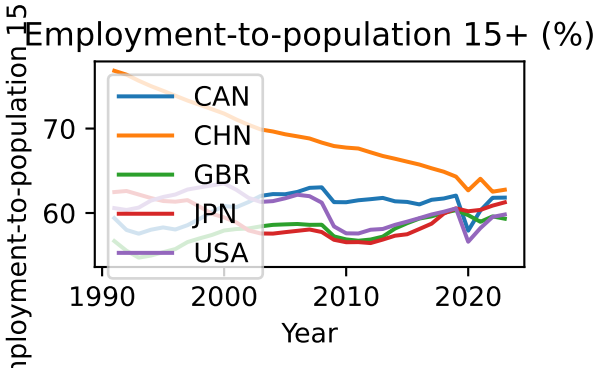
```
CWD: /Users/jackson/Documents/emory/emory2025Spring/QTM350/finalnew/350FinalQuarto
Contents: ['350FinalQuarto.quarto_ipynb', '_quarto.yml', '350FinalQuarto.qmd', '.DS_Store',
/Users/jackson/Documents/emory/emory2025Spring/QTM350/finalnew/350FinalQuarto
```

```
/var/folders/6m/wlb3j20s32q0624t09s3bf7w0000gn/T/ipykernel_40436/1336997099.py:62: Deprecati
```

```
DataFrameGroupBy.apply operated on the grouping columns. This behavior is deprecated, and in
```







The GDP-per-capita plot underscores the prosperity gap that separates North America from East Asia. Real income in the United States rises from roughly thirty-nine thousand dollars in 1990 to about sixty-six thousand in 2023, widening its lead over all other cases. Canada mirrors the American path but remains seven to ten thousand dollars lower throughout. China, starting from a base of just over one thousand dollars, multiplies its income almost ten-fold, yet still reaches only about twelve thousand dollars by the end of the sample. Japan's income climbs during the 1990s but plateaus at approximately thirty-six thousand dollars after 2010. The corresponding growth-rate figures reveal that China's rapid expansion, once firmly in double digits, decelerates to mid-single-digit territory in the 2010s. Japan's growth oscillates around zero, reflecting its long struggle with deflation and demographic ageing. The United States and Canada exhibit more moderate booms and busts, rarely exceeding four percent on the upside or falling much below minus two percent except in the global crises of 2009 and 2020, which strike all four economies simultaneously.

Quarto

Quarto enables you to weave together content and executable code into a finished document. To learn more about Quarto see https://quarto.org.