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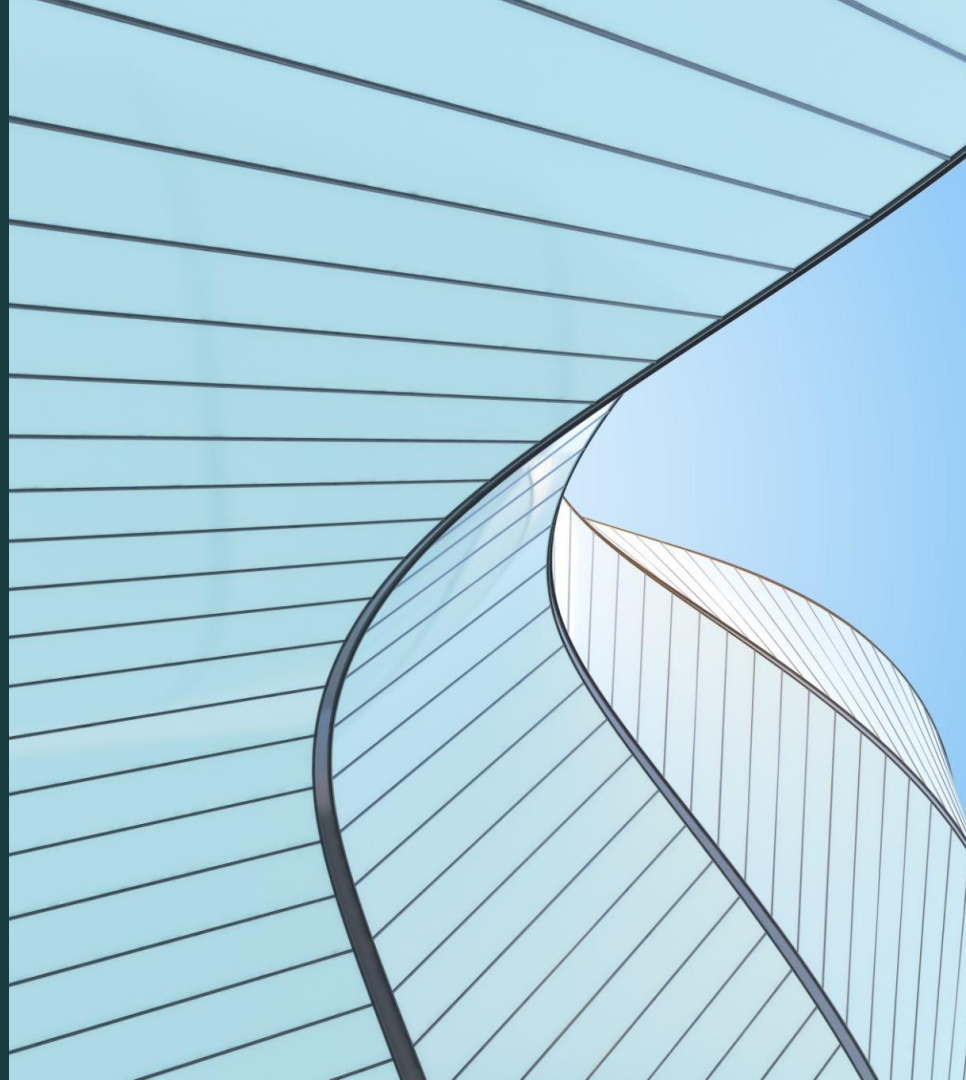
Solow Model x Machine Learning

Presentation

Briefly describe the contents of the presentation or the purpose of the meeting. Tell your audience what to expect.



Background *overview*

As a Development Economist, I strive to find out why some nations flourish faster and why are some lagging behind. Thanks to machine learning, I am now able to combine all countries' historical data with the hope to resolve a pattern based on Solow Model.

What Solow Tells Us:

Economic growth depends on **how much we invest, how fast our population grows, and how quickly we improve technology (human capital).**

Solow Model

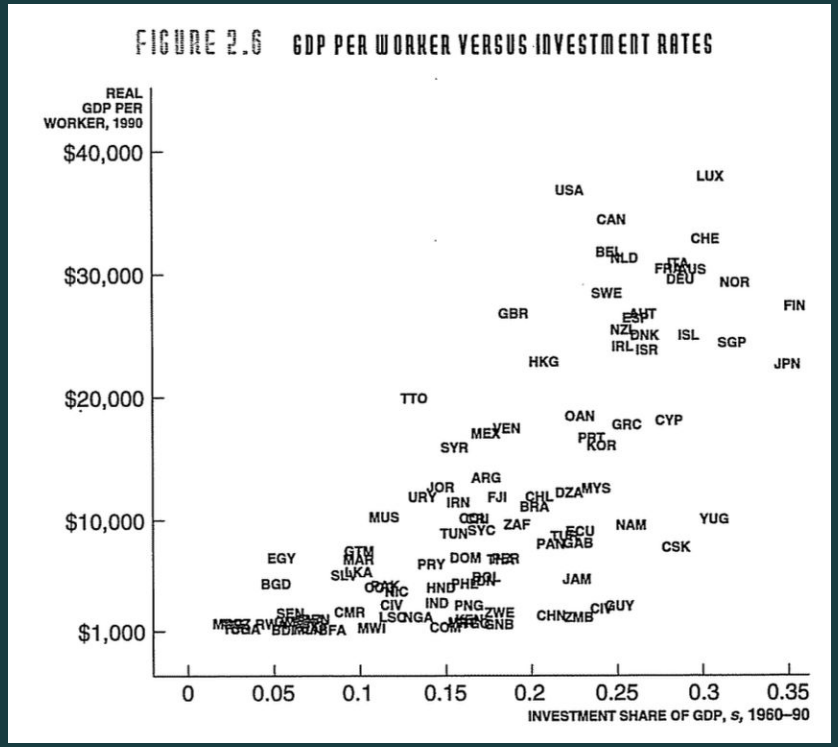


FIGURE 2.6 GDP PER WORKER VERSUS INVESTMENT RATES
REAL GDP PER WORKER, 1990
$40,000
$30,000
$20,000
$10,000
$1,000
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
INVESTMENT SHARE OF GDP, s, 1960–90
LUX
USA
CAN
CHE
NLD
AUS
NOR
FIN
SWE
GBR
NZL
DNK
ISL
SGP
IRL
ISR
HKG
JPN
TTO
OAN
GRC
CYP
VEN
MEX
SYR
PRT
KOR
ARG
JOR
URY
IRN
FJI
CHL
DZA
MYS
BRA
MUS
YUG
ZAF
ECU
NAM
CSK
EGY
GTM
MAR
PRY
BGD
JAM
HND
CIV
IND
PNG
CMR
ZWE
CHN
GUY
MWI

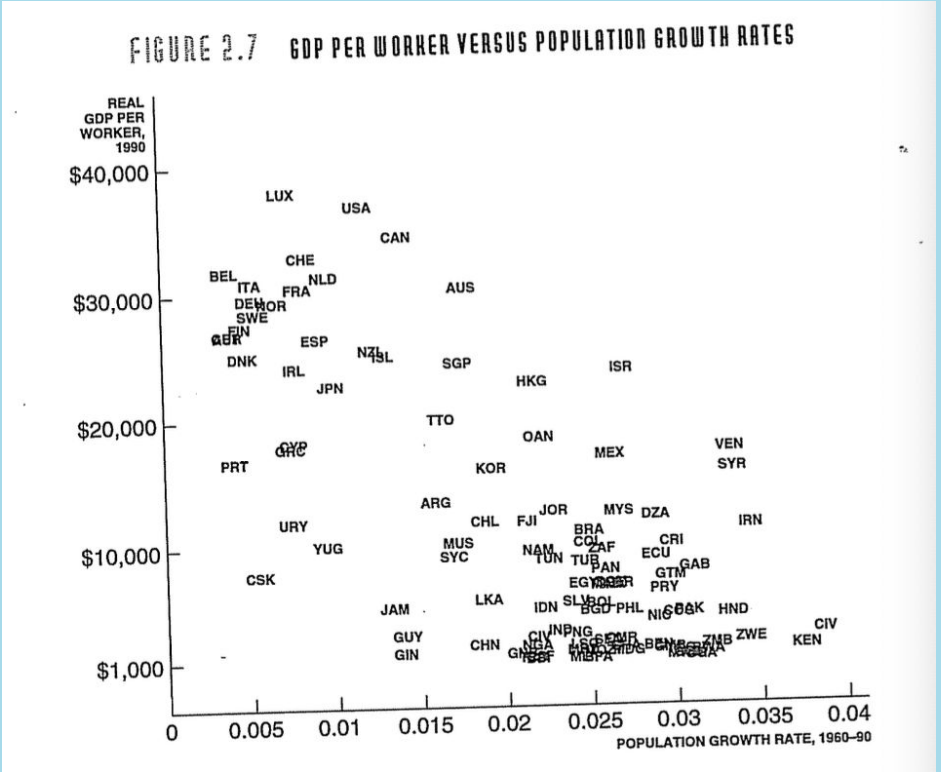


FIGURE 2.7 GDP PER WORKER VERSUS POPULATION GROWTH RATES
REAL GDP PER WORKER, 1990
$40,000
$30,000
$20,000
$10,000
$1,000
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
POPULATION GROWTH RATE, 1960–90
LUX
USA
CAN
CHE
BEL
ITA
FRA
NLD
AUS
DEU
NOR
SWE
FIN
ESP
NZL
ISL
SGP
DNK
IRL
ISR
HKG
JPN
TTO
OAN
MEX
VEN
SYR
GRC
CYP
PRT
KOR
ARG
CHL
FJI
JOR
MYS
DZA
IRN
BRA
COL
URY
YUG
MUS
SYC
NAM
ZAF
CRI
ECU
TUN
PAN
GAB
GTM
PRY
CSK
LKA
IDN
BGD
PHL
HND
JAM
GUY
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CIV
KEN
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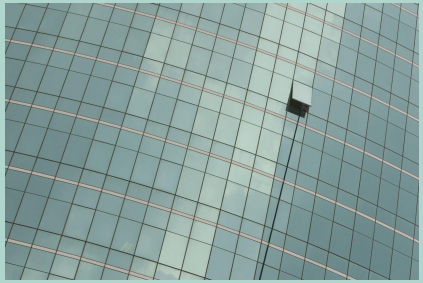

Research Question:

What are the roles of **investment, population growth and human capital** in economic development?

Investment Share → Higher GDP Per Capita

Population Growth → Lower GDP Per Capita

Education (HC) → Higher GDP Per Capita

Data Sources:

- Investment Nominal share within GDP for each country by year (1990-2040, S&P Global);
- GDP Per Capita for each country by year (1990 - 2055, S&P Global);
- Population Growth (1990- 2055, S&P Global);
- Average Years of Schooling (1950-2040, Our World in Data).

Data Prep:

- Data Reshaping from wide to long format;
- Drop NA;
- Merge 4 datasets together by Country and Year;

- Target: GDP Per Capita
- Feature: Avg. years of schooling, investment rate, population growth rate → MaxMinScaler

Linear Regression (actual data 1990-2024 with all countries)

R^2: 0.512

Coefficients:

(population_growth): 1.8

(schooling):4.92

(investment_rate): 0.38

Linear Regression (actual data 1990-2024 with country segmentation)

Developed: NL,UK, AUS

Late industrializers: JP, SGP

Developing: CHN,BRA, ARG, IND

R^2: 0.512 (developed)

Coefficients:

(population_growth): -0.19

(schooling):0.90

(investment_rate): -0.08

R^2: -0.170(Late Industrializers)

R^2: 0.63(Developing)

Coefficients:

(population_growth): -1.75

(schooling):=1.35

(investment_rate): -1.38

KNN Regression (actual data 1990-2024 with all countries)

KNN score: 0.54

Decision Tree (actual data 1990-2024 with all countries)

R^2: 0.47

Prediction (Segmented Country 2024-2040)

R^2: -4.79 (developed)

R^2: 0.525 (Late Industrializers)

R^2:0.925 (developing)

Linear Regression (actual data 1990-2024 with all countries)

R^2: 0.512

Coefficients:

(population_growth): 1.8

(schooling):4.92

(investment_rate): 0.38

After optimization:

Bagging & Pasting:

R^2=0.597

Random Forest: **R^2**=0.631

Gradient Boosting:

R^2=0.563

Adaboost: **R^2**=0.551

Linear Regression (actual data 1990- 2024 with country segmentation)

Before optimization:

R^2: 0.512 (developed)

Coefficients:

(population_growth): -0.19

(schooling):0.90

(investment_rate): -0.08

R^2: -0.170(Late Industrializers)

R^2: 0.63(Developing)

Coefficients:

(population_growth): -1.75

(schooling):=1.35

(investment_rate): -1.38

After optimization:

Developed

Bagging & Pasting: **R^2**=0.770

Random Forest: **R^2**=0.779

Gradient Boosting: **R^2**=0.719

Adaboost: **R^2**=0.774

Late Industrializers

Bagging & Pasting: **R^2**=-0.124

Random Forest: **R^2**=-1.647

Gradient Boosting: **R^2**=-5.314

Adaboost: **R^2**=0.653

Developing:

Bagging & Pasting: **R^2**=0.783

Random Forest: **R^2**=0.725

Gradient Boosting: **R^2**=0.448

Adaboost: **R^2**=0.653