Productivity & Investment in the UK

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Introduction

The Business Problem

Productivity is key to the development of local businesses and the wider economy. Over the past decade, productivity has slowed down globally with the UK lagging behind some other developed economies.

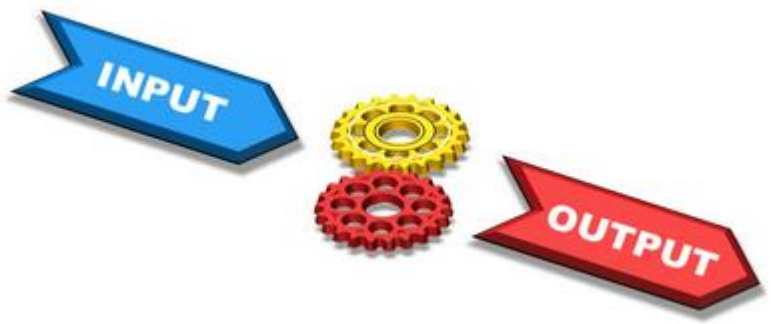
The Business Questions

How can we **improve productivity** within Scotland and the UK overall?

- Does government spending on factors such as **mental health**, **education**, and **research and development** affect productivity in the UK?
- Is there a **relationship** between government investment and productivity?
- Can you **predict** productivity based on investment?

What is Productivity?

- It is the ratio between the output volume and the volume of inputs.
- Productivity measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output.
- Gross Domestic Product (GDP) per hour worked is one of the most widely used measures of productivity
- How is Productivity linked to Investment?
  - When productivity fails to grow significantly, it limits potential gains in wages, corporate profits, and living standards.
  - Investment in an economy is equal to the level of savings because investment has to be financed from savings.
  - Low savings rates can lead to lower investment rates and lower growth rates for labour productivity and real wages.



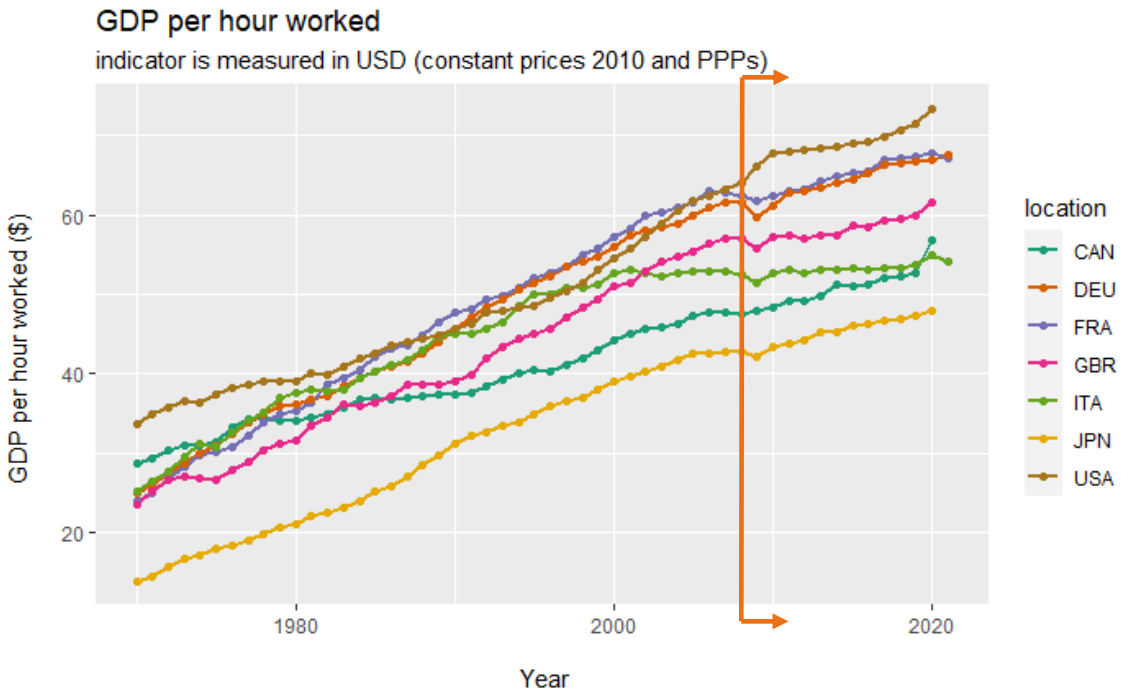
https://www.bls.gov/k12/productivity-101/home.htm#what-is-productivity/home

Challenges

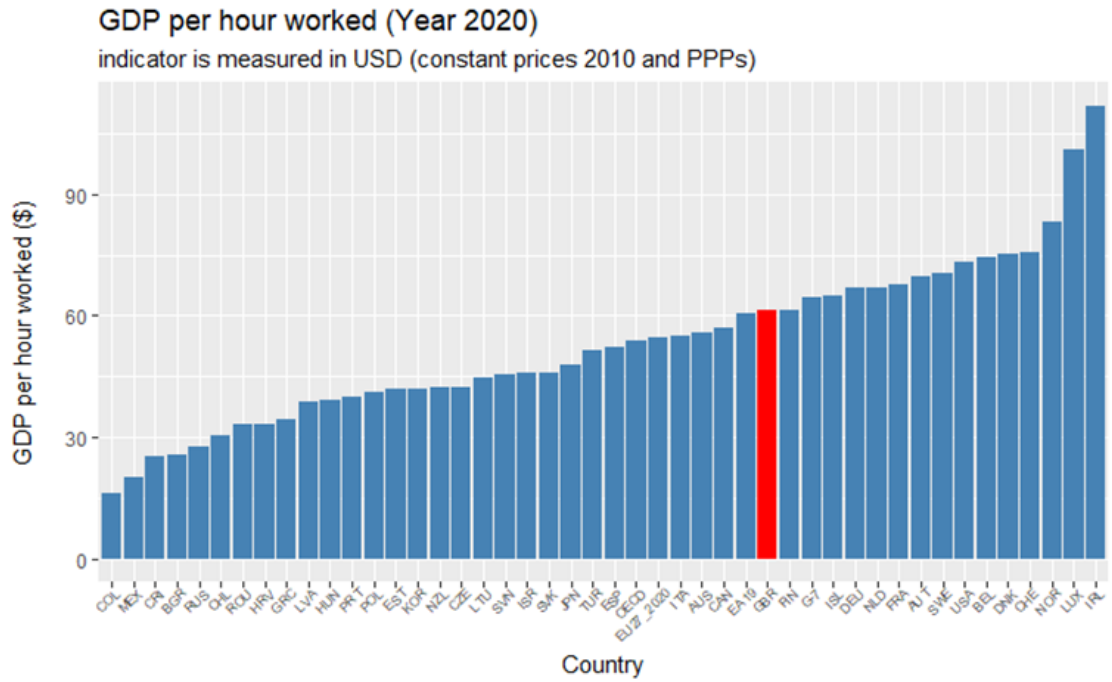
- Wealth of data coming from different sources (eg OECD, ONS) and having different formats (.csv, .xls, .xlsx)
- Data required cleaning and narrowing down
- Scarcity of mental health information for the UK and other countries
- Lack of business intelligence (no background in finance/investment sector)

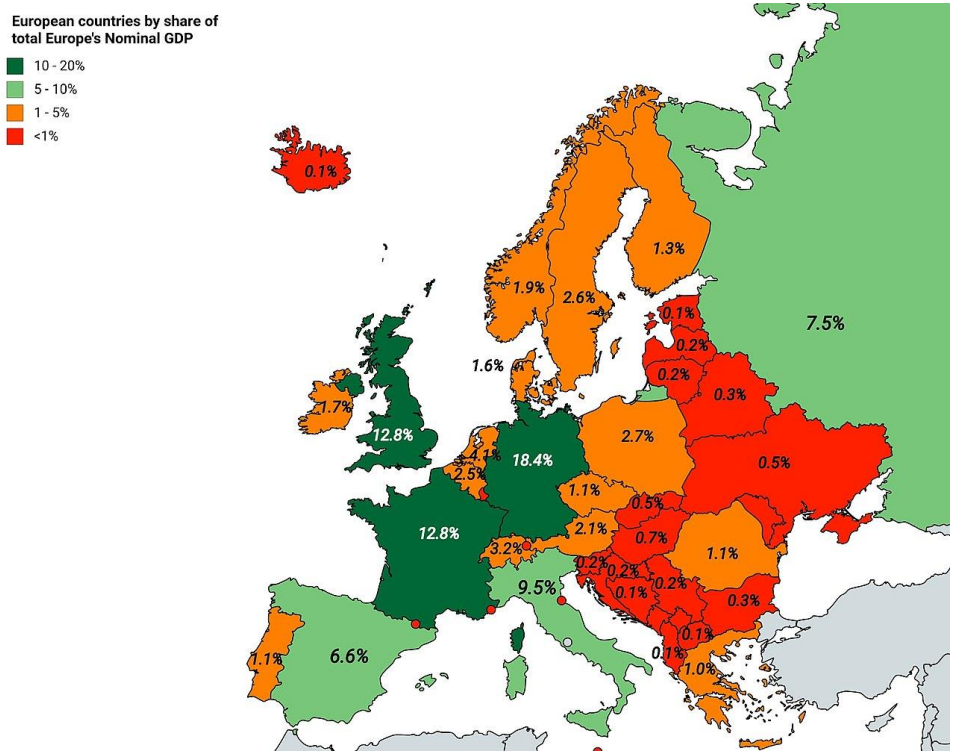
UK Productivity (OECD data)

- UK productivity growth dropped after 2008
- UK productivity among G-7 countries is somewhere in the middle

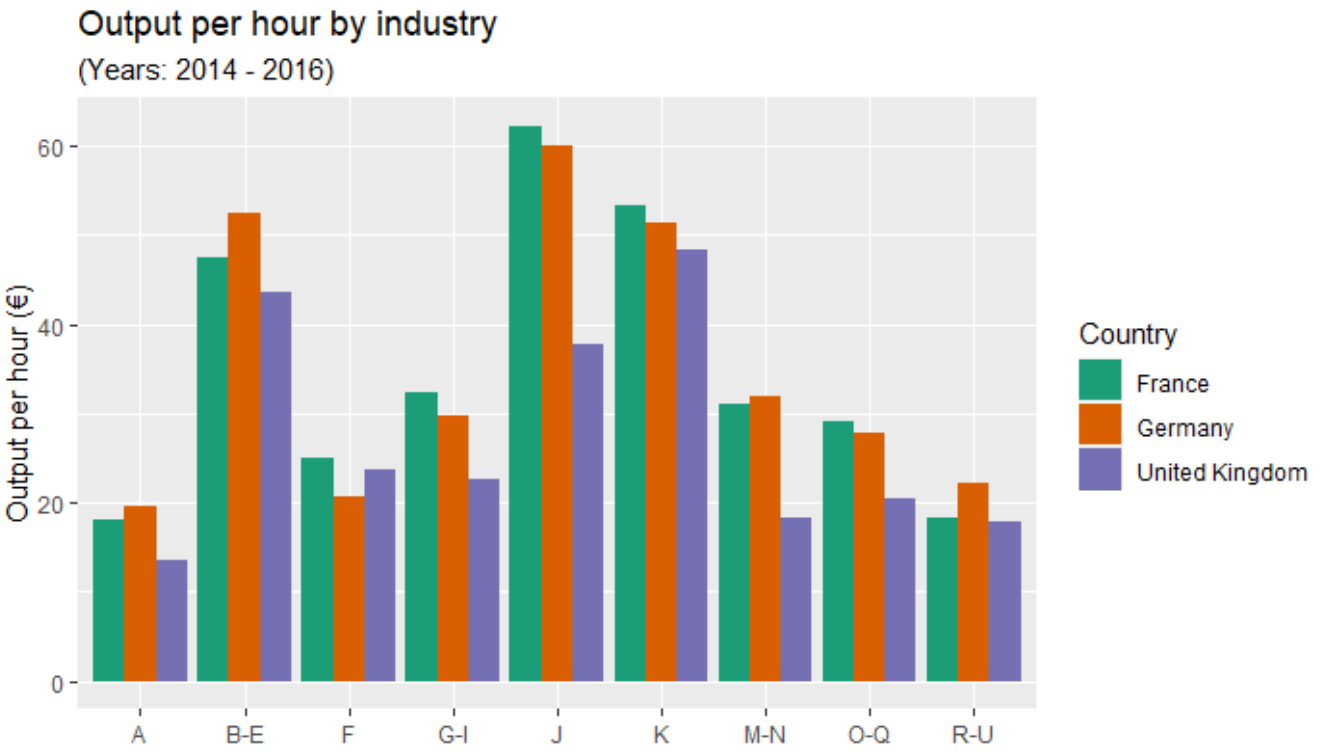


- Overall, the UK productivity is not ranking high



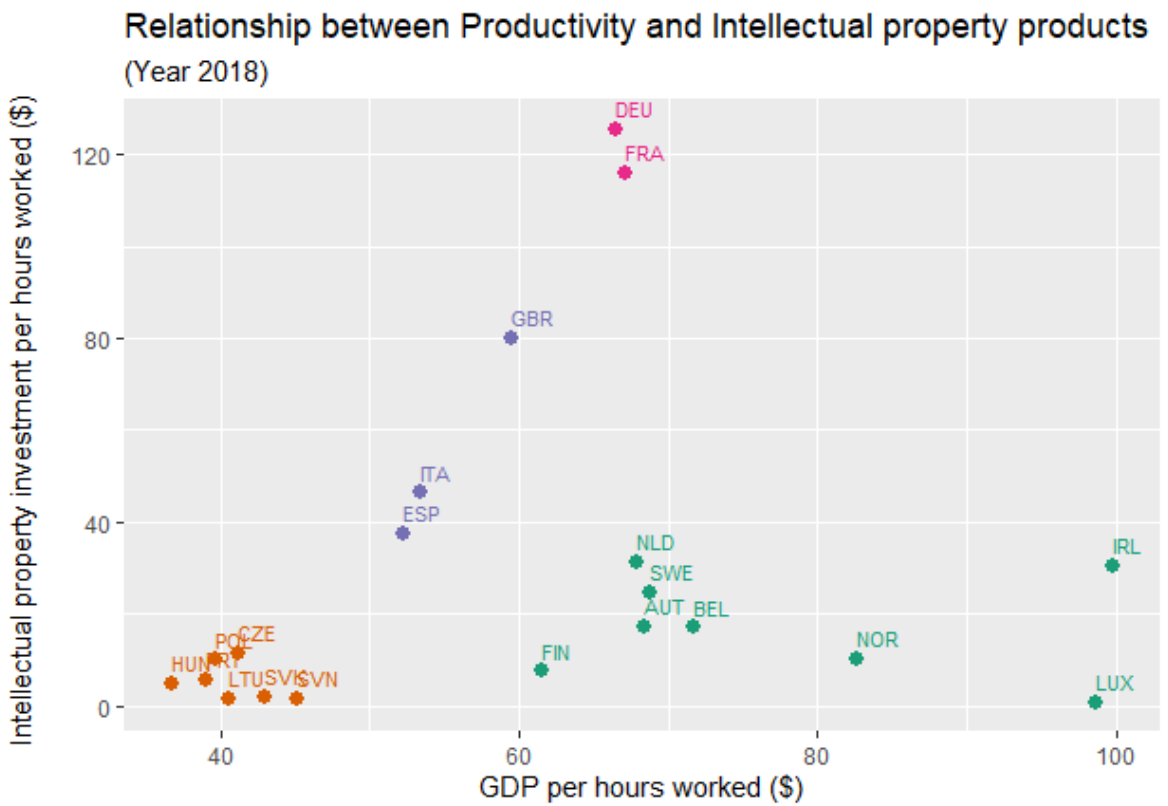


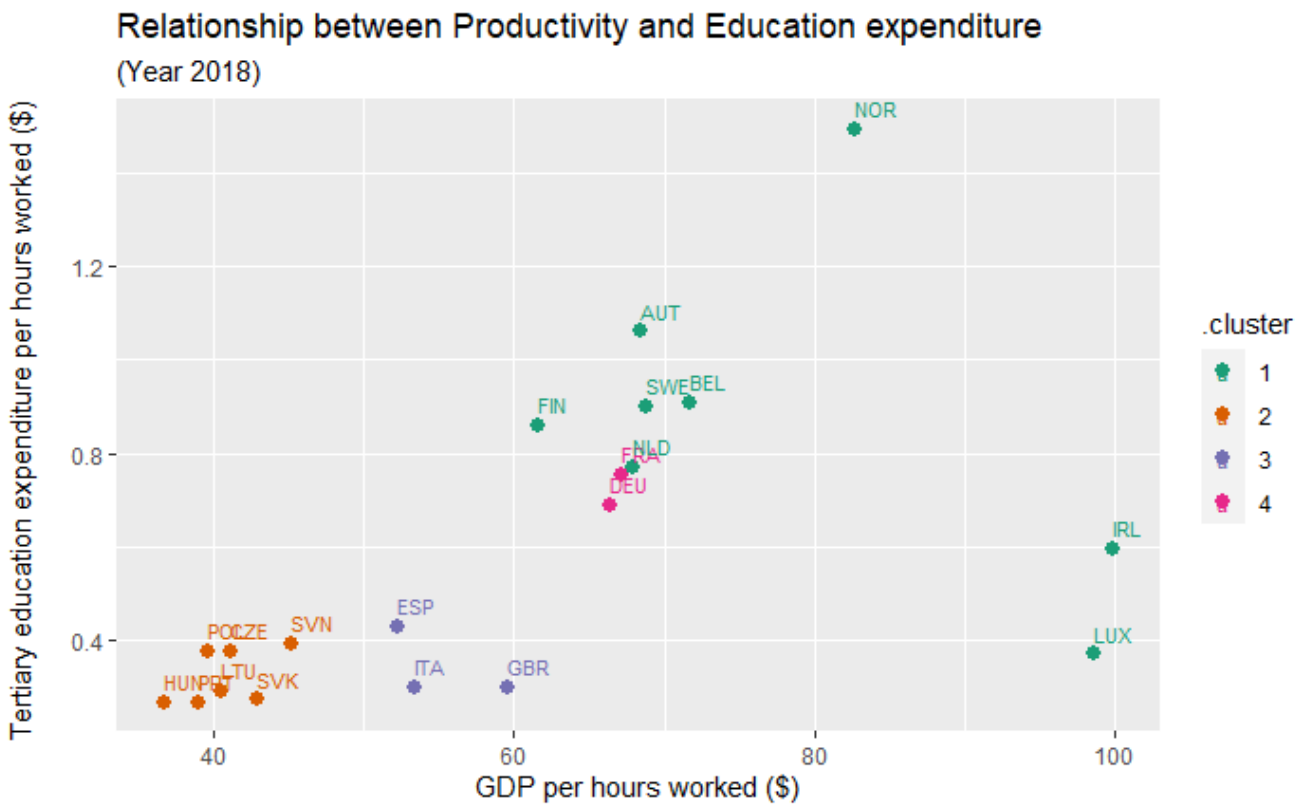
https://www.wikiwand.com/en/Financial_and_social_rankings_of_sovereign_states_in_Europe



Code	Economic Activity
A	Agriculture, forestry and fishing
B-E	Industry (except construction)
F	Construction
G-I	Wholesale and retail trade, transport, accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
M-N	Professional, scientific and technical activities; administrative and support service activities
O-Q	Public administration, defence, education, human health and social work activities
R-U	Arts, entertainment and recreation; other service activities

- The UK is comparable to the economy of France and Germany
- The UK is lagging behind France and Germany in productivity of key economic activities



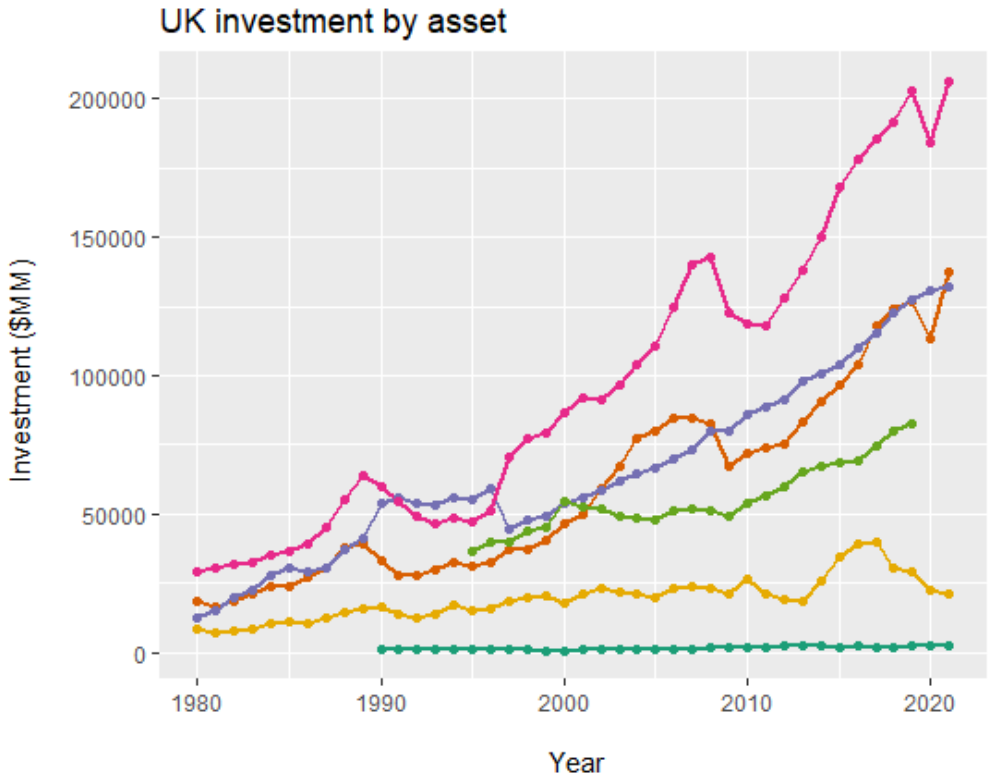


- 20 European countries are compared in terms of productivity and investment in education and key assets such as:
  - Intellectual property
  - Dwellings
  - Cultivated biological resources
  - Infrastructures
  - Transportation equipment
  - Information and Communication Tech

- The data cluster in 4 groups:
  - **Cluster #1:** Higher productivity economies of smaller EU countries and Scandinavia
  - **Cluster #2:** Mid-range to low productivity EU economies
  - **Cluster #3:** Italy, Spain and the UK (mid-range productivity)
  - **Cluster #4:** France and Germany (advanced productivity)

Prediction of Productivity Based on Investment

- Data from years 1995-2020 were used
- Factors used to predict productivity:
  - Intellectual Property (R&D, software & databases, literary and artistic originals, etc)
  - Dwellings (excluding land)
  - Cultivated biological resources (managed forests, livestock raised for milk production, etc.)
  - Infrastructures (roads, bridges, airfields, dams, etc.)
  - Transportation equipment (ships, trains, aircraft, etc.)
  - Information and Communication Tech (software, hardware, databases, telecoms equipment, etc.)
- Education and mental health not included in model due to data scarcity



Prediction of Productivity Based on Investment (cont'd)

Linear Regression model	Variance explained (%)
(GDP per hour worked $) = 31.08	
+ 0.1261 × (Infrastructures $billion)	33.92
+ 0.0498 × (Intellectual Property $billion)	18.23
+ 0.2404 × (Dwellings $billion)	35.00
- 0.001338 × (Infrastructures $billion × Dwellings $billion)	12.85

RMSE	R^2
0.593	0.945

Conclusions

- UK productivity growth dropped after 2008 (onset of great recession) and since then it is not ranking high compared to other countries
- Compared to France and Germany (countries similar in size of population and economy) productivity is notably lower in key economic activities
- Infrastructure and Dwelling investments seem to have the largest impact in the UK GDP per hour worked (approx. 34% and 35% respectively)
- Investments in Intellectual property products in the UK is lagging compared to Germany & France and accounts to a small portion of the UK productivity (approx. 18%)
- The UK Education investments are notably low compared to most higher productivity economies in Europe – scarcity of data didn't allow for including this factor in the productivity prediction model
- Lack of adequate Mental Health data did not allow for any assessments of its impact in productivity

Recommendations

- Investments in Education and key economic activities are vital to increasing productivity in the UK
- A detailed study of the French and German economy may identify areas of improvement in the UK

Future Work

- Acquisition of mental health info to answer the business question
- Explore alternative clustering methods for grouping data (for instance, ANN, distribution-based / density-based methods)
- Detailed literature survey on predicting productivity using investment data with a view to:
  - Identify commonly used modelling approaches (Linear regression, time-series models, ANN etc)
  - Best modelling practices